

# NOTES ON BREEDING, TAIL GROWTH AND OTHER ASPECTS OF THE BIOLOGY OF THE RED-HEADED AGAMA, *AGAMA AGAMA* (SAURIA: AGAMIDAE) IN MAGO NATIONAL PARK, ETHIOPIA

YIRMED DEMEKE

*Nech Sar National Park, P.O. Box 65, Arba Minch, North Omo Region, Ethiopia*

## INTRODUCTION

Mago National Park is in south-west Ethiopia; it has an area of 2 162 km<sup>2</sup> and lies north-west of the main Ethiopian rift valley, between latitude N 05° 19' - 05°56' and longitude E 35°56' - 36°26'; the altitude varies from 450 m (low-lying plains in the south) to 1 776m (top of Mt. Mago). The Mago river runs the length of the park. Virtually no herpetological work has been done in this conservation area and the adjoining Omo National Park, and a similar situation exists in much of Ethiopia. A recent checklist of the snakes of Ethiopia (Largen and Rasmussen, 1994) gives distributions, and a basic checklist of the lizards (Largen, undated) lists the species known to occur within the country, without further data. This lack of factual information on the Ethiopian reptile fauna constitutes a serious handicap to conservation within the country. Ethiopia is a known centre of endemism for birds and small mammals, but much work remains to be done upon the reptilian fauna (Spawls, 1992). This paper details aspects of the biology of *Agama agama*, one of Mago's larger and more conspicuous lizard species, as observed in and around the park. Data on identification, activity patterns, behaviour, diet, predation, habitat selection, tail regeneration and some meristic data are included. Agamas were collected from the habitat around the park headquarters, using the methods described by James (1991) and Harris (1964).

## IDENTIFICATION

*Agama agama* is a common and conspicuous species, and occurs throughout the arid lowland, hot areas of Mago National Park. In appearance it is a relatively large (up to 32.3 cm total length) stocky, flat-bodied lizard with a broad, triangular head; the unregenerated tail is approximately half the total body length. Breeding males are conspicuously marked, with yellow to vermilion heads, purple flanks, a broad pale vertebral stripe and blue-green limbs, the tail has pale bands. Non-breeding males are duller; females and juveniles of both sexes resemble the adult females: they are brown, with pale cross-bands and are heavily speckled with green and whitish spots; the females have pinkish stripes on the flanks behind each limb where it is joined to the body. As juveniles increase in size, the spotting becomes more conspicuous. Both sexes are capable of distinct colour changes; this is very marked in the males, and depends upon seasonal, environmental and excitational stimuli. Such changes were very marked prior to and during combat displays.

## MATERIALS AND METHODS

This species was studied in the vicinity of the park headquarters (Latitude N5,40, Longitude E 36.26) and the adjacent savanna. The vegetation types of the study area are savanna, riparian formations, semi-arid xerophilous and open woodland. The common

plant species are *Terminalia spinosa*, *T. bournnii*, *Ficus sycamorus*, *Combretum aculeatum*, *Tamarindus indica*, *Grewia biolar*, *Acaca mellifera* and *A. elatior*, growing on sand, silt and clay soils, with some minor basalt intrusions from the Miocene volcanics (Stephensen and Mizuno, 1978). There is a mean annual temperature range of 24 to 38 degrees Centigrade; highest temperatures occur between December and March. Rainfall is heavier in the northern (higher altitude) sector of the park; in the study area it is less, around 480 mm per year (Hillman 1993). There are two rainy seasons, March to April and August to September. The Park contains a good selection of Ethiopia's larger mammals (elephant, black rhinoceros, buffalo, lion, African wild dog, giraffe). Among the mammal species distinctive of the semi-arid lowland fauna are Lelwel Hartebeest and Patas Monkey, and over 230 species of birds have been recorded, including four endemic species.

### HABITAT SELECTION

Within the National Park itself, this species was more common in low-lying areas, below 1000 m altitude, and fewer *Agama agama* were observed at altitudes above this. On the alluvial plains in the southern part of the park, this species is most often seen on rocky hills and outcrops. In southern Ethiopia, this species is also known from similar habitats in the Omo National Park, Gambella National Park and Wito valley, between Jinka and Arba Minch (Cherie Enawgaw and Gebrie Admassu, pers comm), and it seems likely that *Agama agama* is widespread in such semi-arid areas. In undisturbed habitat, these agamas favoured rocks as basking sites, but were also observed on tree trunks, and around the park headquarters were often seen on walls. Once warmed up, they foraged actively on both trees and rocks, but would descend to the ground to feed and often entered inhabited compounds in the headquarters in the pursuit of prey.

### BREEDING

Mating was observed on several instances, with the male mounting the female and the genitals of each individual being turned sideways. However, there did not seem to be any fixed period for mating, with matings occurring randomly throughout the year, unlike egg-laying, which did occur during periods of heavy rainfall, as may be expected, to enable the female to dig a nest site easily, and for the neonates to profit from the large numbers of small insects present towards the end of an arid-country rainy season.

Eight undisturbed females in the park headquarters area that were obviously gravid were closely observed, and nesting behaviour was monitored, in order to record the numbers of eggs laid, the date of oviposition, the range of incubation periods and hatching successes. When a nest was located, a stick was placed near to the nest, and a card for recording information was attached to the stick. Such marked nests were inspected daily until the hatchlings emerged. Imminent emergence of the hatchlings were indicated by the appearance of a small depression in the soil above the nest site.

Initially, gravid females selected an area of loose, moist soil, usually near the base of tree or rock, occasionally near a building. The female dug a shallow hole, deposited the soft-shelled eggs and then buried them, the ground surface appearing relatively undisturbed after laying.

Data from eight monitored laying sites is given in Table 1. Clutch numbers 3 and 7 were both eaten by white-tailed mongooses, (*Ichneumia albicaudata*) during the third week after laying, the remainder of the clutches all hatched between 52 and 54 days after laying. Hatching success ranged from 77 to 100%. The neonates began to hunt and eat

insects within a few minutes of hatching. These eight monitored clutches were all laid during the rainy season. However, it is of interest that during October 1994, (which is normally a dry month), there were several unexpectedly heavy rainstorms, and five female *Agama agama* were observed laying eggs during this month.

**Table 1.**  
**Data from eight egg clutches**

Sample	Date of Laying	Number of eggs laid	Hatching date	Number of Hatchlings
F1	1st April 1992	9	24th May 1992	7
F2	4th April 1992	7	25th May 1992	7
F3	11th April 1992	5	—	—
F4	21st April 1992	7	11th June 1992	6
F5	29th April 1992	8	19th June 1992	8
F6	10th May 1992	6	30th June 1992	5
F7	14th May 1992	8	—	—
F8	19th May 1992	8	10th July 1992	8

### TAIL REGENERATION

According to Branch (1988), agamas cannot autotomise their tail or regenerate a new one. Observations around the study area suggested this statement to be incorrect, at least as far as *Agama agama* was concerned, as individuals with naturally broken tails were frequently observed, others were seen to lose their tails during combat, and regenerated tails (which are rarely as long or as uniformly tapered as original tails) were seen on several Agamas. Thus some experiments on tail regeneration were carried out. In August and early September 1992, a number of individuals were captured and their total length (snout-tail tip) and tail lengths were measured. Eight individuals were captured by noosing, placed on a sheet of white paper, straightened out and the position of the snout and tail tip marked. Two of these eight had freshly broken tails as a result of combat, and the remaining six had their tails cut off using a small sharp knife. Before cutting, the lengths detailed in Table 2 were measured, and before release, individuals were marked with a coded system of rings of white thread tied loosely but closely around the throat of the animal. Each individual was then recaptured three times between early October 1992 and mid-February 1993, and the tail length measured, this data is shown in Table 2. As shown in the table, the tails did regenerate, at an appreciable rate, over the six month period the increase varied from 0.5 cm to 4.5 cm length, with the most rapid growth occurring between August and December. The regenerated tail tip was very different to the original tail and never attained the length of the original piece, it constituted an unjointed rod of ossified tissues covered with scales similar to that of the original tail, much as observed by Harris (1963). In addition, the regenerated tail quite often had a prominent bulbous stump at the end, and this was observed to be used in combat.

**Table 2.**  
**Regeneration of truncated tails in *Agama agama***

All dates 1992, unless stated otherwise, all lengths in centimetres

Age of lizard	Sex	Date tail cut	Tail length before cut	Tail length after cut	Length increase on:		
					2nd Oct	3rd Dec	9th Feb 1993
Adult	F	26th Aug	14.5	4.0	1.5	2.3	lost*
Juvenile	F	31st Aug	13.5	2.2	2.0	2.7	3.1
Adult	M	31st Aug	lost in fight	7.5	2.5	2.6	2.6
Sub-adult	M	28th Aug	17.0	8.0	1.9	3.2	3.4
Juvenile	F	28th Aug	13.0	1.7	1.1	3.5	4.4
Sub-adult	M	26th Aug	17.5	5.0	1.1	2.3	2.4
Adult	F	26th Aug	14.6	4.0	swollen*	0.5	0.5
Adult	M	1st Sept	lost in fight	4.0	4.2	4.4	4.5

\*lost = agama disappeared

\*swollen = tail very swollen but no increase

### MERISTIC DATA

A small number of adult agamas were collected and their snout-tail tip measurements taken. This information is given in Table 3. A number of hatchlings were also collected, and the mean snout-tail tip measurement of these hatchlings was 8.7 cm.

**Table 3.**  
**Total Lengths of adult *Agama agama* in Mago National Park. All lengths in cm.**

Males	Females
32.0	24.5
27.0	23.3
28.4	25.0
30.6	25.5
31.4	23.0
32.3	22.3
Mean 30.3	Mean 23.9

## ACTIVITY PATTERNS

Activity among the agamas was observed mostly around the National Park headquarters, and much of the observation took place from dawn until 11.30 a.m. and in the late afternoon, which was the time that most activity occurred.

*Agama agama* in Mago National Park appear to live in colonies, with one (sometimes two) adult males, and a larger number of females and juveniles. All sexes and all age groups of this species show head-bobbing behaviour. They bask frequently, and adult males seem to bask more often than females. More feeding activity was observed in the rainy season, when, of course, much more prey is available. Once warmed up after basking, they usually stationed themselves near the bases of trees or rock outcrops, and fed upon streams of ants. They favoured areas of partial shade, and rarely descended onto the ground, except to move across to another tree or rock (or building).

When threatened, they retreated rapidly to holes or rock cracks for shelter. They can move very rapidly, and climb the sheerest of rock faces, they were frequently seen to jump considerable distances (at least 50 cm) from one rock to another. If captured, they can deliver a painful bite.

## DIET

In Mago, *Agama agama* were observed to be insectivorous and partially herbivorous. They were observed feeding on a broad range of small to medium sized arthropods; including ants, termites, winged and wingless insects, beetles, millipedes and centipedes. They were also observed to take bites from leaves and eat small grass stems. They appear to hunt arthropods by sight, and quickly spot moving objects. They were also seen to catch flying insects, leaping upwards from their perch in a most acrobatic manner. On several occasions, cannibalism was witnessed, with adult males eating juvenile agamas.

## PREDATION

A number of other species were observed preying on *Agama agama* (both on the eggs, the juveniles and the adults) in Mago National Park. Due to their habits of basking, and that (of the adult males) of occupying a prominent rock, they are frequent targets for diurnal, keen-sighted predators. Females and juveniles were often captured and eaten by Grey Kestrels (*Falco ardosiacus*), males were also attacked but nearly always escaped, due not only to their superior speed but to the fact that they would sometimes confront the kestrel. All class sizes except adult males were observed being captured and eaten by Sand Snakes (*Psammodphis* sp.), and at night both Red Spitting Cobras (*Naja pallida*) and Black-necked Spitting Cobras (*Naja nigricollis*) were observed climbing on the walls of the headquarters compound and catching and eating sleeping agamas. At night, White-tailed Mongooses (*Ichneumia albicaudata*) dug up the egg nests and ate the eggs.

Man is also a significant predator in certain areas; these lizards (especially the adult males), are a frequent target for small boys displaying their prowess with stones and/or catapults, and in certain areas these lizards are feared due to local superstition and may be killed.

## BEHAVIOUR

Males of this species develop vivid breeding colours to indulge in territorial displays, maintain exclusive home ranges and chase off vanquished opponents (Branch, 1988). Many instances of aggressive encounters were recorded among the study animals, in both sexes above the sub-adult age group. At times of combat, both individuals rapidly bob their heads up and down. At such times, they seem fearless of external danger, even ignoring humans approaching closely. They then shuffle and sidestep around in a tight circle, either with their heads pointing inwards or outwards. Once combat is joined, the bright body colour fades to a colour phase denoting fear (Harris 1964, Fitzsimons 1943) and the dorsal crest is fully erected.

If an intruder enters the territory of another adult male, the home male jumps down, as soon as the intruder is observed, and rushes towards him, raising and lowering his chest and gular fold. In combat, the males use their two fang-like teeth, and once they have seized their opponents, they attempt to use their tails as clubs. In most cases, the resident male triumphs, but such interactions were frequently observed, as maturing males attempt to seize and hold a territory for themselves.

## DISCUSSION

*Agama agama* is a colourful and interesting species, which would repay further study, especially in the Mago area. Reptiles are an important component of many ecosystems, and they are universal, penetrating much of the remotest areas upon earth. Directly or indirectly, they are beneficial to man; they consume numerous arthropods, including many insects pests, and where they are commensal with man they control the number of noxious arthropods in the area. However, it is the author's wish that these useful creatures be respected and protected. It is hoped too that this paper will stimulate respect for and interest in the lizards of southern Ethiopia, and also lead towards the setting up of community-based conservation projects, which will involve local people in joint responsibilities for natural resources, with consequent shared benefits.

In the attached appendix, it can also be observed that, so far, a total of some 21 species of reptiles have been recorded in Mago. In some ways, this indicates the lamentable lack of knowledge of the herpetofauna of a most interesting area. The final list could well be expected to be over 50 species, and it is hoped that this paper will also stimulate zoological research in this area, and that interested organisations will provide funds for this research to be carried out.

## ACKNOWLEDGEMENTS

I am grateful to the Ethiopia Wildlife Conservation Organisation (EWCO) for permitting me to carry out the programme of study that led to this paper. I also thank Ato Yilma Dellelegne who has shared my enthusiasm, and for his useful comments on this paper. My grateful thanks go to Dr. Afework Bekele of the biology department of the University of Addis Ababa, for his comments. I would like to express my appreciation to Ato Leykune Abune, the EWCO manager, for his encouragement of the study. Finally I am indebted to Stephen Spawls for his generous help in extracting references and for his valuable comment; he also word-processed the text of this paper.

## REFERENCES

- Branch, B. (1988). *Field Guide to the snakes and other reptiles of south Africa*. New Holland; London.
- Fitzsimons, V.F. (1943). *The Lizards of South Africa*. Transvaal Museum Memoir #1: Pretoria.
- Hillman, J.C. (1993). *Compendium of wildlife conservation information: Ethiopia*. Vols 1 and 2. pp 165-167 and 619-621 Ethiopian Wildlife Conservation Organisation; Addis Ababa.
- Harris, V.A. 1964. *The life of the rainbow lizard*. Hutchinson Tropical Monographs: University of Ibadana; Nigeria.
- James. C.D. 1991. Growth rates and ages at Maturity of sympatric scincid lizards (*Ctenotus*) in central Australia. *Journal of Herpetology*. Vol # 25(3).
- Lagen, M.J. & Rasmussen, J.B. (1993) . Catalogue of the snakes of Ethiopia (Reptilia Serpentes), including identification keys. *Tropical Zoology* 6: 313-434.
- Lagen, M.J. (undated). The lizards of Ethiopia: EWCO
- Stephenson, J & Mizuno, A 1978. *Recommendations on the conservation of wildlife in the Omo-Tama-Maho rift valley of Ethiopia*. Ethiopian Wildlife Conservation Organisation. Addis Ababa. pp 19-21.
- Spawls, S. (1992). The snake fauna of Ethiopia, a preliminary report. *Journal of the Herpetological Association of Africa*: 41: pp 19-21.

## APPENDIX

Preliminary list of reptile species recorded in the Mago National Park.

### Serpentes:

<i>Typhlops lineolatus</i>	Lineolate Blind Snake
<i>Python sebae</i>	African Rock Python
<i>Eryx colubrinus</i>	Kenya Sand Boa
<i>Coluber florulentis</i>	Flowered Snake
<i>Lamprophis fuliginosus</i>	Brown House Snake
<i>Psammophis punctulatus</i>	Spotted Sand Snake
<i>Psammophis sibilans</i>	Stripe-Bellied/Hissing Sand Snake
<i>Crotaphopeltis hotamboeia</i>	White-Lipped Snake
<i>Naja nigricollis</i>	Black-Necked Spitting Cobra
<i>Naja pallida</i>	Red Spitting Cobra
<i>Bitis arietans</i>	Puff Adder

### Chelonia:

<i>Geochelone pardalis</i>	Leopard Tortoise
<i>Pelomedusa subrufa</i>	Marsh Terrapin
<i>Pelusios sinuatus</i>	Serrated Hinged Terrapin

### Sauria:

<i>Agama agama</i>	Rock Agama
<i>Varanus niloticus</i>	Nile Monitor Lizard
<i>Varanus exanthematicus</i>	Savanna Monitor Lizard
<i>Mabuya striata</i>	Striped Skink
<i>Lygosoma sundevalli</i>	Sundeval's Writhing Skink
<i>Cordylus tropidosternum</i>	Girdled Lizard

### Crocodylia

<i>Crocodylus niloticus</i>	Nile Crocodile
-----------------------------	----------------