WORKS ON THE VARANIDAE, TRANSLATED FROM VARIOUS LANGUAGES INTO ENGLISH

This is a collection of papers concerning the monitor lizards of the family Varanidae, translated from European and Asian languages into English. It is the result of an ongoing four year project and has relied very heavily on donations of time from many people. Additional papers will be prepared from time to time. Very few of the translators were paid for their work, those that were paid often had to wait many months for their reward. Some are still waiting. My apologies to them and heartfelt thanks to everyone concerned.

Three thousand years ago Alexander the Great of Macedonia, sick and tired of prejudices and misunderstandings between the different nationalities of his army, made 30,000 of his officers marry Persian women. The object of the exercise was a first step towards uniting the races and thus do away with the notion of "foreigners". Perhaps if he had lived for longer than 33 years he would have been successful, conquered the rest of the world and thus made this project unnecessary. Thus this humble work is dedicated to the memory of that great and farsighted man.

Daniel Bennett.

L'Alimentaire des Varanides du Senegal

The Diet of Varanids in Senegal.

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Translated by Daniel Bennett.

Introduction.

Several authors have given information on the diet of monitor lizards. ROUX (1936) states that "The monitors are carnivores, but not exclusively so. They eat mice, small rats, lizards, fish, frogs and also ripe banana and honey diluted in a little water. They take dead prey readily". We do not know which species of monitor he is referring to. Moreover he is citing an example of captive animals.

FITZSIMMONS (1943) speaks of the food of Varanus albigularis and V. nilocticus.

GAUTHIER (1967) deals with the diet of V. griseus and GUIBE of the monitors in general.

Because of these accounts and many others which we have not cited, it seems superfluous to say more about the diet of monitor lizards. Nevertheless it is known that the greater part of these studies have been done in the different regions of the "Sahelo- Sudanese" savannah, so the use of an analysis of the food in this area can been seen. Besides, the diet of V. exanthematicus exanthematicus has not been the object of many publications, and to our knowledge there is not another comparative study of its dietary regime, nor of that of V. nilocticus. This is to be the object of these notes. We have attempted an analysis of the diets of these two species in order to establish the similarities and differences. The work has nothing original, but we hope that this contribution will, in some measure, give more specific information on the diets of Varanids.

Materials and Methods.

We conducted our research in Senegal, a tropical "sahelo Sudanese" area characterised by alternate wet and dry seasons. V.e. exanthematicus Bosc and V. nilocticus Linne are the only monitors which live there. The first is terrestrial, the second primarily amphibious. The seasonal activity of these animals is strictly bound by climatic conditions.

During the winter season they are very active and fed themselves to satiety. During the dry season they observe a more or less complete fast, according to the species (CISSE 1971). We studied them over two seasons and have analysed their stomach contents by identifying, weighing and counting the ingested prey.

The two monitors are diurnal. They emerge from their retreats at about 0900 and return at about 1730. We took their stomach contents between 1300 and 1900. For this we have returned once or twice a month to an area where both species are relatively abundant; the sector of Fissel - Diaganiao in the region of Thies. There we recruited some villagers who were well experienced in the capture of animals. Each monitor was immediately weighed, killed and the stomach contents removed and weighed separately. Next the stomach was labelled and put into a glass jar containing formalin. Afterwards they were transferred to the I.F.A.N. for identification by the department of Zoology of Invertebrates.

Results.

I. Research of nourishment and prey.

A. Varanus exanthematicus exanthematicus.

The animal finds its prey by active searches in which the eyes play an essential role. The chase begins when the animal has left its retreat around 0900, although the animal suspends its activity between 1400 and 1500. The prey are found in the branches of trees, amongst the bases of plants (in the flowers of Ipomea in particular) and in organic material in a state of

decompostion (especially in ruminant dung). V. exanthematicus is voracious. It swallows its prey whole and can ingest up to 10% of its own body weight. A specimen weighing 600g had stomach contents that weighed 61g, another weighing 1kg contained 115g of ingested prey.
The taking of prey is greatest from July to October. It begins to diminish in November, at the end of the dry season. Thus all individuals taken from July to August have completely full stomachs, those captured from 20 November had either meagre stomach contents or were empty. Towards the end of December the monitors rarely has any foods in their stomachs. Of 8 specimens collected on December 22 only one contained an item of prey. In January all monitors had empty stomachs.
In total we analysed the stomach contents of 28 animals. The results are presented by monitor and by month in table I. The identified prey was made up exclusively of invertebrates except for the eggs of Agama agama and V. exanthematicus. The following were found;
1. Insects.
a. Coleopera:
- Carabids: Ctenosta senegalense, Megacephala megacephela, Scarites sp.
- Curculionids: Episus sp.
- Dytiscids: Cybister sp.
- Meloids: Psalydolytta fusca.
- Scaribids: Adoretus sp. Anomala sp. Oryctes sp. Schizonycha africana.
- Tenebrionids: Pimelia senegalensis, Phrynocolus dentatus, Vieta senegalensis.
b. Dictyoptera: Mantes: Epitenodera gambiensis
c. Hymenoptera: Aphids: Xylocopa sp.
d. Lepidotera: chiefly Chenilles and Sphingids.
e. Orthoptera:
- Acridids: Acanthacris ruficornis citrina, Anacridium sp., Kraussaria angulifera, Cataloipus sp., Oedaleus nigeriensis, Humbe tenuicornis.
- Gryllids: Gryllus bimaculatus
- Pyrgomorphids: Zonocerus variegatus
- Tettigonids: Homorocoryphus nitidulus vicinus.
2. Arachnids: a scorpion of the family Buthidae.
3. Myriapods: Diplopodes (Iules) and Chilipods (Scolopendra).
4. Molluscs: Gasteropods pulmones Helicarionines.
5. The eggs of Varanus exanthematicus and Agama agama.
In order of number, prey was distributed as follows;
Myriapods 48.32%
Insects 45.49% of which 21.22% were Coleopterids, 15.21% Lepidoterans (Chenilles) and 8.84% Orthopterans.
Eggs of Agama and V. exanthematicus 3.75%.
Gasteropod molluscs 2.35%.
Arachnid scorpions 0.11%.
These results interpret the respective percentages of prey items, but they do not give information on their distribution in the predators. This we have indicated by the degrees of prescence (LESCURE). The number of animals containing each prey is given. In other words, it shows the percentage of animals containing each prey.
Table II shows the different prey with their percentages and frequency of prescence. The prey most frequently consumed by V. exanthematicus in the area where our research was based was the Coleopterids (64.28%), the Myriapods (53.57%), larvae of Lepidopterans (46.42%) and the Orthopterans (35.71%).
If we consider this diet by month we need to establish whether it reflects the availability of the large invertebrates of that period. In fact, the Coleopterans, larvae of Sphingides and the Myriopods, which are abundant during the first half of the winter constitute the main items of prey during this season, whilst they are absent from the intestines towards the end of the season, replaced at that time by the Orthopterans which become more numerous. Otherwise, except for the reptile eggs (Agama and Varanus) we did not find any trace of vertebrates in the diet of V.exanthematicus. This species feeds exclusively on invertebrates and eggs (including those of its own species). Towards the end of December all feeding ceases until favourable conditions return.
Is this diet different from that of Varanus nilocticus? This is what we are going to find by examining the stomach contents of the second species.
B. The Diet of Varanus nilocticus.
Like V.exanthematicus, V.nilocticus makes an active search for its prey. Leaving the burrow around 0900 it warms itself up before it begins to hunt. One day we observed an individual which took its morning sunbathe close to the Sea of Ndiokoda, not far from Diaganiao. The

animal was in a tree (Celtis intigrifolia) which contained its retreat, laid against the trunk with its back turned towards the sun. It rested in that position for more than half an hour. This species is very ubiquitous during the winter. It can be found in all the microbiotopes of the region, in ordinary fields, on the edge of water, in the water and in areas of human habitation. Sometimes one has the impresssion that it sets traps for its prey. In fact, in the fields the animal often digs shallow burrows which differ from its normal retreats. This would probably be to unearth prey at some earlier time. But later on these holes must have served as traps, as the lizards dig them, systematically outside its daily exits in order to take its prey. We once suprised a male who was in the process of exploring a burrow in a field of groundnuts in Bafaye, close to Fissel. After capturing it we excavated the hole and found a toad. In addition another V. nilocticus was stalking (nearby). We have seen them in Acacia bushes in the act of waiting for the little birds that nest there. The animal will eat dead prey readily. It is possible to catch one on a hook and line with dead bait (frog, lizard, rat etc.). This operation is never successful with V.exanthematicus, which appears to eat only live prey.

We have analysed the stomach contents of 32 V. nilocticus. The prey are listed in table III. We have ascertained that this species eats invertebrates like V. exanthematicus. But in addition it takes vertebrate prey. Among the prey ingested, we have identified;

Fish - Protopterus annectens.

Bachtrians - frogs and toads

A turtle - Pelusios subniger.

Lizards - Agama agama, Mabuya and V. exanthematicus.

A bird of the genus Ploceus.

Murides.

V.nilocticus takes its prey from all classes of terrestrial and freshwater vertebrates. The case of the turtle is particularly striking, and we have photographed the stomach with its contents. The specimen was a juvenile whose carapace measured 5.5cm in length and 4.3cm in width. A countryman of ours affirms that he has found a snake it the stomach of V. nilocticus, and we believe him. Thus this species is a complete carnivore. It will attack any animal that it is able to swallow. Its diet is more varied than that of V.exanthematicus, whose young it does not spare. Its different prey are listed in table IV with percentages and frequency of prescence.

Fig.1. The stomach of a V.nilocticus containing a turtle (Pelusios subniger). Nematodes are frequently encountered in the intestines of monitor lizards.

Here we are concerned with the species diet according to season. In our previous publication we have shown that these animals feed themselves in water within their range, but that they fast and are inactive during the dry season when their environment shows a deficency of water.

Comparisons of the diets of the two monitor lizards.

After our results we can ascertain;

1. That the two species feed on the same invertebrates including all the available species of a large enough size.
2. That Varanus exanthematicus feeds exclusively on invertebrates and eggs, whereas V. nilocticus also eats any vertebrates it is able to swallow.
3. That V.exanthematicus young invariably endure all the dry season when V.nilocticus does not, and aestivates whilst its water is absent.

Discussion and Conclusion.

Our analysis of the diet of monitor lizards relies on the list of identifiable prey in the stomach contents. A simple summary of the limits of such a method; it does not make allowance for prey that are digested very quickly. In order to be exhaustive it would be worth while making a study of the animals' excrement. But this is very difficult to do in the field. And, as for food that disappears quickly in the stomach we do not feel that they are numerous. The greater part of ingested prey is more or less sclerotic if it is not of vertebrate origin, and is therefore resistant to rapid digestion. The identifiable prey in the stomach contents represents the major part of ther diet. Also, we think that our work, despite its shortcomings, is not devoid of interest. It allows us an idea of the actual food of V.exanthematicus and V.nilocticus in the savannah "sehelo soudanienne". This diet is made up exclusively of invertebrates in the case of V.exanthematicus and of all available prey in the case of V. nilocticus.

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FROM: Le Cycle Genital des Varans au Senegal.

FROM The Genital Cycle of Varanids in Senegal.

Marmadou Cisse. Bulletin de l'Institute Fondamental Afrique Noire. Ser. A 38(1):188-205.
Translated by Daniel Bennett.

In a previous study concerning the variations in gonad mass and fat deposits of Varanus

nilocticus in Senegal (CISSE 1973), it was noted that the sexual cycle of this animal consists of two phases: a period of glandular development from June to October (wet season) and a period of regression and rest from November to May (dry season). Furthermore, the appearance of growth in the testes in February was noted. But as the results simply recorded an increase in weight it gave no precise information about the nature of the growth. Was it an artefact or evidence of a actual abortive activity? The present study aims to clear this ambiguity. It concerns both V. nilocticus and V. exanthematicus, the only Varanids living in Senegal. The analysis considers the gonads and is followed by a histological study. [N.B. The greater part of the histological studies have been omitted in this translation because my French wasn't up to the job - D.B.]

Materials and Method.

The study animals were caught in the wild and sacrificed towards the middle of each month after being weighed. The gonads were likewise weighed separately from the body and were fixed in "Bouin-Hollande", 5 microns were cut from each and dyed with "Trichrome de Masson". The weight of the gonads was expressed as a percentage of body weight. The monthly average measurements were calculated and the limits of their reliability determined to the level of probability where P = 95%. The severed tissues were examined by "photonique" microscope and the characteristic stages of the gametes photographed.

Results.

1.Sexual cycle of males.

A) Changes in testes weight.

The monthly average measurements are given in table 1, the curve of variation in figure 1.

In V.nilocticus the graph shows little variation from January - May, except a slight transistory rise in February. In contrast, a progressive rise took place between June and September, followed by a decrease from October to January.

In V.exanthematicus the curve behaved the same way as above, except that growth appeared a little earlier, in May instead of June.

These preliminary observations suggest that the reproductive cycle is similar in males of both species. After resting from January until April the testes develop until September and shrink from October to December. However the period of rest allows a transitory growth in February

B. Histological Study.

Microscopical examination of testes tissue show that spermatogenesis is synchronized alike in both these Varanids. In January the germinal epithelium does not allow a category of cell germination. Spermatagonia are primitive (figure 2). The external limits of seminiferous tubules are festooned and the spaces between tubules are large. The tissue of the intervening spaces is formed of small cells loaded with granulations.....etc.

Thus, the histological examination reveals two principle phases in the annual testicular cycle; a phase of spermatogensis from April to October, followed by a period of regression and rest from November to March with some abortive activity in February, complying with the recorded increase in weight.

Elsewhere, one notices that sexual awakening occurs in the full dry season; at this time the Varanids eat little or nothing at all. This leads one to think that the initial energy needed for "unlatching the door" of spermogenesis is of endogenous origin.

2. Sexual cycle of females.

A. Study of ovaries

i) Changes in weight.

Monthly averages are shown in table 1 and their representative curves in figure 9. In V.nilocticus the graph does not show any notable changes between January and May. They begin to grow in June, culminate in October and decrease in November and December.

In V.exanthematicus no great change is seen from January to March. Growth begins timidly in April, to become explosive in September. It is followed by rapid descent from October to December.

Histological Study.

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The females show a genital cycle parallel with that of the males. The ovaries develop from April until September/October and afterwards regress and put themselves to sleep from November until March.

2. The Eggs.

From the end of December until mid September no eggs were found in the oviducts. However in most of the female sacrificed between mid September and the beginning of September were gestating. In the same(?) species the number of eggs seemed to vary with the size of the individuals. In effect, in V.exanthematicus one female weighing 500g contained seven eggs, the larger females up to 40. The number of eggs found was equally dependant on species, so that in

V.nilocticus there were never more than 30, whereas V.exanthematicus yielded as many as 41. The eggs were slightly larger in the former species (5-4cm) than the latter (4-3cm).
The laying of eggs takes place from late October until early November. But in V.nilocticus the females lay eggs as late as December. One gravid specimen of this species was caught on December 31 by a terrier. It was probably about to bury its eggs, which indicates that these animals oviposit in the ground and cover their eggs with earth. This opinion is confirmed by the fact that gestating females kept in terraria would deposit their eggs in the terriers' diggings and recover them with earth.
Hatching takes place with the first rains of July. The remains of two very young V.exanthematicus were recovered from the stomach of a V.nilocticus caught in July. Furthermore, the very young monitors in the collection of the I.F.A.N. were caught in July.
Discussion and Conclusions.
The sexual cycle of varanids in Senegal is divided into two distinct phases; a phase of activity which essentially displays itself it the wet season, and a period of rest in the dry season. It is a seasonal cycle leading to annual egg deposition. Activity begins in April, maturation of the gonads and copulation occur in September and October, months in which (lesquels) free spermatozoa are visible in the seminiferous tubules and the {epididymis}. Ovulating females are numerous from mid September until the end of October. The eggs, which are laid from the end of October to the beginning of November and December, do not hatch until July, after the first rains. Incubation therefore takes place throughout the dry season (six months).
The genital cycle presents two peculiarities, the `unmooring' of gemetogenesis in the dry season (a period of fasting) and the abortive growth of testes in February. To deal with the first question, it causes one to think that the primordial metabolic energy necessary for sexual awakening is of endogenous origin. It is thought, according to the opinion of different authors, that it is furnished by the fat reserves of the animals (DUGAY 1963; ZAIN & ZAIN 1967; GAFFNEY & FITZPATRICK 1973).
As for the abortive activity of the testes in February, could it be a vestige of another reproductive season which once existed in a primitive time of the monitors' history?