# ON THE BIOLOGY OF THE GIANT INDONESIAN MONITOR LIZARD (Varanus komodoensis Ouwens)

by I. S. Darevskii and S. Kadarsan

Zoologichesky Zhurnal
(Zoological Journal)

volume 43, number 9
pp. 1355-1360

1964

Translated from the Russian by Z. Knowles, N.I.H.
Edited by J. A. Peters

SMITHSONIAN HERPETOLOGICAL INFORMATION SERVICES, 2
1965

In the half century that has passed since the day of the discovery of the largest of contemporary lizards, the giant Indonesian monitor lizard (Varanus komodoensis Ouwens), this relict reptile has repeatedly attracted the attention of zoologists (Burden, 1927, 1928; Dunn, 1927; Mertens, 1930, 1959; Tänzer and Heurn, 1938; Lederer, 1942; de Jong, 1944; Hoogerwerf, 1948, 1954, 1958; Pfeffer, 1959; and others). However, despite the investigations carried out, the basic question of the biology of the giant monitor, including propagation, postembryonic growth, and population dynamics, are all still in the initial stage of study.

The materials collected by the authors in July and August, 1962, at the time of the work of the First Indonesian-Soviet Expedition on the islands of Komodo, Padar, and Rintja in the Lesser Sundas Archipelago, have served as the basis for the present work, which supplements the information in a number of areas of the biology of the monitor lizard. The authors express gratitude to all their comrades in the work, who took part in the collection of the materials used by the authors. In general form, some of the results of the investigations made by the expedition have been published earlier (Darevskii and Maleev, 1963).

## Propagation and postembryonic growth

The data in the literature on the propagation of the giant monitor are based exclusively on observations of the animals in captivity.

For the purpose of clarifying the actual breeding periods of the monitors in nature, at the time of work on the Komodo [dragon] we dissected two sexually mature males, 157 and 238 cm. long, and a female, 171 cm. in length, the gonads of which have been subjected to microscopic study. (The microscopic investigation of the gonads has been done by V. N. Kulikova of the Institute of Cytology of the Academy of Sciences, U.S.S.R.) For both males, dissected August 3 and August 5, the testes were found in a state of rest, being loose, wrinkled bodies 4 cm. and 6 cm. in length. Microscopic study revealed small ducts, chiefly in initial stages of spermatogenesis, passing in the walls and complete cut-off of production of mature spermatozoa, which were also lacking in the collapsed appendages of the testes. Judging from the state of the

gonads, sexual activity of males had already been interrupted in extreme measure by mid-July and, consequently, mating could occur no later than this period. It is interesting that in the smaller female, with a length of 157 cm., well developed fat bodies with a weight of 120 g were observed, while in the adult specimen fat deposits were lacking. Inasmuch as the deposition of shaped fat bodies usually begins in lizards only at completion of the breeding period, it is possible to assume that in the young female the interruption of sexual activity set in correspondingly earlier, obviously already at the end of June.

In the female studied, dissected August 26, the oviducts were empty, but in the ovaries numerous white oocytes were found, some of which attained 8 to 10 mm. in diameter. Furthermore, in the left ovary eight and in the right ovary seven well-defined corpora lutea with distinct cicatrices were found which indicate that the output of 15 ova in the oviduct had occurred no more than a month ago and, consequently, oviposition might have occurred at the end of July or at the very start of August. The well-developed fat bodies in the female also speak in favor of such a conclusion, the lobes of which have reached 27 cm. in length with a weight of 220 g. The fact that the female studied laid only 15 eggs is apparently connected with her relatively small size, 171 cm., 74 of which are for the torso and head. According to the data of Pfeffer (1959), the number of eggs per clutch for large females reaches 25 to 26.

It may be noted that in many Palearctic reptiles a state of the gonads similar to that which was observed for the monitors under study usually is found in the fall of the year in the period preceding hibernation. Evidently for the giant monitor, as also for a number of other tropical reptiles, the dry season that lasts on the islands for more than three months is such a period of repose.

Thus, the studies made by us showed that in natural conditions the breeding of the monitors occurs 2 to 3 weeks earlier than in the zoological gardens of Java and at entirely different periods than in the zoological gardens of Europe. (In 1963 for the females captured by us, which had already mated in conditions of freedom on Komodo, egg-laying at the Surabaja Zoological Garden [eastern Java] was observed throughout July).

Assuming that the length of the incubation period on Komodo is the same as in the zoological gardens of Java and is equal to 8 to 8.5 months, it must be thought that the young monitors make their appearance here as early as March and the start of April, shortly after completion of the rainy season, i.e. in very favorable periods biologically.

As has already been mentioned, the period of work on Komodo of our expedition coincided with the periods of egg-laying and, consequently, the smallest of the specimens encountered by us might

be no older than four months; if one accepts their hatching as having been in the March-April period of this year. Such small specimens have been observed several times by the members of the expedition. However, the youngest of the monitors caught by us have attained a length of 115 to 125 cm., i.e., they have been 16 to 18 months old and probably hatched in March and April 1961. The measurement and marking of the young monitors which we did (see table 1) will permit in subsequent captures obtaining data on migrations and intensity of their growth in nature. The marking of the animals has been done by a standard method, by cutting off the terminal phalanges of the digits. The sites of release of the marked monitors on the Island of Komodo are indicated in the figure.

Judging from the data that are to be had, males make up a considerable part of the monitor population on the island of Komodo. Of the 17 specimens acquired here by Americans in 1926, 14 were males, and there were only 3 females (Dunn, 1927). Judging from the measurements of this author, two skeletons found in abandoned traps set by local residents belonged to males. Proceeding from the dimensions of the body (females of the mammoth monitor do not exceed 2 m. in length), six of the nine skins from the Island of Komodo examined by us at the Bogor Zoological Museum on Java also belonged to males. Two males from Komodo were delivered in 1935 to the zoological garden of the city of Surabaja (Tänzer and Heurn, 1938). Finally, among the 26 specimens caught on Komodo by our expedition, 22 were males and 4 females. Thus, at least 46 of the 56 monitors acquired on the Island of Komodo at various times, i.e., more than 80 percent have been males. In other words, the ratio between the sexes on this island is approximately 6:1. It may be noted that chiefly males have been acquired in different zoological gardens, the same as on the islands of Rintja and Flores. The clear predominance of male specimens in the island population of monitors apparently is no accident, but rather reflects the actual ratio of the sexes existing in nature. It is possible that the sharp reduction in number of females is the manifestation of a special mechanism of regulation of the number which prevents overpopulation of the monitors on the island. The small territory of the island, together with the limited amount of food (carrion), as well as the great length of life of the monitors themselves, might fully play the role of factors that have produced in the process of evolution the selection of such a mechanism.

Feeding Habits

The feeding habits of the giant monitor have been studied rather fully. According to the data of Burden (1927, 1928), Hoogerwerf (1954, 1958), and Pfeffer (1959), and also according to the observations of our expedition, the monitor's food is composed primarily of the carrion that appears more or less regularly on the islands as a result of the natural death of the red deer that have been guided here (Cervus rusa timorensis), of the wild hogs (Sus scrofa subsp), and of wild buffaloes and horses. The specialized sense of smell, together

with the highly developed Jacobson's organ, permits the animals to discover the food quickly, which they, in distinction from other reptiles, do not swallow whole but tear apart with their teeth, remindful in this respect of the carnivorous mammals. It should be emphasized that, with the exception of crocodiles, giant monitors are the only present-day reptiles that act in such way, which permits speaking of a definite skip in character which, at greater morphological comparison, distinguishes it from the other representatives of the genus Varanus.

In devouring the carrion the monitor, like a number of other carnivores, first rips open the abdomen, swallowing the entrails. In addition, it often buries its head in the abdominal cavity of the host, to which the long neck of the reptile contributes much.

The predator plays with the host, usually standing on stretched-out legs, and by this its abdomen is quite visible which, as it is filled with food, sags more and more, gradually reaching the ground.

While eating chiefly carrion, the mammoth monitors are capable of also attacking live prey, up to wild hogs and deer inclusively. Table 2 give some concept of their ration on the Island of Komodo, which was compiled on the basis of the selection of 18 specimens of dry droppings, collected in the first half of August. It may be noted that these specimens, in the majority of cases, have been collected on open summits of hills, at the edge of wooded areas, and at other sites apparently favored by the monitors as lookout points.

To this should be added that in the stomach of one of the monitors dissected by us a large rat was found, Rattus sp, and in another the skull of an adult boar, partly digested. As our observations on Komodo and Rintja indicate, the monitors regularly appear on the shore after high tide, where they pick up the fish and invertebrates thrown up by the sea. It is interesting to note that the majority of the pit clusters of the brush turkeys (Megapodius freicineti), observed by us on the islands, were dug by the monitors in searches for eggs, which was easily established by the tracks in the sand.

It is puzzling to note that monkeys and deer, which are regularly subjected to the attack of the monitor lizards on the islands, fearlessly permit them to come close to them, discovering the danger only at the very last moment when it is already practically impossible to be saved from the teeth or a blow of the tail of the carnivore. Similar observations in regard to monkeys (Macaca irus) have been made on the Island of Rintja by Hoogerwerf (1958) and in regard to deer by our expedition on the Island of Komodo (Darevskii and Maleev, 1963). It is suggested that such an astonishing lack of caution of the victim is explained in considerable measure by the method of hunting of the monitor, which approaches the prey slowly and completely noiselessly, reminiscent in this respect of snakes.

Body temperature

Date on body temperature of monitors in natural setting were obtained for the first time by our expedition on the Island of Komodo. The cloacal temperature was measured by deep insertion of a mercury thermometer, calibrated to an accuracy of $0.5^{o}$, into the cloaca. The measurement was usually done in the morning at the withdrawal of the monitors from the cage snares placed in the shade into which they had fallen the day before. As a rule, the temperature of the air at a height of 0.5 m from the ground was also observed simultaneously. (see Table 3.)

From the table it is seen that the body temperature of active monitors, depending on the temperature of the medium, fluctuates between 26 and $33^{o}$[C] i.e., it is found within limits that are customary for many other tropical lizards. These data agree well with the observations of G. Lederer (1942), according to which the optimal temperature of the medium for keeping monitors in captivity lies within the range of 25 to $30^{o}$ [C]. Our observations showed that at a temperature of the air of over $30^{o}$ [C], the monitors try to keep in the shade and, in case of an obligatory stay in the sun, for instance at the devouring of a prey that lies out in the open, from time to time they open their mouths wide and breathe out repeatedly, thus contributing to the cooling of the body like mammals devoid of sweat glands.

Table 1.

Marking of monitors trapped on the Island of Komodo in August 1962

| No. | Animals Marked | Sex | Date Marked | Length Torso with Head | Tail | Total | Site of Release |
|---|---|---|---|---|---|---|---|
| 1 | 10 | male | Aug. 1 | 46 mm. | 69 | 115 | Vic of base camp (see fig.) |
| 2 | 11 | female | Aug. 4 | 51 mm. | 73 | 124 | " " |
| 3 | 12 | male | Aug. 4 | 58 mm. | 80 | 138 | " " |
| 4 | 13 | male | Aug. 4 | 66 mm. | 88 | 154 | " " |
| 5 | 14 | female | Aug. 19 | 50 mm. | 75 | 125 | " " |
| 6 | 15 | male | Aug. 19 | 61 mm. | 84 | 145 | " " |
| 7 | 16 | male | Aug. 22 | 55 mm. | -- | -- | " " |
| 8 | 17 | male | Aug. 26 | 62 mm. | 89 | 151 | " " |
| 9 | 18 | male | Aug. 26 | 80 mm. | 105 | 185 | " " |
| 10 | 19 | male | Aug. 26 | 67 mm. | 93 | 160 | " " |
| 11 | 20 | male | Aug. 26 | 76 mm. | 93 | 170 | " " |
| 12 | 30 | male | Aug. 25 | 81 mm. | 103 | 184 | Vic.upper camp (see fig.) |

Table 2.

Composition of 18 specimens of dry droppings of the mammoth monitor, collected on the Island of Komodo

| Key: | Number of Encounters | |
|---|---|---|
| Components of the Droppings | Absolute | Percent |
| fur of ungulates | 18 | 100 |
| deer hooves | 5 | 2.8 |
| scales of lizards | 9 | 50 |
| scales of snakes | 4 | 2.2 |
| scales of fish | 2 | 1.1 |
| bird feathers | 4 | 2.2 |
| chitinous parts of insects | 4 | 2.2 |
| remnants of plants | 7 | 3.8 |

Table 3.

Body temperature of monitors on the Island of Komodo

| Serial No. | Date of measurement | Cloacal Body Temperature, °C | Temperature of Air in Shade, °C |
|---|---|---|---|
| 1 | Aug. 4 | 33 | 33.5 |
| 2 | Aug. 4 | 31 | --- |
| 3 | Aug. 4 | 29 | --- |
| 4 | Aug. 4 | 29.5 | --- |
| 5 | Aug. 4 | 32 | --- |
| 6 | Aug. 1 | 28 | 29 |
| 7 | Aug. 19 | 25.5 | 27.5 |
| 8 | Aug. 19 | 30 | 30 |
| 9 | Aug. 22 | 27 | 27.5 |
| 10 | Aug. 22 | 27 | --- |
| 11 | Aug. 22 | 30 | 30 |
| 12 | Aug. 22 | 29 | 33 |
| 13 | Aug. 26 | 29.5 | 31.5 |

Legend to Figure 1: Islands of Komodo, Podar, and Rintja

1 - Expedition camps; 2 - routes through marsh of the Indonesian-Soviet expedition; 3- central peaks of the islands; 4 - region of release of the marked monitors on the Island of Komodo at the upper camp; 5 - region of release of the marked monitors on the Island of Komodo in the environs of the base camp.

Reading from left to right: Island of Komodo, Komodo jungle; Sea of Flores; Pada Island; Rin ja Island; Flores Island.