HUSBANDRY

Captive Care of Monitors Part II: Diet and Reproduction[1]

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Photographs by author.

In the previous issue of IGUANA, we presented Captive Care of Monitors, Part I: Introduction and Housing. Part II follows.

Diet

Almost all monitors are carnivorous, that is, they are exclusive meat eaters. Two notable exceptions are *Varanus olivaceus* and the newly described *V. mabitang*, both of which live in the Philippines and prefer to eat fruit and leaves (Auffenberg 1988, Gaulke and Curio 2001). Insects, spiders, crayfish, fish, amphibians, reptiles, eggs, birds, and mammals make up the bulk of the diet of most monitors. Prey size and type generally depends on the size of the monitor. In the wild, monitors, particularly *V. niloticus*, *V. gouldii*, and *V. panoptes*, are known to find clutches of eggs of other monitors or crocodiles (Bayless 1992, Lenz 1995). In general, monitors do not appear to be particularly selective regarding food. Occasionally, they are even cannibalistic. *Varanus komodoensis*, from Komodo Island, not only feeds on pigs, which occur on this island, but also takes Red Deer and other feral animals. Humans also have fallen prey to the Komodo Monitor.

Because size varies considerably between species, the food spectrum is also highly variable. In the wild, members of the smaller species feed mainly on insects and smaller reptiles, which they can overpower. The examination of stomach contents from wild monitors has revealed the preferred food items of some species (James et al. 1992, Losos and Greene 1988, Pianka 1968, 1969a, b, 1970a, b, c, 1982, Shine 1986, Sprackland 1993, Ziegler and Böhme 1996, Gaulke and Curio 2001).

Grasshoppers make an appropriately sized meal for the Pilbara Monitor (*Varanus pilbarensis*).

A Dwarf Monitor (*Varanus storri*) at mealtime.

The variety of food available to captive monitors is much more limited. Common food items suitable for smaller species include crickets, grasshoppers, locusts, cockroaches, and larvae of the giant mealworm. Newborn mice (thawed or recently euthanized) are occasionally offered to expand the menu. Any captive diet lacks the balanced mixture of vitamins, minerals, and fiber available in the wild, thus supplementation is necessary to provide these nutrients. All insect prey should be dusted with a vitamin and mineral mixture such as Nekton MSA® or Miner-all®. Do not offer too much food, especially crickets and cockroaches, as they tend to hide within the furnishings of the cage, where the monitors cannot reach them. Unconsumed nocturnal insects also may represent a physical risk to the sleeping monitor. To date, no reports have documented crickets attacking healthy monitors, but evidence suggests that crickets in a cage have consumed dead monitors. The risk of injury, especially for young offspring, should not be overlooked.

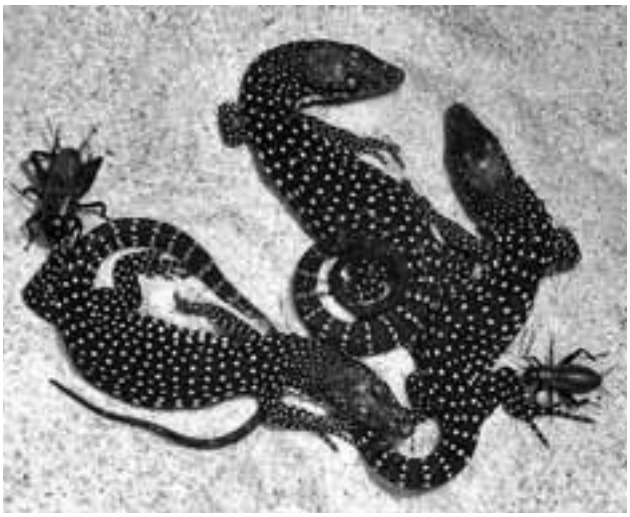
Larger monitors require larger food items. Feeding a lizard the size of a *V. mertensi* on crickets and locusts is prohibitively

[1] Adapted by AJ Gutman from B. Eidenmuller, *Monitors: Natural History — Captive Care — Breeding*. Herpeton Verlag, Offenbach, Germany.

expensive. Mice, and occasionally rats and chicks, are much more appropriate food items. The unit price is low and the protein more concentrated so less total food volume is required. Feeding chicks has at least one drawback for the keeper; it tends to result in monitor excrement that is very runny and smells unpleasant. If you feed monitors on chicken, the enclosure should be cleaned immediately for hygienic reasons. Canned dog or cat food should not be fed to captive monitors as these products contain too much protein and are very low in minerals and fiber. ZuPreem (Premium Nutrition Products, Inc.) produces a canned monitor and tegu diet that provides the proper balance of nutrition.

Conditioning for Breeding

All monitors live a solitary existence in the wild and, in captivity, should be maintained singly or at most as pairs. In order to synchronize pairs of animals sexually, I recommend an occasional period of separation. Separations lasting between four weeks and three months can be carried out several times during the year. Similarly, a brumation period lasting between one and three months, with an ambient temperature of approximately 15 °C is appropriate for animals from colder areas (e.g., for monitors from the southern parts of Australia or South Africa). A period of quiescence also will simulate a summer aestivation for animals from a tropical climate (e.g., *V. mertensi* or *V. acanthurus*), thereby promoting synchronization of the sexes and post-hibernation breeding. Another possibility is the introduction of a rainy season that simulates the conditions required by animals from the equatorial rain forests (e.g., *V. prasinus*). A hibernation or aestivation period is comparatively simple to adopt in captivity by continuously reducing both the photoperiod and the amount of time that heat is supplied to the lizards over a winter rest period. In the middle of winter, the animal does not require significant heat and illumination within its enclosure. Therefore, a spotlight that is switched on for short periods of time for the animal to bask is sufficient. Throughout this period of relative dormancy, animals should always have a bowl of fresh drinking water available in the enclosure, so that



Large food insects can pose a hazard to hatchlings such as these Timor Monitors (*Varanus timorensis*).

This Mangrove Monitor (*Varanus indicus*) has just eaten a mouse.

when they wake up, they are able to drink. A real hibernation, in which animals are maintained without light and heat over long periods of time, is neither required nor recommended for any monitor species. When an animal enters this period of dormancy during the colder months, little other care is required until it emerges with the onset of warmer months. Most animals will survive this period in their hiding places and remain inactive. Animals should not be reactivated too quickly when the weather warms. They will note the change in climatic conditions and gradually over a period of days and in some cases weeks, reappear to seek a basking site and food. After they have recommenced basking over a few days, food can be offered.

Monitors from a tropical rainforest environment (e.g., members of the *V. prasinus* complex and *V. scalaris* from Cape York Peninsula) do not require the above-mentioned hibernation period. A rainy period can trigger mating behavior. The entire enclosure can be moistened two or three times a day with water from a spray bottle to simulate a rainy season. This will raise the humidity, as will a water basin placed in the enclosure on top of an under-tank heating mat. Ultrasound humidifiers can increase humidity during the day by repeatedly switching on and off. These are very effective, but generally expensive.

Bird nest boxes have proven to be acceptable egg-laying sites for tree dwellers such as *Varanus prasinus*.

Emerald Tree Monitors (*Varanus prasinus*) mating on the back wall of their terrarium.

Reproduction and Egg Husbandry

If pairs of monitors have been maintained together for some time and they appear compatible, these animals may be successfully bred to produce clutches of eggs and healthy offspring. The time between the last observed mating and egg-laying in most monitors is between four and eight weeks. An exception seems to be *V. mertensi*. In this species, the time appears to be three weeks between mating and egg-laying. After mating activity has ceased, the female should be allowed to bask and obtain food as needed; therefore, after mating behavior has stopped, the male should be removed from the enclosure. This is particularly important for *V. prasinus*, because these animals are very stress-sensitive, even outside of the mating season. The high stress induced by contact with conspecifics is an indication that members of this species are generally found as solitary individuals.

Prior to egg-laying, females show an increase in body size, becoming more rotund. At this stage, a suitable egg-laying box should be offered. The size of the egg-laying box should be suited to the size of the animal (e.g., a box 40 x 25 x 20 cm, LWH is sufficient for *V. acanthurus*). For larger species, the egg-laying box should be proportionally larger. Bird nesting boxes have been used successfully for *V. prasinus*; these can be natural hollow logs with a cap on each end and a hole part way down for entry (Eidenmüller 1996, Eidenmüller and Wicker 1992) or made of plywood (Dedlmar 1994). These nests are filled with lightly moistened bark mulch or vermiculite. Irrespective of whether the box is made of wood or plastic, the animal must be able to gain access to it from above. The box must be light impermeable, show a thermal gradient ranging from about 30 °C at the top to about 25 °C at the bottom, and the substratum must contain sufficient moisture to prevent desiccation of the eggs before they can be removed and incubated elsewhere. In some cases, the placement of a piece of cork bark on the substratum in the box may be helpful. This serves two purposes, first, it will allow little light into the burrowing material (bark mulch, sand, or vermiculite), and second, the digging animal gains a sense of security that the walls of her nest burrow will not collapse.

An appropriate nest box for a small ground-dwelling monitor.

Many monitors cease feeding prior to egg-laying. While food denial is not a sure sign of forthcoming egg-laying, it is nevertheless a good indicator that a lizard is gravid. If an animal does cease to feed, access to the egg-laying chamber is imperative. A substantial amount of energy is used during reproduction, and food must be available to the exhausted animal after oviposition. The tail base and thigh musculature have generally collapsed. Egg-laying is a stressful time and can be accompanied by problems.

In general, stress is the single greatest factor that can lead to difficulties in husbandry during reproduction. For example, animals that have not laid in the prescribed time are likely stressed by some unseen and intangible factor that can be very difficult to ascertain. Possible conditions that can result in an animal failing to lay eggs include the nest box not being in place or in an inappropriate position, a male still present in the cage, insufficient nest humidity, or that the keeper had spent too long viewing the animal. Stress factors must be teased out by a process of elimination.

Most monitors undertake test-diggings for suitable egg chambers some days before actually being ready to deposit eggs. As soon as they stop test-digging and refuse food, egg-laying is nigh. Similarly, the collapse of the tail base and thighs may indicate imminent ovipositioning. If the monitor has been digging test holes for some time and then ceases all activity at a time when you are confident she should be laying but has not yet done so, medical help should be consulted. This is the single largest indicator that something has gone wrong. Often a qualified veterinarian can induce egg-laying using the hormone oxytocin. If, however, egg-laying is long overdue, a Caesarean section may be needed. Examples of a prolonged egg-laying period include clutches of both *V. acanthurus* and *V. scalaris* that were only partially laid, with the remaining eggs becoming bound to the oviduct. Surgery was required to save the female and ensure her reproductive health for subsequent years. This is only one of many situations that can arise when egg-laying in a monitor is overdue. If egg deposition is weeks overdue, I can only suggest that the animal be placed in the care of a reliable reptile veterinarian.

Incubation

As soon as the eggs have been laid, they must be removed from the enclosure or the egg-laying box. Eggs are part of the diet of most monitors and they will be consumed quite readily by adults or destroyed during digging activities. In reptile eggs, the embryo attaches to a disk at the top of the egg and adheres via a membrane to maintain its position within the egg. In bird eggs, however, the embryo is held in position via a sinew, which allows the egg to be rotated during incubation. Monitor eggs must be kept oriented along a single plane and not rotated. Eggs can be marked on the upper (dorsal) surface with a graphite pencil to show the plane of orientation. A pen should not be used to mark eggs, as some types of ink contain toxic substances that can be fatal to the embryo. When marked, the eggs can be placed into a prepared box that is used for incubation. This box should contain either vermiculite or perlite mixed with an equivalent weight of water. *Varanus mertensi* eggs can tolerate a huge range in humidity or water potential, and this ranges from a 2:1 to a 5:1 ratio of water to substrate (Eidenmüller and Wicker 1998). The particle size of either substrate is not significant. During incubation, the temperature should be between 26.5 °C and 29.5 °C, with humidity between 80% and 90%. If the water uptake of an egg is too high, the embryo inside can

Freckled Monitor (*Varanus tristis orientalis*) hatching.

Gould's Monitor (*Varanus gouldii flavirufus*) hatching in a perlite incubation medium.

Mertens's Water Monitor (*Varanus mertensi*) hatching.

become stressed by the water pressure and die. A small indentation of the egg is not a concern, provided that the eggshell is white. If more water is added to the substrate, this will be absorbed by the egg and plump up any indentations, especially if this occurs early in the incubation process. Be careful not to drop water onto the surface of the egg, as this may harm the development of the embryo. Generally, the incubation period correlates with the adult size of each species, but it may also depend on the temperature and humidity during incubation. Incubation is a process that requires a great deal of patience, because the incubation periods in the literature can be different than the incubation period that you experience, even for the same species. If hatchlings are overdue and the eggs still appear viable, do not open the egg. In most cases, the egg will be opened too early and reveal a premature hatchling, which is unlikely to survive.

If the humidity in the egg-incubation box is high it sometimes becomes apparent that eggs have swollen and in some cases there is water exuded from the egg. This is called "sweating." If one or more eggs start to sweat during incubation, carefully slit the egg on the upper side. This slit in the egg decreases the pressure on the embryo and may enhance its chances of survival.

Rearing Hatchlings

After hatching, each individual should be measured and weighed carefully. These data may be of interest to other breeders. Special care should be taken to avoid injuring the young animals, especially when trying to weigh and measure them. They likely will be intent on escape and even seemingly innocuous movements in the hand can damage a young varanid. After measuring the hatchlings, they should be placed in a cage where they can be reared. The size of the enclosure should be sufficient for the animals to move about their new quarters with ease. The cage should not, however, be so large that you do not have sufficient control over the food items being presented to the new arrivals. This will prevent insects that escape the hatchlings from becoming hidden in some recess of the cage, reappearing at night when the hatchling is asleep, and presenting a physical risk to its survival. The furnishings within a hatchling enclosure should be much the same as those of the adults, although they may be somewhat smaller. Care must be taken to ensure that cork bark and stones are securely positioned so that they cannot fall and crush the hatchlings. A small bowl of fresh water should always be available.

Hatchlings of most monitor species can be kept together in small groups. Exceptions to this are *V. storri* (Eidenmüller and Horn 1985) and *V. prasinus*, which should always be raised separately. Young *V. storri* have fatally injured each other through constant biting, and the only way to avoid this is by keeping them separately. Other species also may exhibit aggression toward one another, so I suggest keeping a close eye on all groups of hatchlings until a determination that they are compatible is justified. The problem of stress can be quite pronounced in *V. p. beccarii*; hatchlings in some instances have been known to refuse food and die within hours (Eidenmüller

Hatchling Emerald Tree Monitors (*Varanus prasinus*) must be raised individually.

Hatchling Pilbara Monitor (*Varanus pilbarensis*) in the terrarium.

1996, Eidenmüller and Wicker 1991). Most other monitor species are not problematic in this respect. When rearing a group of hatchlings, close attention should be paid to the feeding behavior of all individuals to ensure that they are all obtaining sufficient food. As they grow, some animals will become dominant and exclude others from the food. These animals should be removed.

During the first two to ten days, the small monitors still live on yolk, which is the last thing to be incorporated into the body cavity before hatching. This food source for a newly hatched varanid can last between hours and days depending on the health of the female, size of yolk in the egg, and metabolic rate of the hatchling. Hatchlings should be offered food items that are small enough for them to overpower, such as small crickets or cockroaches. Food animals should always be treated with a vitamin and mineral powder. Freshly caught grasshoppers are an excellent addition to the diet of a captive monitor as they contain more vitamins and fiber than cultivated insects. Be certain to avoid catching insects from agricultural land, beside freeways, or in some gardens, where they are likely to have been subjected to pesticide and herbicide applications. Many of these applications may be harmful to your hatchling. Cultivated crickets and locusts are fed a biased diet that may not have all the necessary vitamin and mineral components to ensure the long-term health of your monitors. Several manufacturers sell gut-loading cricket diets that considerably improve the nutritional value of food insects.

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