HUSBANDRY

Captive Care of Monitors[1]

Part I: Introduction and Housing

Bernd Eidenmüller

Frankfurt, Germany

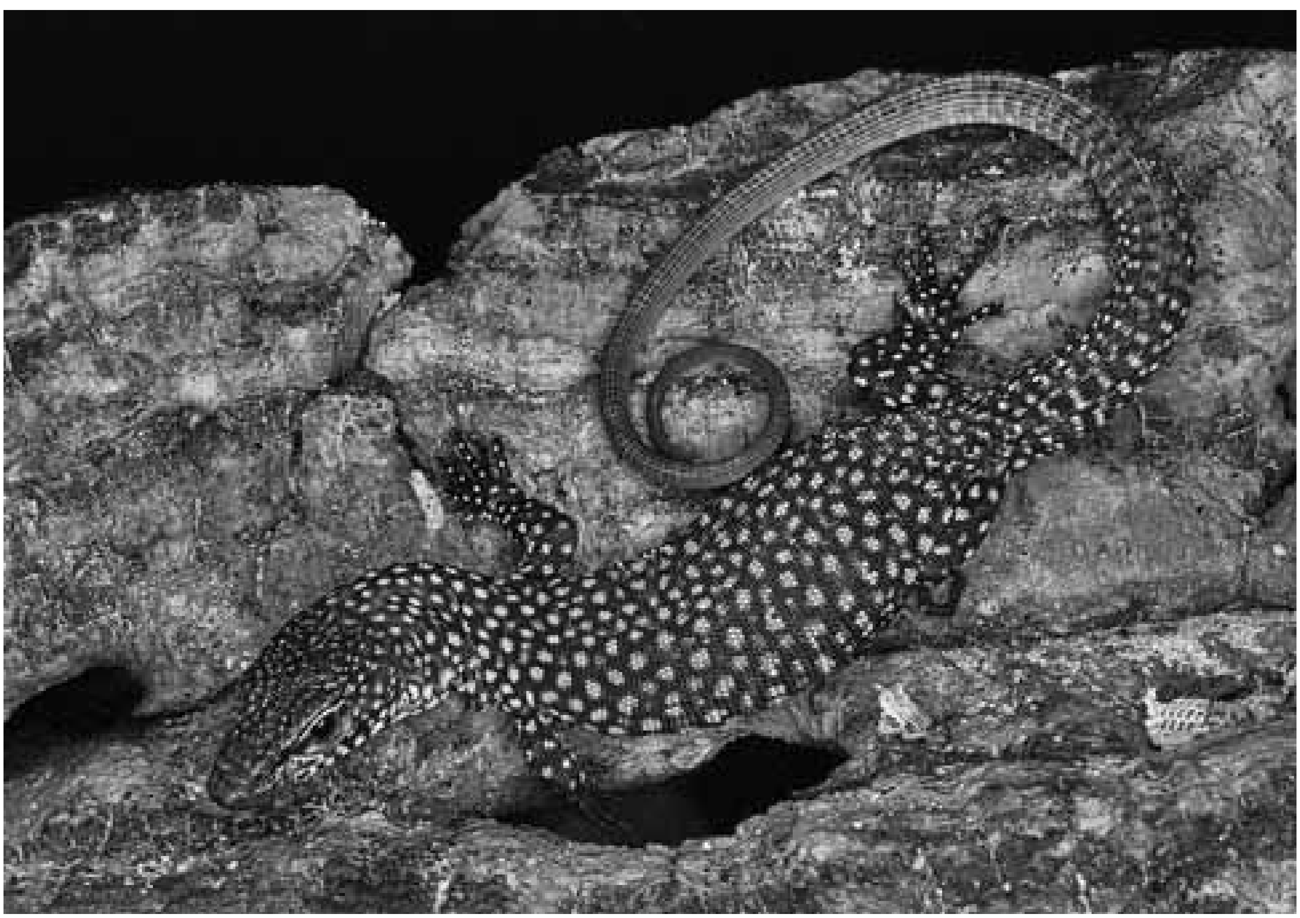
The family of monitors is monotypic, and all living members belong to the genus *Varanus*. The genus is subdivided into nine subgenera. Two distinct geographical radiations have been identified (Böhme 1988a, 1993). The Afro-Asian radiation includes the subgenera *Psammosaurus*, *Empagusia*, *Philippinosaurus*, and *Polydaedalus*. The Indo-Australian radiation includes the subgenera *Odatria*, *Varanus*, *Papusaurus*, *Euprepiosaurus*, and *Soterosaurus*.

Monitors are restricted in distribution to the Old World, where they inhabit the tropical and subtropical climatic zones of Africa, Asia Minor, South and Southeast Asia, Australia, and the Indo-Australian archipelago. Australia appears to be a significant hub for monitors worldwide, with 25 species and ten subspecies in three subgenera.

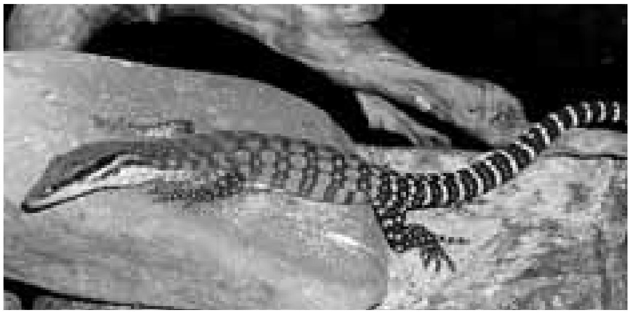
Monitors occupy almost all habitats: they live in sandy deserts, open savannas, and even tropical rain forests. Rivers and lakes are used as habitat refugia by some species. Monitors can be categorized by their preferred habitat. These include: water monitors, ground-, rock-, and tree-dwellers.

All monitors share certain characters. They all have a completely ossified skull, which makes it possible for them to swallow large food items without the risk of pressure on the brain. The throat can be enlarged by raising the hyoid cartilage appa-

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



Juvenile *Varanus kingorum*. This small species needs a rocky habitat equipped with many hiding places.



Juvenile *Varanus glauerti* basking in a terrarium.

ratus, helping them to swallow food. This inflation of the gular region increases the overall body size, and also acts to help intimidate enemies or impress rivals. All monitors have four limbs with five toes that are equipped with strong, backward-curving claws. The head is situated on a long neck, the eyes have round pupils, a distinct tympanum is clearly developed, and the tongue is very long and deeply forked. Using the tongue, monitors extract minute particles from the air or substrate and convert these into a traceable scent using chemoreceptors in Jacobson's organ, which consists of a pair of pits in the roof of the mouth into which the tips of the forked tongue are inserted. These cues can be used to detect food, rivals, or sexual partners.

The difference in size between the largest (Komodo Dragon, *V. komodoensis*, from the island of Komodo, length to 350 cm, weight 150 kg) and smallest (the Short-tailed Monitor, *V. brevicauda*, from Australia, length about 23 cm, weight about 20 g) living monitors spans almost four orders of magnitude (i.e., *V. komodoensis* is 7500 times heavier than *V. brevicauda*). This represents the largest size disparity between vertebrates within a single genus in the world.

Care

As some species of monitors can reach both substantial total length and body mass, potential keepers must carefully consider the amount of space needed to properly maintain these animals. Most enthusiasts are limited in the size of enclosures they are able to provide. Given such constraints, the monitors in the subgenera *Odatria* and *Euprepiosaurus* are the most appropriate, although nearly all species within these subgenera are from either Australia or the Indonesian islands. The export of monitors from Australia is strictly forbidden, and export from Indonesia is very restricted. Therefore, captive-bred animals must be sought. These animals are legal and offered regularly in fairly large numbers.

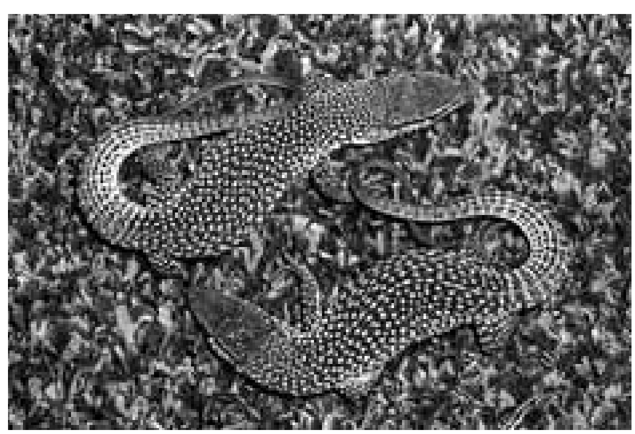
Which Species Suits Me?

Deciding which species to purchase should be guided by the amount of space you have available for an enclosure and the amount of money you are prepared to pay. If you purchase a relatively inexpensive monitor such as the Water Monitor (*V. salvator*) from a pet shop, you need to be aware that this animal, if properly fed, has the potential to grow to more than two meters in less than two years. It will very quickly outgrow that small enclosure in the living room. Furnishing the enclosure should be another consideration. Preferably, the enclosure should be set up to mimic the type of habitat and climate that your particular species of monitor would encounter in the wild.

In most monitor species, the sexes are almost impossible to differentiate. Although a degree of sexual dimorphism (variable size and color) exists in some species, this tends to be the exception rather than the rule. Many lizards and snakes are easily sexed by inserting a rounded probe into the hemipenial pockets at the base of the tail. The probe slides posteriorly into the pouch in the direction of the tail tip. The length of the inserted probe is used to determine sex, with males having a deeper probe depth than females. This method is not appropriate for sexing monitors, as females have a similar pouch at the base of the tail, which is the mirror of the hemipenial pocket of the male. This hemipenial structure in the female has been described as the hemiclitoris (Böhme 1995, Ziegler and Böhme 1996a). Similarly, the clusters of spines located at the base of the tail in some monitor species do not always indicate sex. In *V. tristis*, this feature is prominent in males but not females. In order to be 100% certain of sex in monitors, a reptile veterinarian must perform an endoscopic inspection of individual animals (Schildger and Wicker 1992, Schildger et al. 1993).

Captive-bred animals obtained from a private breeder are generally healthy and should present few maintenance problems. Wild-caught animals from reptile dealers are very often of inferior quality; these animals are likely to be highly stressed from capture and transport. Although the initial cost may be a little higher, captive-bred animals are likely to be much more cost-effective in the long term. The exception is for species new to the market, which may not as yet have been bred in sufficient numbers for their breeding biology to have become understood by specialist keepers who will eventually make them available as captive-bred progeny.

Opportunistic infections often appear in parallel with parasitic infestations, thus wild-caught animals should be observed for at least six weeks in a quarantine enclosure following acquisition, without exception. During this period, feces should be collected and examined by a reptile veterinarian for parasites. Medication should not be administered without direct instructions from a reptile veterinarian. Visible external injuries should also be referred to a veterinarian. Problems seldom appear with captive-bred animals, although some exceptions to this may



Juvenile *Varanus storri* are often aggressive towards cagemates and must be raised separately.

A tree dweller, such as this *Varanus timorensis*, benefits from plenty of vertical structure within a terrarium.

become apparent as more and more people keep monitors as pets. *Varanus storri*, for example, should be housed individually and paired only for the breeding season, as they tend to fight.

The wide geographic distribution of some monitors presents another problem. A visual inspection of a wild-caught animal will not necessarily reveal its point of origin. With considerable climatic divergence within the distribution ranges of some monitors, problems may occur in synchronizing mating with seasonal differences between locations. A *V. tristis* from Kingoonya in South Australia may mate at one time of the year and the same species from Daly Waters, some 2000 km north in the tropics, may mate at another time of year. Thus, even when two animals of the same species are paired, breeding success can remain elusive. With captive-bred animals, this does not appear to be a big problem, nor with animals that are long-term captives (i.e., three years or more).

To date, little attention has been paid to the territoriality of monitors. In captivity, one animal simply cannot be replaced with another. Monitors have an acute sense of smell and any new intruder in the cage is immediately recognized, a phenomenon I have observed in *V. storri*. When a new animal is introduced into a cage, it immediately begins to tongue-flick to investigate the entire enclosure. In several places within the cage, it will rub its cloaca, presumably to mark its territory, as well as to inform rivals and sexual partners living in the area/enclosure of its presence (Eidenmüller 1993).

The Enclosure

The goal of every responsible private keeper should be to strive for species-specific care for his or her captive monitors. Each species will have different needs in terms of climate (including temperature, lighting and humidity), housing, and diet.

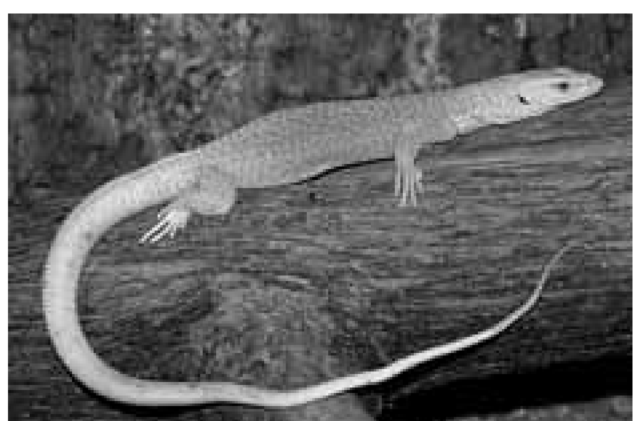
The captive habitat should be set up to simulate as closely as possible the natural environment of its inhabitant(s). Obviously, attempting to recreate natural elements such as flood and fire is neither simple nor desirable. However, this still leaves us with any number of parameters to manipulate in order to provide the greatest natural comfort and the highest probability of breeding success for our captive charges.

Monitors appear unable to distinguish between types of branches in the enclosure, be they cherry tree or some other tree branch. In my experience, the most important consideration is allowing the animal to feel secure when climbing and holding a branch. Illumination is perhaps the most important and one of the most overlooked elements of the captive setup. Since artificial lights cannot approach the degree of illumination provided by natural sunlight, in general, the highest degree of illumination that can be provided without overheating the enclosure is most appropriate. Diet also is of great importance and appropriate food items (mice, rats, chickens, insects) to approximate each species' natural diet should be provided.

Social conditions within any one enclosure must be closely monitored. Housing animals of unequal size together may result in one becoming prey for another. Parasitic infections in captive animals also require immediate intervention. Under natural conditions all monitors carry both endo- and ectoparasites and appear unaffected except in exceptional circumstances. In captivity, any number of factors can result in a parasitic imbalance, which can rapidly overwhelm an already stressed animal.

Let me again emphasize that the care of animals should approximate conditions in the wild as closely as practicable. The highest objective in captivity should be to maintain fit and healthy captives, capable of reproduction. Enclosure size and furnishings need to be adapted to the natural movement and behavior patterns of the animals you wish to keep.

Different species will have different spatial needs within an enclosure. Every keeper should offer the animals as much space as possible. Recommended enclosure size for tree dwelling animals is 5 x 2 x 4 (length x width x height) times greater than snout-vent length (SVL) or 4 x 2 x 5 times SVL. For ground dwelling animals, cages should be 5 x 2 x 2 times SVL. These guidelines will ensure that your monitor has sufficient room to move. For quarantine and hibernation enclosures, these meas-



An albino juvenile *Varanus kingorum* relaxes on a bare branch.

urements can be reduced by half. During quarantine, the enclosure should be cleaned frequently and a small space can be cleaned with relative ease. During hibernation at lower temperatures, the movements of the animals are restricted and a smaller enclosure is sufficient.

Water monitors have different cage requirements compared to terrestrial and rock-dwelling monitors. They require a fairly large water tank in which they can swim and dive. A small water dish is not sufficient. Animals from arid regions should be provided with dust-free sand as ground cover. Sand need not be sterilized before use. Cypress mulch is the perfect substrate for animals from the tropics. This substrate retains moisture over long periods, thus increasing humidity within the enclosure. Mulch should not be sterilized, as this will kill off natural microorganisms that serve to retard the growth of fungi.

Furnishings should be such that they are compatible with the general movements of the monitor being housed. Most monitors are good climbers, and both the side and rear walls of the enclosure should be formed so that they can be used for climbing. This will increase the amount of activity area available to the animals. Ground- and rock-dwelling animals from desert areas will make ready use of a terrarium that has a rear wall modeled with styrofoam and epoxy-resin. As the resin dries, the whole wall can be dusted with sand to give it a stone-like texture (Eidenmüller 1989, 1992a). For tree monitors, thick cork sheets can be affixed to the side and rear walls (Eidenmüller and Wicker 1992) to form climbing areas. Cage structure can be enhanced further by using tree branches in the enclosure. Smooth branches should be avoided, as they are difficult for the animals to grip. The overall layout of the terrarium is basically one of personal preference. My own water monitor terraria are built on top of an aquarium. Atop the aquarium, I used Styrofoam and epoxy resin to construct a ground area onto which the animals climb from the water. This type of layout offers the monitors both water for swimming, and a large overhanging ground area. The styrofoam rock area also serves as a basking area suitable for thermoregulation (Eidenmüller 1990, 1995, Eidenmüller and Wicker 1995).

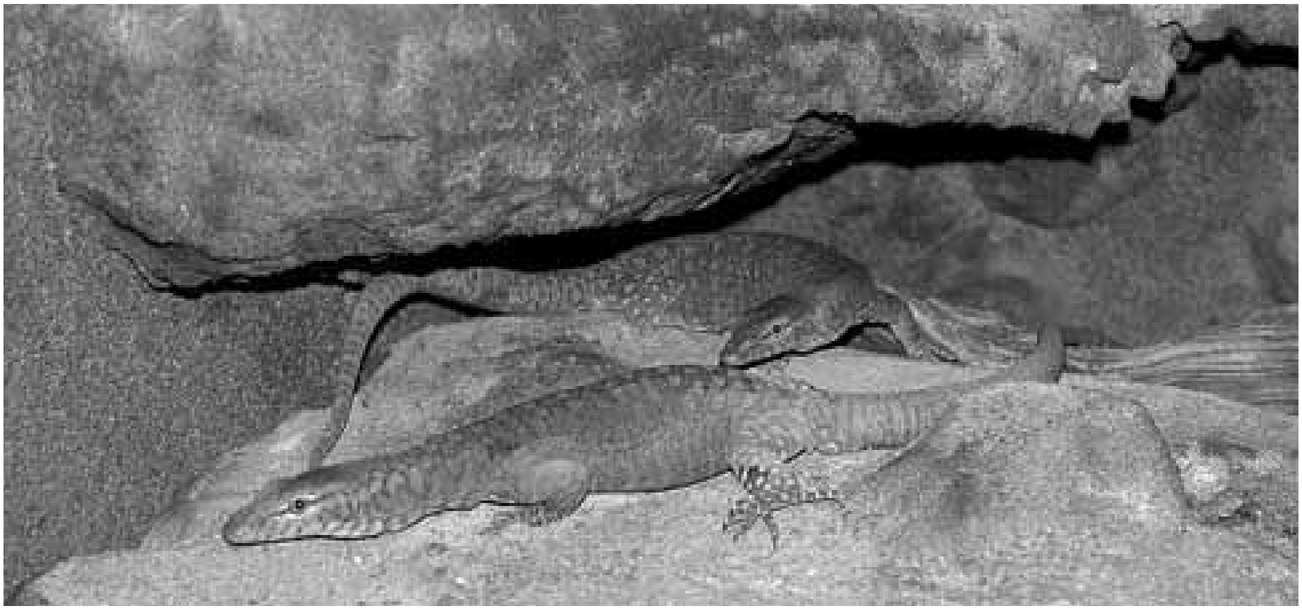
JOHN BINNS

Although animals such as this Black-throated Monitor (*Varanus albigularis* ssp.) can become quite tame, potential owners must consider the amount of space required by a pet that can attain a length of up to 200 cm.

Varanus mertensi is a highly aquatic species from Northern Australia and even a juvenile requires a fairly large swimming area. Appropriate housing can be constructed above an aquarium.

Since live plants rarely survive in monitor enclosures, I do not recommend their use. Ground-dwelling monitors will inevitably dig, and during these excavations plants become uprooted and die. Even the hardiest plants can only survive this activity for a short period. Living plants in an enclosure for rainforest inhabitants (e.g., *V. prasinus*) appear very natural; however, even trees like the robust Fig Tree (*Ficus benjamina*) die in a very short time when continually subjected to monitor claws. Plastic plants do very well in some of my enclosures. They appear fairly natural and are easy to clean. Animals do not seem to care whether the cover is natural or not. When using artificial plants, however, be careful that monitors do not ingest any broken parts of these plants along with their food.

Proper lighting is critical for the well-being of monitors in captivity; nevertheless, I find that many keepers fail to provide sufficient illumination in their enclosures. No amount of artificial light will replace natural lighting conditions. Whereas low-intensity bulbs and common fluorescent tubes may be more efficient in terms of initial cost and long-term energy expenditure, and may even provide lighting that appears sufficient to the human eye, they represent a false economy and will inevitably result in health problems for captive monitors in very short order. In my experience, the use of mercury vapor lamps has a positive influence on the behavior of animals. Mercury vapor lamps radiate ultraviolet (UV) light, which is critically important in a monitor enclosure. Ultraviolet lighting must be installed in such a manner that animals have direct access to it without any intervening glass barriers that can block the UV rays. The temperature range produced within the enclosure should be carefully measured to avoid the problem of overheating. To this end, proper ventilation of the enclosure is essential.



Varanus pilbarensis is a small, attractive rock dwelling monitor from Western Australia.

Also, ensure that no animal can come in direct physical contact with any of the heating lamps. Burns from lights are all too common, and can potentially result in fatalities.

All monitors are diurnal, and should be provided with a daytime photoperiod of appropriate length and intensity. The animals must also be able to regulate their body temperatures. A basking area under a spotlight should be provided as well as cooler areas more distant from a direct heat source. Many keepers think that desert animals require high to very high temperatures. In actuality, animals in the wild can move from areas with high solar radiation to areas that offer protection from extreme temperatures. This movement in and out of high temperatures is known as "shuttling" behavior and is common to many reptiles.

Conditions that support this type of behavior are difficult to reproduce within an enclosure. Keepers rarely have a terrarium deep enough to offer their captive monitors the opportunity to dig into 50 cm of sand or other substrate. I would recommend keepers use a heating source that has been installed to heat only one half of the enclosure. In many of my own enclosures, I have a 60-watt spotlight with a wide angle of light directed onto a flat rock some 40 cm away. This provides a good thermal gradient within the cage, but allows the monitor to attain an optimum body temperature without risk of overheating. I would not recommend the use of a ceramic heater, because it does not give off light; the animals do not realize that the amount of heat generated is substantial and can cause severe burns or even death. Larger monitors will sometimes incur localized burns under a spotlight because the part of the body directly under the lamp heats up to burning point while the temperature over the rest of the body is insufficient to warn it of the danger presented by the spotlight.

In Sri Lanka, Water Monitors (*V. salvator*) occasionally suffer dorsal burns due to their propensity for hiding in rubbish heaps. When the rubbish is burned, the animals are caught with a low body temperature while the flames create a high single-point temperature.

An under-tank heating pad can be installed beneath the preferred hot spot. If a heating cable is used, it can be coiled around one half of the enclosure to create a temperature gradient. Because most monitors are accomplished at digging, the cable must be secured so that the animals cannot dig it out or sustain electric shocks. The best method is to install the cable under the half of the terrarium that is to be heated.

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