HUSBANDRY

Iguanas and Artificial Ultraviolet Light: How and How Much Made Simple — Well, Not Exactly Simple…[1]

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All photographs by the author.

Readers will recognize that, in order to stay healthy, iguanas require UV-B (ultraviolet radiation in the "B" range) as much as they need the complex salads we prepare for them daily. Without UV-B, the all-important mineral, calcium, cannot be effectively absorbed — and calcium is as critical as nutritious food, water, and heat. In responsible husbandry, we must replicate the UV spectrum required for the photochemical process involved in metabolizing vitamin D_3 (which mediates calcium absorption) — while never forgetting that this will be of little importance if the diet, heat, etc. are less than optimal. Also remember that this is a discussion on what is best for reptiles, NOT humans.

Since extensive research published in reputable scientific journals has yet to be performed, the recommendations that follow are based on logic, atomic physics, engineering principles, existing knowledge about the natural habitat of iguanas and their biology, and my own personal experience.

Proper placement of bulbs will provide an iguana access to heat and UV light and permit proper thermoregulation by allowing the animal to move toward or away from the heat source.

UV-B is part of the electromagnetic spectrum. This spectrum includes everything from radio waves at one end to gamma rays on the other. Visible light is somewhere in the middle. Wavelengths are read in nanometers from 0.001 nm (x-rays) to 100 billion nm (radio waves). A reptile bulb can be subjected to testing by an ultraviolet radiometer and spectrographs in order to measure precisely the wavelengths that are being produced.

The UV range is from 180–400 nm, the B range specifically from 280–320 nm. However, we are most concerned with readings from 290–300 nm. Why? This is the D-UV range, which triggers the miracle of photo-biosynthesis and is responsible for creating pre-vitamin D_3 (cholecalciferol). We think that about 80% of this photochemical reaction is triggered by ultraviolet waves in this range. Ingested vitamin D (7-dehydrocholesterol or 7-DHC) in the reptile's skin absorbs the UV-B protons, which allows the photochemical reaction that converts the 7-DHC to cholecalciferol. The latter is then converted in the liver to 25-hydroxycholecalciferol (25-HDCC). The final step toward becoming biologically active vitamin D_3 (1,25- dihydroxycholecalciferol or 1,25 DHCC) takes place in the kidneys through the process of thermal isomerization. Biologically active vitamin D_3 is stored in the liver and kidneys and its primary function is to regulate calcium metabolism. This gives you some idea of why reptiles suffering from metabolic bone disease (the lack of sufficient D_3 to metabolize calcium) also suffer from forms of liver and kidney disease.

Having mentioned reptilian skin, let's quickly consider the amount of exposure of an animal to

[1] All references to brand names reflect the author's personal experiences and should not be construed as an endorsement by the IIS.

natural sunlight that is necessary for this chemical reaction to take place. The assumption that a few minutes a day is sufficient is based entirely on studies with humans. Keep in mind that the protons from the UV radiation have to penetrate the skin deep enough to reach the capillaries underneath the skin in order to produce this reaction. Anyone with experience around iguanas can appreciate how tough and thick their hide is. Several hours a day of natural sun exposure is much more appropriate for a large reptile.

However, the ultraviolet we need to supply for our animals must be "useable" (in other words, in the D-UV range). How can we measure and be confident that we have supplied our creatures with ample amounts of D-UV? By far the most reliable method is to test specifically for blood levels of 25-HDCC (wild iguanas have levels of 175–275 nmol/L of this form of D_3 in their blood). This test can be performed by a qualified veterinarian and is the final say on whether we have provided optimum husbandry for our iguanas. This is much more reliable than using a standard blood panel test (which measures only calcium and phosphorus levels). Even iguanas that have what appear to be good blood panels have been found to be on the low end of the active 25-HDCC level. This helps to explain why iguanas in the wild can drop 20 feet out of a tree and hit the ground running, whereas stories of captive Green Iguanas falling 5 feet and ending up with compound fractures are common.

Just what kind of ultraviolet levels are these creatures exposed to in their natural environment? The standard for measuring intensity of the UV spectrum is read in microwatts per square centimeter (μW/cm^2). The USDA recently did a study with an Ultraviolet Pyranometer and found readings of UV-B in Florida on June 1st that reached 450 μW/cm^2 (remember, however, that only a certain percentage of this falls into our "usable" D-UV). Hobbyists have the ability to take their own UV-B readings with a simple hand-held ultraviolet radiometer from Solarmeter (model 6.2). The measurements taken by the USDA are extremely close to the readings that I have been taking for the last two years in a study of reptile lamps and I have used this as a constant for meter calibration.

Although iguanas may not be exposed to as much as 450 μW/cm^2 on a continuous basis, they

The low-cost hand-held ultraviolet radiometer from Solarmeter (model 6.2) provides hobbyists with the ability to take their own UV-B readings.

will spend several hours a day exposed to relatively high numbers. My studies, as well as those of others, have found that, even in the shade, global UV-B readings reach 30–50 μW/cm^2. These numbers give us an idea of the minimum and maximum ultraviolet B exposure levels in nature.

Interestingly, another study has proven that D_3 biosynthesis is a naturally self-limiting process. Without getting too technical, this "safety valve" ensures that toxic levels of vitamin D_3 are not created, and that the excess is broken back down into inert ingredients (but please see the references at the end of this article). Basically this means that as long as we do not expose our iguanas to any more UV than that to which they are exposed in their natural environment, we will stay within safe perimeters.

Two styles of reptile UV-B bulbs are available. One is the fluorescent tube and the other is the mercury vapor (MV) reptile lamp. Both style lamps use the heavy metal mercury as a catalyst for producing ultraviolet radiation. An electrical charge passing through liquid mercury excites the molecules until they vaporize (when the mercury cools, it resumes liquid form). In the fluorescent tube, the mercury must combine with high-grade phosphorus to achieve the ultraviolet results.

Over the past two years, I have studied failure and decay rates of mercury vapor lamps and conducted a general study of the major brand fluorescent tube reptile bulbs. I am constantly asked if I have tested a certain fluorescent brand bulb by individuals who have seen them listed inexpensively — in spite of the fact that, for many years, I have been telling people that quality UV is not cheap (unless we're talking about the great and wondrous sun). In a recent conversation with

ZooMed 5.0 fluorescent tubes are built to the most exacting tolerances.

Voltarc Technologies, one of the largest manufacturers of reptile fluorescent bulbs in the nation, the engineers confirmed the fact that money buys UV.

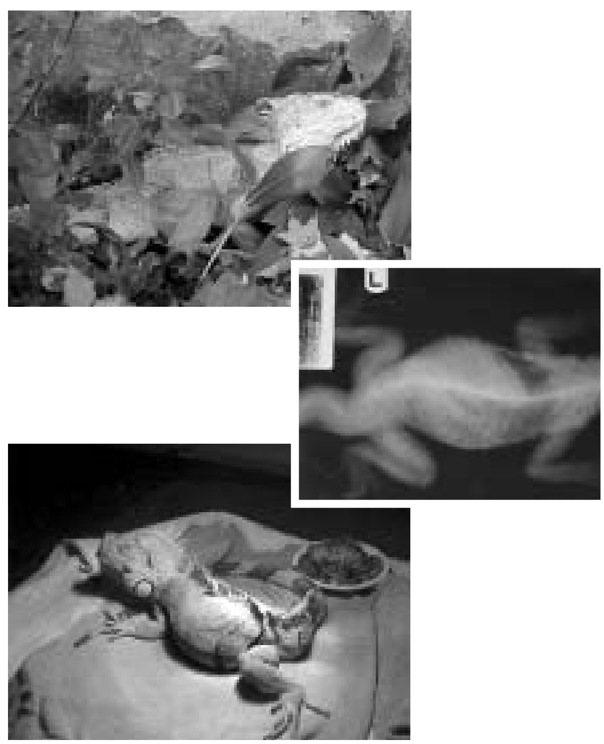
Production costs rise with more exacting specifications (how much UV-B and where precisely it is to be delivered). In order to build a tube that will provide not only high UV-B readings, but one that will generate output in the useable 290–300 nm range, manufacturing tolerances have to be very precise. Two different fluorescent tubes can emit equal amounts of total UV-B, yet one will do a much better job keeping your pet healthy than the other (even though both bulbs might have been manufactured by the same company, but for two different distributors' specifications).

The best fluorescent tubes tested emit 12–15 $\mu W/cm^2$ at 12" after initial burning. A variety of good fluorescents (as well as some absolutely terrible ones) are on the market, but ZooMed 5.0 is built to the most exacting tolerances according to all of the manufacturers with whom I have spoken.

The other choice in artificial UV is the mercury vapor reptile lamp, which comes in a variety of styles and wattages. Anyone who has done rehabilitation work has seen the effects of these bulbs compared to even the best fluorescent tubes. Why is this the case? Do they emit huge amounts of UV? Are they reliable? Is one brand better than another?

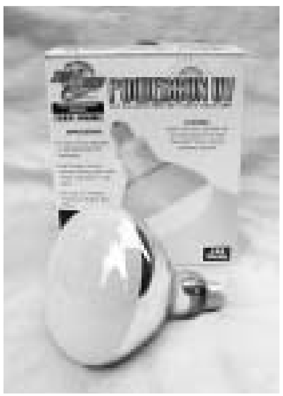
Self-ballasted MV lamps suffer from a 50% failure rate over the first six months and a 70% decay rate in total UV-B emitted. The best-selling style MV bulb, the 160 watt FLOOD, emits much less UV-B than stated on their endorsements after decay. These bulbs settle in at about 12 $\mu W/cm^2$ at 12". Why, then, do we see such incredible results with MV lamps when compared to fluorescents? After all, two high-quality fluorescents will produce 25–30 $\mu W/cm^2$ at 12". The answer is simple: MV lamps emit less total UV-B than fluorescents — but more "usable" UV. Studies have shown that MV lamps produce the same percentages of D-UV (and UV-A, which is another subject) as a percent of total energy emitted as the sun.

Self-ballasted SPOT-style lamps produce much higher UV readings than any other reptile bulb on the market. They still are subject to the failure rates of all self-ballasted MV lamps. These lamps settle in at about 100–150 $\mu W/cm^2$ (at 12"), but have a much narrower disbursements of UV-B. These are excellent rehabilitation bulbs for treating animals suffering from severe metabolic bone disease. Regarding concerns that iguanas under this style of lamp will need "goggles" to prevent blindness from "excessive" UV exposure, remember the exposure levels in their natural environment. We have five iguanas that have spent two years exclusively under mercury vapor SPOT lamps with no negative impact on vision. However, the distance from any MV lamp to the basking area must be regulated in order to provide optimum temperatures, regardless of any distances stated by the distributor!



Erving, a rescued Green Iguana, made a remarkable recovery following six months of therapy under UV lamps (top). Note the severe spinal scoliosis (center) and evidence of severe metabolic bone disease (bottom) when he was initially rescued.

The T-Rex UV Heat 100- and 160-Watt lamps are among those recommended.



ZooMed's Powersun 160-Watt lamp is another lamp that performed well when tested.

At this time I recommend only 100- and 160-watt T-Rex UV Heat, 160-watt ZooMed Powersun, and the Westron Lighting 60-watt in-line ballast MV lamps. Others performed poorly in my tests. A new 60-watt in-line ballasted MV lamp from Westron Lighting produces excellent UV-B after decay, and without the problem of failure (no self-ballast to fail). Its primary drawback is limited heat production, although this could be an asset for keepers of smaller reptiles kept in glass habitats. It also generates poor-quality visible light. According to the manufacturer, these limitations of the current bulb will not apply to models that will soon be available.

So, what is best for iguanas? I recommend 30–50 µW/cm^2 at 12" for 8–12 hours per day (comparable to minimal natural exposures in the wild). The best way to realize this number is to use an ultraviolet radiometer (such as the Solar Meter 6.2 hand-held version; see references) to measure the amount of UV-B available to your iguana. The ZooMed 5.0 fluorescent lamps are at the top of the ladder in terms of meeting these specific requirements (i.e., the best "usable" UV-B). Use at least two of these lamps to achieve the desired

The Westron Lighting MV in-line ballast lamp requires complementary heat and full-spectrum lighting but outlasts other MV lighting.

exposure levels. The 100- or 160-watt T-Rex FLOOD lamps or the 160 watt ZooMed FLOOD lamp also may be used in conjunction with a ZooMed 5.0 fluorescent tube. If you do not have a meter, you should rely on the security provided by the quality of the 5.0 bulbs. Alternately, T-Rex SPOT bulbs (100- and 160-watt) will emit 50–150 µW/cm^2 (at 12" after break-in) — as long as they burn. No other supplemental UV-B source is necessary with these lamps. Finally, the Westron Lighting MV in-line ballast lamp can produce 30–50+ µW/cm^2 after break-in. This lamp will need additional heat and full-spectrum complements, but should not fail as quickly or frequently as other MV lamps.

References and Resources
(listed by topic)

25 HDCC blood level study with radiograph (and much more information on ultraviolet bulbs), http://www.myiguana.com

25 HDCC vitamin D Test, University of Michigan, Animal Health Diagnostic Laboratory, PO Box 30076, Lansing, MI 48909 (517-353-0621)

Calcium physiology, Bogoslavsky, B. 2002. Calcium metabolism in iguanas. *Iguana Times* (*Journal of the International Iguana Society*) 9(1&2):32–34.

Electromagnetic spectrum, http://csep10.phys.utk.edu/astr162/lect/light/spectrum.html

Photochemistry and biology, http://www.photobiology.com

Ultraviolet radiometers, www.solarmeter.com

UV-B and D3, http://home.att.net/~chameleons/zoomedUV-B.html

Vitamin D discussion, "The Merck Manual," 17th ed., p. 35