

## THE IMPORTANCE OF LIGHTING FOR ZOOLOGICAL COLLECTIONS IN THE MIDDLE EAST

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The Middle East has such an extreme climate during the summer months that many zoological species are maintained within the closed environment of buildings for part, or even all of their lives. The problem with 'artificial' environments is that the animals are totally dependent on the inputs provided by their human carers. Given our incomplete understanding of the biological requirements of the majority of the zoological species kept in captivity it is hardly surprising that things go wrong. When the 'inputs' are incorrect, then the animals tell us something is wrong by getting sick, by not breeding or by producing young that fail to thrive.

In aviculture, photoperiod, temperature, humidity and diet have traditionally been considered the key factors requiring precise management for projects breeding or moulting birds (Cooper 2002). However, the importance of providing the correct type of lighting in general and specifically ultraviolet (UV) radiation on the health and welfare of animals maintained in artificial conditions has only recently been realised. The authors have seen cases of nutritional secondary hyperparathyroidism in young animals, calcium deficiency in older animals and episodic epileptiform seizures associated with inadequate lighting in projects.

**Why is UV light important for birds?**

The eyes of most diurnal birds are, as in some reptiles and fishes, enabled for light perception in the UV spectrum, ie between 360 and 700nm (Varela et al, 1993; Korbel, 1999). This ability is bound to special retinal cones with a maximum sensitivity within the light spectrum between 360 and 420nm. In comparison, the human eye lacks UV sensitivity (UV blindness) as UV light cannot pass through the lens which acts as a UV filter. Thus total light perception in man ranges from 400-680nm.

One of the earliest field studies to demonstrate the significance of UV perception to birds was in 1994 when scientists demonstrated that the urine and faecal scent marks of small voles are visible in UV light. European kestrels are able to see these scent marks in UV light and to use them as a sign of prey patches in a habitat (Viitali et al, 1994). The role of UV perception in birds is summarised in Table 1.

Table 1

- Sex recognition. UV reflection of the plumage can differentiate sexes.
- Food selection. Ripeness of foods assessed from their UV reflection.
- Calcium metabolism.
- Food intake.
- Comforting behaviour.

**What about flicker frequency?**

Normal neon lights emit a non-continuous light with a frequency of 50 cycles per second (on/off switching per second). While this frequency is not discerned by the human eye, birds possess a spatial frequency that can distinguish up to 160 frames/second and it is thought that the stroboscopic effect of neon light may lead to negative consequences. Indeed Verwoerd (2001) reported episodic epileptiform seizures in peregrine falcons maintained in a facility that used old neon lights that were observed visibly flickering to human eyes. These birds recovered when they were moved into outside pens and exposed to natural light. Korbel (1999) has postulated that the stroboscopic effect of too low a flicker frequency for birds (50Hz) could lead to negative behaviour in birds, such as cannibalism and feather picking.

**Recent research**

In 2007 the William Hunting Award was awarded to Mr Michael Stanford from the UK by the Veterinary Record, a leading professional journal for his paper "*Effects of UVB radiation on calcium metabolism in psittacine birds*" (Veterinary Record, 2006, vol 159, pp 236-241). This research was considered to have extremely important health and welfare implications for parrots and other exotic birds kept in captivity. Mr Stanfords study is the first, and to the authors knowledge the only major study of this subject in any bird species. The study took two groups of parrots fed either a seed or pellet-based diet and kept in an indoor aviary. In a carefully designed experiment over the course of a year, exposing the birds to artificial UVB lights (36W, FB36, ARCADIA, <http://www.arcadia-uk.info/>) for 12 hours a day increased concentrations of ionised calcium in the plasma of both groups of birds independent of the calcium and vitamin D3 content of their diet. On the basis of this research Mr Stanford recommended the provision of artificial unfiltered UVB light for captive grey parrots, in addition to a formulated diet with adequate levels of calcium and vitamin D3. This research has clear implications to other species of birds maintained in artificially controlled conditions and an increasing number of falcon and bustard breeding projects in the UAE are using full spectrum lighting.

**Not only birds**

Interestingly in the UAE the UVB and calcium issue is not just a veterinary problem, this is a medical problem and there have been numerous articles in the National paper (<http://www.thenational.ae/article/20080518/NATIONAL/253051252>) about the high numbers of human infants developing rickets because of a culture of not exposing children or adults to the sun. Indeed 95% of UAE National women are reported to be deficient in vitamin D which can be linked to colon cancer, liver or kidney disorders and multiple sclerosis, among other conditions.

### How much is enough UV?

There are no studies showing how much UV is necessary for optimum calcium metabolism, let alone all the harder to measure behavioural functions. More studies are needed. Francis Baines (UK) and Laura Wade (USA) and a small team of enthusiastic herpetologists have done a considerable amount of research on the use of UV light on reptiles (see: <http://www.uvguide.co.uk/>). What is clear that too much UVB can be both dangerous and lethal. Ultraviolet light induced photokeratitis in parrots caused by aviculturalists using some brands of UV spectrum bulbs manufactured in China has been reported by Wade (2008). Potential users should pay great attention to sourcing UV spectrum bulbs from reputable companies.

### Conclusion

The use of synthetic ultraviolet (UV) lighting is now being more widely recommended by veterinarians and aviculturalists for environmental enrichment in birds housed indoors (Wade, 2008). In addition to the positive effects on vitamin D3 synthesis, other benefits are thought to include improved vision and behaviour.

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### References

- Cooper JE (2002) *Birds of Prey: Health and disease*. Blackwell publishing, Oxford.
- Verwoerd, D (2001) Case study: episodic epileptiform seizures in peregrine falcons in Dubai. *Falco* 18: 10-12.
- Korbel, RT (1999) Ultraviolet Perception in Birds. *Proceedings of the Association of Avian Veterinarians*. Pp. 77-81.
- Stanford, M. (2006) *Effects of UVB radiation on calcium metabolism in psittacine bird*. *Veterinary Record*; 159: 236-241.
- Thornton, S. (2002) Primates. *BSAVA Manual of Exotic Pets*. Pp 129.
- Varela, FJ. , Palacios, AG and Goldsmith TH. (1993) Color Vision of Birds. In: "Vision, brain, and behavior in birds". Eds. Zeigler & Bischo. Cambridge, MA: MIT Press. <http://users.mis.net/~pthrush/lighting/cvb.html>.
- Viitali, J, Korplmaki, E, Kolvula, M (1994) Attraction of kestrels to vole scent marks visible in ultraviolet light. *Nature*. 373: 425-427.
- UV Guide UK website <http://www.uvguide.co.uk/>
- The National website <http://www.thenational.ae/article/20080518/NATIONAL/253051252>
- Wade, L. (2008 ) Ultraviolet-induced photokeratitis in a Meyer's parrot and Ultraviolet-induced photodermatitis in an African grey parrot. *Proceedings of the Association of Avian Veterinarians*. Pp 421.