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As an avid reptile keeper, Georgia strives to promote and educate more advanced methods of keeping amongst the captive reptile community. Georgia's rescue Staffordshire bull terriers are a huge part of her life and she is also keenly interested in canine behaviour, which she hopes to further her knowledge of during her career.

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# Nutritional secondary hyperparathyroidism in reptiles

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**ABSTRACT:** Metabolic Bone Disease (MBD) is a clinical sign of a disease called Nutritional Secondary Hyperparathyroidism (NSHP). This is when there is not enough calcium in the diet and incorrect/insufficient UVB provision, or the calcium:phosphorus (Ca:P) ratio becomes imbalanced, causing the calcium levels in the blood to decrease resulting in hypocalcaemia (low blood calcium). This decrease is detected by the kidneys and the parathyroid gland is alerted to produce parathormone to rebalance the blood calcium levels by removing calcium from the bones to increase the level in the bloodstream.

**Keywords:** Nutrition; reptiles; metabolic bone disease

The purpose of this article is to provide husbandry advice to registered veterinary nurses (RVN) so that they are able to provide up to date and correct advice to clients and owners of exotics within their practice. This is especially important for RVNs of practices who are not knowledgeable in the care and treatment of reptiles.

Metabolic Bone Disease (MBD) can affect all animals but is mostly seen in captive reptiles. It is most commonly caused by poor husbandry (including insufficient UVB provision and insufficient thermal provision) and incorrect diet, however there are other causes too. MBD is a generalised term to include many different diseases affecting bone density and formation and is more correctly a clinical sign of another underlying disease; other possible causes of MBD include renal secondary hyperparathyroidism, hypertrophic osteopathy and chronic osteomyelitis (Avian & Exotic Animal Clinic, 2015; Centre for Avian & Exotic Medicine, 2020; Kolb, 2017; Rendle & Cracknell, 2012). It is a disease that affects lizards and chelonians more regularly than snakes, due to snakes generally eating whole prey therefore receiving calcium and Vitamin D from their prey (Mancinelli, 2015).

MBD is a clinical sign of a disease called Nutritional Secondary Hyperparathyroidism

(NSHP). This is when there is not enough calcium in the diet alongside incorrect or insufficient UVB provision, or the calcium:phosphorus (Ca:P) ratio becomes imbalanced, causing the calcium levels in the blood to decrease resulting in hypocalcaemia (Kolb, 2017). This is especially prevalent in plant rich, or insectivorous diets, which are high in phosphorus but require supplementation with calcium (Rendle & Cracknell, 2012). This decrease is detected by the kidneys and the parathyroid gland is alerted to produce parathormone to rebalance the blood calcium levels by removing calcium from the bones to increase the level in the bloodstream (Carmel & Johnson, 2018). All of this is perfectly normal and happens in the body naturally; the problem occurs when the animal is hypocalcaemic for long periods of time. Due to the calcium levels in the bones dropping, the bones become soft and brittle, resulting in deformities and pathological fractures can occur (Centre for Avian & Exotic Medicine, 2020; Figure 1 and 2). The soft bones tend to then have altered shapes; floppy jaws, curved legs, dipped spines in the extremes and most severe cases are fatal. It is possible to halt the progression and restrengthen the bones, but bony changes can never be reversed (this is the same for all animals so the effects of spondylosis, rickets, etc., will remain so forever, even if the bones are now strong, the deformity will remain) (Grünberg, 2018).



Figure 1. Bearded Dragon with normal bone density (Ash Croft Vets, 2020).

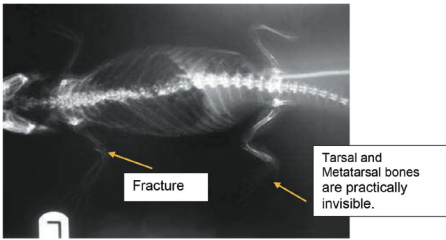


Figure 2. Bearded Dragon with poor bone density—note the distal limbs have disappeared on the xray and the pathological fracture in the left humerus. NB: both images were taken with the same exposure settings (Ash Croft Vets, 2020).

### Clinical signs of NSHP

This is very dependent on species, and often, when more obvious signs become apparent, such as curved limbs and rubber jaw, the damage is done. NSHP/MBD has been occurring within the animal's body for a lot longer than originally thought when the obvious signs become noticeable. The first clinical signs are usually anorexia and lethargy, but these are very vague, non-specific symptoms and can be related to many other ailments, it is no wonder NSHP has the opportunity to develop further. More severe symptoms include ataxia, muscle tremors, trembling, seizures (Klapshake, 2010) however all of these symptoms are very common with Vitamin D toxicity also, which can therefore present more concerns; the owner believes the animal to have MBD so offers more calcium with D3 to combat the issue, or vice versa. It is very important to check husbandry and parameters, and a consultation with an exotic veterinary specialist for diagnostic tests before attempting any at home treatment, because tipping too far in either direction can be fatal for the client's pet (Centre for Avian & Exotic Medicine, 2020; Klapshake, 2010). That being said, if husbandry is not corrected, then treatment by a veterinary surgeon may be pointless, as once the treatment has concluded, the inadequate husbandry may simply cause a recurrence of NSHP.

Even more severe signs include malocclusion, 'rubber jaw' (Figure 3, 6 and 7), bowed legs, swollen joints, dipped or



Figure 3. A leopard gecko with malocclusion (Barten & Simpson, 2019).

hurdled spine (Figure 4). With Veiled chameleons, the casque becoming sunken is often a giveaway of MBD as the bone structure within the casque softens, the muscles pull the structure in on itself, before the muscles too eventually become weak. Chelonians will often present with soft shells that appear too small, or with misshapen scutes (Klapshake, 2010; Kolb, 2017; Figure 5).



Figure 4. (Centre for Avian & Exotic Medicine, 2020).



Figure 5. (McCormack, 2015).

Renal MBD works in the same way as above. It can be caused by severe dehydration, a congenital condition, bacterial infection, viral infection, and many other possible factors that cause renal disease meaning that the kidneys alert the body (incorrectly) that it is hypocalcaemic (Centre for Avian & Exotic Medicine, 2020).

All of the images show varying severities of NSHP, and all can be found with a simple internet search.

Nursing reptiles is a varied role, as many species require different husbandry parameters; UVB provision is a vital one, but providing the correct amount is difficult to gauge without such equipment as a solar meter, which can provide the



Figure 6. (VetStream, 2020).



Figure 7. (VetStream, 2020).



Figure 8. This image shows a healthy chameleon radiograph—good bone density and shape with no pathological fractures or folding (Long Beach Animal Hospital, 2020).

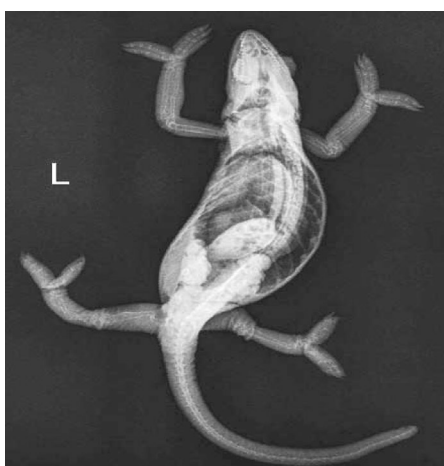


Figure 9. This image shows a chameleon with quite severe NSHP/MDB with pathological fractures in all 4 legs as well as bowing of both front ulnas (Long Beach Animal Hospital, 2020).

Table 1. commonly kept captive species, the Ferguson zone they fall into and the UVI they require (Baines et al., 2016).

Zone	Characteristics	UVI Zone range (all-day average)	Max UVI recorded (one-off maximum)	Species in original study	Species typical of Zone commonly held in captivity
1	Crepuscular or shade dweller	0 - 0.7	0.6 - 1.4	Cottonmouth water moccasin Texas rat snake Jamaican brown anole Broad-banded water snake	Leopard gecko Crested gecko Corn snake Burmese python
2	Partial sun or occasional basker	0.7 - 1.0	* 1.1 - 3.0	Western ribbon snake Green anole Jamaican blue-pants anole Yellow-bellied water snake	Redfooted tortoise Monkey-tailed skink Chinese water dragon Boa constrictor
3	Open or partial sun basker	1.0 - 2.6	2.9 - 7.4	Desert side-blotched lizard Eastern fence lizard Cuban brown anole Texas spiny lizard	Bearded dragon Spur-thighed tortoise Red-eared slider Day gecko
4	'Mid-day' open sun baskers	2.6 - 3.5	4.5 - 9.5	Lesser Earless Lizard Sagebrush Lizard Northern Prairie Lizard	Uromastyx Chuckwalla Rhinoceros iguana (NB: shade is vital even for these)

UVI-Tool 'Shade method'

UVI-Tool 'Sunbeam method'

\* Zone 2 reptiles in a larger enclosure would probably utilise gentle "sunbeam" UVB up to approx. UVI 3.0

\* larger enclosure

**Shade Method (Fluorescent UVB)**  
UV Index up to approx 1.0

**Sunbeam Method (Mercury vapour, metal halide, or T5-HO Fluorescent UVB)**  
UV Index up to approx. 7.0

ultraviolet index (UVI). Further research into the species being nursed will provide information as to the amount of UVI required. The author recommends sources of Dr Francis Baines who provides scientific research and field studies, using the work of Dr Ferguson, into UVB provision of captive reptiles. Dr Ferguson coined the Ferguson Zone of Reptiles of the world and outlines the amount of UV provision for multiple species around the world (Baines et al., 2016; Table 1).

### Conclusion

Reptile husbandry is a careful balance of multiple factors including humidity, temperature gradients and correct UV provision, however NSHP seems to be the most commonly encountered issue. With recent research and information being provided across many platforms online, we are able to provide our clients with correct information to ensure they have a healthy reptile.

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