

## Zool 567 Topic Summary lit review

**Captive snake rectilinear behaviours and stress.**

Snakes are unique compared to most animals in that they have an extremely elongated body plan, and this body shape leads to a variety of behaviours that are specific to snakes. In the wild, many snakes have large home ranges and will occupy a diverse variety of habitats (Warwick *et al.*, 2021; Hollandt *et al.*, 2021). Furthermore, snakes are ectotherms and require access to a range of temperatures (Spain *et al.*, 2020). In the wild, snakes will swim, burrow, climb, and bask for thermoregulation, dispelling the common belief that they are sedentary animals (Hoehfurtner *et al.*, 2021a; Warwick *et al.*, 2019). Due to their elongated body, a technique that snakes do to relieve digestive discomfort is laying in a position known as the rectilinear position (Warwick *et al.*, 2019), which is where the snake adopts a fully stretched-out body position that could be seen during locomotion or when at rest (Warwick *et al.*, 2021; Warwick *et al.*, 2019; Hoehfurtner *et al.*, 2021b) The presence of wild behaviours is often used as welfare indicators in captivity.

Many snakes are currently being held in captivity including those in zoos, breeders, private collections, and as pets. Studies show that while captivity will never completely replicate an animal's natural habitat, enrichment is one of the best ways to avoid stressful situations while promoting natural behaviours (Mason *et al.*, 2007). Enrichment is anything in a captive animal's enclosure that promotes natural behaviours or stimulates mental activity (Mason *et al.*, 2007). The problem with captive snakes, however, is that they are often not afforded the same care that is provided to most captive mammals (Warwick *et al.*, 2013). Additionally, due to common misconceptions that snakes are sedentary and feel exposed and unsafe in large enclosures, many snakes are kept in small enclosures with limited enrichment opportunities (Warwick *et al.*, 2021). Some snakes may even be kept in enclosures too small to provide a thermal gradient or to allow for rectilinear behaviours. The effects of keeping snakes in enclosures that lack sufficient space for enrichment and for rectilinear behaviour is currently an active area of study to see how stress and welfare is impacted.

While rectilinear behaviours are often signs of a snake's comfort in their enclosure, behaviours such as excessive time spent hiding, extreme lack of activity, and sudden, quick movements are all possible indicators of stress related to deficiencies in the snakes' enclosure (Warwick *et al.*, 2013). Researchers were interested in understanding the effects of enclosure size on captive snake behaviour. Though a combination of observational and experimental studies, they found that when provided with adequate space to adopt a fully stretched out, rectilinear position, most snakes would do so at least daily (Warwick *et al.*, 2019; Warwick *et al.*, 2021; Hollandt *et al.*, 2021; Hoehfurtner *et al.*, 2021b). The findings of these studies suggest that rectilinear behaviours are important in the context of daily life for snakes. Hollandt *et al.* (2021), and Hoehfurtner *et al.* (2021b) also observed that when confined to a small enclosure, snakes exhibited increased stress behaviours such as excessive hiding and rubbing of their head against the edges of the enclosure. Furthermore, Hoehfurtner *et al.* (2021b) observed that snakes would choose to be in larger enclosures over smaller ones when given the option between the two, suggesting that large enclosures are important for proper snake welfare.

Researchers were also interested in the effects of enrichment on snake behaviour and welfare. Using experimental and observational techniques, they found that snakes provided with enrichment are less stressed when exposed to novel experiences and that the snakes will be more active (Hoehfurtner *et al.*, 2021a; Nagabaskaran *et al.*, 2021; Spain *et al.*, 2020; Almli & Burghardt 2006). Furthermore, the researchers observed that snakes displayed more natural behaviours when enriched and that snakes kept in enclosures without enrichment were less active, less cognitively engaged, and expressed stress behaviours (Nagabaskaran *et al.*, 2021; Spain *et al.*, 2020). When analyzed together, these studies suggest that enrichment is important for captive snake welfare.

Through reviewing these ten studies, the effect of different colour morphs on behaviour, and the effects of handling on stress in captive snakes remain unanswered and could be potential areas for future research.

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