Influence of environmental conditions and facility on faecal glucocorticoid concentrations in captive pygmy rabbits (Brachylagus idahoensis)

CD Scarlata†‡, BA Elias§, JR Godwin†, RA Powell†, D Shepherdson‡, LA Shipley§ and JL Brown*#

† North Carolina State University, Raleigh, NC, USA
‡ Oregon Zoo, Portland, OR, USA
§ Washington State University, Pullman, WA, USA
* Smithsonian Conservation Biology Institute, National Zoological Park, 1500 Remount Rd, Front Royal, VA 22630, USA
* Contact for correspondence and requests for reprints: brownjan@si.edu

Abstract

The objective of this study was to determine if housing conditions, specifically pen size and soil enrichment, had an effect on faecal glucocorticoid concentrations in the endangered pygmy rabbit (Brachylagus idahoensis). The success of the captive breeding programme has been limited, so one hypothesis is that chronic stress due to sub-optimal housing conditions may be responsible for poor fecundity. Faecal glucocorticoid concentrations were assessed in 50 females housed among several pen types at two breeding facilities. The highest glucocorticoid concentrations were found in females housed in 0.37 m² crates as compared to enclosures ranging from 0.96 to 75 m² in size. Results also indicated that enrichment of enclosures with soil had a significant influence on adrenal activity, based on a reduction in glucocorticoid excretion for females moved from non-soil pens to those with soil. Last, a significant facility effect on glucocorticoid concentrations was observed, suggesting that factors other than housing influenced adrenal activity in these rabbits. In conclusion, based on measurements of faecal glucocorticoids, pygmy rabbits are best managed in enclosures that contain soil for digging burrows. Pen size had little effect on stress hormones, except for crates where limited space and/or absence of soil was associated with higher glucocorticoid concentrations. These results underline the importance of monitoring glucocorticoid concentrations in captive breeding programmes to identify optimal husbandry and management practices.

Keywords: animal welfare, captive breeding, environmental enrichment, faecal glucocorticoids, husbandry, pygmy rabbit

Introduction

For zoo animals, the number of potential stressors in captive environments can be numerous, and the effects often are species-specific. Identifying what captive conditions are associated with high levels of stress is critically important for effective population management and ultimate success of captive breeding programmes. The biological stress response is defined as a physiological reaction to an animal’s perception of threat or uncertainty in its environment (Seyle 1976; Sapolsky 2002). One of the main components of the stress response is activation of the hypothalamic-pituitary-adrenal axis, which results in the release of glucocorticoids (ie stress hormones). These steroids cause the mobilisation of energy and the temporary suppression of non-essential functions, such as the reproductive and immune systems, so that an animal can respond adaptively to a threat. Long-term exposure to a stressor, however, can turn temporary suppression into chronic inhibition, which has negative consequences for reproduction and health (Sapolsky et al 2000; Sapolsky 2002; Young et al 2004; Boonstra 2005). In many species, temporary increases in glucocorticoids can be used to identify acute stressors, whereas long-term elevations of glucocorticoids are more likely to indicate the existence of a chronic stressor (Young et al 2004; Reeder & Kramer 2005). For endangered species management, an optimal way to assess adrenal activity is to quantify the amount of glucocorticoids excreted in faeces under various conditions. The non-invasive nature of this approach allows evaluation of adrenal activity without handling the animals, which can compromise the accurate assessment of stress (Millspaugh & Washburn 2004). In addition, faecal hormone data provide a pooled estimate of hormone production from the previous 12–24 h, thus averaging across acute fluctuations in secretion (Millspaugh & Washburn 2004).

Between 2002 and 2012, a captive breeding programme for the endangered Columbia Basin pygmy rabbit (Brachylagus idahoensis) was established to produce animals for restoration to native habitats from which they had been extirpated (Hays 2001, 2003; United States Fish and Wildlife Service [USFWS] 2007). Since little was known about the biology of pygmy rabbits when the programme began, the three captive breeding facilities (Washington State University, Oregon Zoo and Northwest...