Using technology to monitor and improve zoo animal welfare

JC Whitham* and LJ Miller

Chicago Zoological Society, Brookfield Zoo, 3300 Golf Road, Brookfield, IL 60513, USA

* Contact for correspondence and requests for reprints: jessica.whitham@czs.org

Abstract

While the international zoological community is committed to enhancing the welfare of individual animals, researchers have yet to take full advantage of the tools available for non-invasively tracking behavioural and physiological indicators of welfare. We review technology currently being applied in studies of zoo, farm and laboratory animals to regularly monitor welfare status, as well as to evaluate responses to particular stimuli and situations. In terms of behavioural measures, we focus on automated assessments that offer insight into how animals — even those that are nocturnal or elusive — behave when humans are not present. Specifically, we provide an overview of how animal-attached technology (accelerometers, global positioning systems, radio frequency identification systems) can be implemented to generate activity budgets, examine use of space, conduct gait assessments, determine rates of movement and study social dynamics. We also emphasise the value of bioacoustics, as the rate and acoustic structure of certain vocalisations may vary across contexts and reflect an animal’s internal state. While it can be challenging to identify non-invasive methods for investigating physiological welfare indicators, we discuss approaches (thermography, tracking measures of heart rate) that may be especially useful for monitoring affective states and psychophysiological functioning. Finally, we make a concerted effort to highlight tools that allow welfare scientists to consider measures of positive welfare. Ultimately, zoos can ensure that each animal has the opportunity to thrive by employing technology to create baseline behavioural and physiological profiles, conduct ongoing monitoring schemes and assess responses to specific conditions, events and stimuli.

Keywords: animal welfare, automated monitoring, behaviour, physiology, positive welfare, technology

Introduction

Recently, zoos and aquaria (hereafter zoos) have dramatically increased efforts to monitor and improve animal welfare (Walker et al 2014). Zoo associations across the globe, including the World Association of Zoos and Aquariums (WAZA), have expressed a commitment to proactively identifying and resolving welfare issues faced by populations and individual animals (Hosey et al 2009). Indeed, WAZA’s World Zoo and Aquarium Animal Welfare Strategy offers guidance on attaining high welfare standards, outlines best practices, promotes research and encourages its members to serve as animal welfare leaders (Mellor et al 2015). Among organisations accredited by the Association of Zoos and Aquariums (AZA), a handful of centres have been established to examine welfare policy and/or implement welfare research (eg Chicago Zoological Society’s Center for the Science of Animal Care and Welfare). Within the zoo community, there is a consensus that future research efforts must focus on identifying tools for systematically tracking and assessing animal welfare (Barber 2009; Hosey et al 2009; Butterworth et al 2011). Indeed, the mission of AZA’s Animal Welfare Committee (AWC) includes, “encouraging the development of research projects and assessment tools to advance and monitor animal welfare” (AZA 2015). This mission reflects a more widespread movement that urges the zoo industry to move beyond a resource-based approach to welfare assessment. While zoos traditionally have focused on outlining particular environmental requirements and management practices for accreditation purposes, welfare researchers emphasise the importance of incorporating animal-based measures (eg hormones, behaviour) that reflect an individual’s physical and psychological states (Barber 2009; Butterworth et al 2011; Siegfried 2013; Whitham & Wielebnowski 2013).

Over the past several decades, zoo welfare scientists have adopted a variety of valuable methods for assessing individual animal welfare. Most commonly, researchers have relied upon tracking hypothalamic-pituitary-adrenal axis (HPA) activity via non-invasive hormone monitoring, conducting behavioural observations (eg recording self-injurious behaviours), or documenting health indicators (Wielebnowski & Watters 2007; Hill & Broom 2009; Melfi 2009). While zoos have gained extensive knowledge by employing these approaches, there are certain limitations for those hoping to regularly monitor the welfare status of individual animals. For instance, it can be challenging to distin-