



Urban roost temperatures of large-spotted-genets: The effect of anthropogenic structures

C.D. Widdows, C.T. Downs*

School of Life Sciences, University of KwaZulu-Natal, Private Bag X01, Pietermaritzburg 3209, South Africa

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ABSTRACT

Generally, large-spotted genets (*Genetta tigrina*) use tree hollows and canopies as daytime roosts during their inactive phase. However, there has been an increasing tendency for individuals to make use of anthropogenic structures, such as roofs, within urban landscapes in KwaZulu-Natal, South Africa. This study investigated the roosting thermal dynamics of large-spotted genets within the urban suburbs of Kloof. Roost temperatures were recorded with *i-Button*® temperature loggers at known large-spotted genet roosts in anthropogenic structures as well as in natural roost sites. Over the seasons, temperatures varied significantly between months and among different roosts. However, anthropogenic roost temperatures were higher than ambient temperatures throughout the study period. Furthermore, anthropogenic roosts had higher temperatures (with lower variability) than natural roost sites. This study highlighted the importance of anthropogenic structures as daytime roosts for large-spotted genets within an urban mosaic. However, high temperatures experienced during the summer can be detrimental to juvenile large-spotted genets resulting in plasticity of breeding behaviour and a switch to producing young in cooler months.

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1. Introduction

Urbanization is currently the fastest growing type of land use globally, with recent estimates predicting that 60% of the global population will be living in urbanized landscapes by 2030 (Lowry et al., 2013; Murray and St. Clair, 2015). This anthropogenic conversion, alteration, and fragmentation of natural habitats has resulted in a dramatic loss of biodiversity worldwide (Jung and Kalko, 2011; Murray and St. Clair, 2015). This reduction of natural habitats has subsequently forced many species to live in close proximity to human settlements (Bateman and Fleming, 2012; Lowry et al., 2013). Responses to urbanization vary among species with some thriving while others avoid and are subsequently excluded from urbanized landscapes (Fischer et al., 2012; Newsome et al., 2015). Species that are able to live within urban areas are often generalists that are able to adapt to anthropogenic landscapes and exploit urban resources (Sol et al., 2013). These species exhibit significant ecological, behavioural and demographic plasticity (McCleery and Parker, 2011; Lowry et al., 2013). These adaptations include reduced wariness, reduced dispersal and home ranges, generalist diet, increase in population densities and altered diel activity patterns (Parker and Nilon, 2012). The urban

landscape provides a variety of novel resources for species that are able to persist in anthropomorphic environments (Newsome et al., 2015). However, there is an array of threats facing wildlife living in urban landscapes, such as their vulnerability to human persecution, collisions with motor vehicles, or attacks by domestic animals (Magle et al., 2012).

Roost sites, such as tree hollows and cavities under root systems, provide a variety of benefits for taxa including thermo-regulation, denning, breeding and evasion from predators (Isaac et al., 2014). More than 360 mammal and bird species make use of these roost sites worldwide (Davis et al., 2014). As urban areas continue to expand, the availability of natural roost sites for fauna are declining and this can have an impact on their breeding ecology and subsequent persistence within this environment (Carvalho et al., 2014; Davis et al., 2014). This is particularly true for solitary carnivores where each roost site is generally used by a single individual at a time, with the exception of females and cubs during the breeding season (Carvalho et al., 2014). Urban expansion is replacing natural roost sites with anthropogenic alternatives including roofs and outbuildings (Isaac et al., 2014). Faunal species spend a large portion of their time roosting and as a result roost selection and behaviour provides an important mechanism for energetic optimization (Gruebler et al., 2014). The reduction of natural roost sites such as tree hollows can be overcome through the use alternative roosting options within an individuals' range.

Urban carnivores use anthropogenic structures for secure

* Corresponding author.

E-mail address: downs@ukzn.ac.za (C.T. Downs).

shelters, roosting and breeding sites (Bateman and Fleming, 2012). In some instances, anthropogenic structures are utilised even when natural alternatives such as green belts are available (Lowry et al., 2013). The use of man-made structures as resting areas is not isolated to carnivores; certain urban bat species such as *Epomophorus wahlbergi*, *Eptesicus fuscus*, *Eptesicus serotinus* and *Vespertilio murinus* make use of anthropogenic structures for roost sites (Neubauer et al., 2007; Mazurska and Ruczyński, 2008; Monadjem et al., 2011). Day roosts provide buffering from severe climatic conditions and provide protection from predators (Moussy, 2011). Temperature plays a significant role in roost selection, as microclimate is considered an important parameter for endotherms (Kerth et al., 2001; Gruebler et al., 2014). The selection of a thermally suitable resting and breeding site reduces thermoregulatory costs. This has implications for individual fitness, as low roost temperatures during juvenile growth and development stages can result in long-term impairments to fitness (Kerth et al., 2001; Moussy, 2011). Furthermore, this allows for the relocation of conserved energy to other important processes. This is particularly true for certain bat species that require efficient balancing of their energy budget due to their energetically costly mode of locomotion (Moussy, 2011). Other features that influence roost selection include proximity to water and food resources (Moussy, 2011), risk of depredation and competition with other species utilising similar roosts (Kerth et al., 2001).

Large-spotted genets (*Genetta tigrina*) are semi-arboreal, nocturnal carnivores that use tree and root hollows as well as rock overhangs for their daylight roosts (Skinner and Chimimba, 2005). These are also roosts used for the rearing of young, as they provide protection against inclement weather and reduce the risk of predation. However, large-spotted genets have been recorded using anthropogenic structures such as roofs, eaves, and outbuildings as daylight roosts within the urban landscape (Widdows and Downs, 2015). The use of these anthropogenic roosts isolate the individuals' body from the external climatic conditions and the resultant decline in thermal conductance increases the roost cavity temperature (Davis et al., 2014). Furthermore, the presence of geyser tanks (boilers) within roof spaces will increase the internal roost temperature. It is therefore important to determine the roost characteristics and associated benefits and risks of anthropogenic roosts for large-spotted genets.

Hybridization has been recorded within the *Genetta* genus, particularly within South Africa (Gaubert et al. 2005). *Genetta tigrina* and *G. maculata* form part of the large-spotted genet complex (Gaubert et al. 2005). The morphological similarities between *G. tigrina* and *G. maculata* has provided uncertainty regarding the assessment of taxonomic boundaries. This is particularly true within coastal KZN where hybridization and range overlap have been recorded for *G. tigrina* and *G. maculata*. As a consequence of the uncertainties within the large-spotted genet complex within KZN, we generally referred to large-spotted genets as *G. tigrina* in the current study. This was particularly useful when utilising citizen science as guide books for the area refer to large-spotted genets as *G. tigrina*. Furthermore, residents would have experienced difficulties differentiating between *G. tigrina*, *G. maculata* or hybrids within this complex.

The study investigated roosting dynamics of large-spotted genets in the urban environment of Kloof/Hillcrest, KwaZulu-Natal (KZN), South Africa, using temperature as the response variable. It was predicted that roosts in anthropogenic structures would have higher temperatures than natural roosts in hollows of trees and vegetation. The higher temperatures recorded within the anthropogenic roosts may have thermoregulatory benefits as well as reduced predation risk for *G. tigrina*. It was also predicted that anthropogenic roosts would have more stable temperatures than natural roosts and less seasonal temperature fluctuations.

2. Methods

2.1. Study area

We conducted the study in the suburbs of Kloof/Hillcrest (S-29.781215 E 30.829669) in KZN, South Africa. The mean annual rainfall of the area is 947 mm and the mean maximum and minimum temperature is 24 °C and 13.9 °C respectively (<http://en.climate-data.org/location/27097/>). This landscape has several urban conservancies and protected areas such as Springside, Ipithi, Glenholme and Kranzkloof nature reserves within the urban mosaic.

2.2. Roost temperatures

Anthropogenic roost locales used by large-spotted genets were identified during a survey conducted between April 2012 and July 2013. A pilot study was conducted in four anthropogenic roost sites between August and October 2015. Natural roost locales were identified by public sightings of large-spotted genet within urban conservancies and these roost sites were ground truthed to confirm active use by large-spotted genets.

Roost temperatures were recorded with calibrated data logger *i-Buttons*® (Model DS 1922L ± 0.06 °C, Dallas Semiconductor, Sunnyvale, CA) at eight large-spotted genet roost sites within the suburbs of Kloof, KZN (Fig. 1). A single *i-Button*® was placed at each roost site and programmed to record ambient temperature at 15 min intervals continuously. Four *i-Buttons*® were placed in roosts in anthropogenic structures (roof spaces) and three *i-Buttons*® in natural roost sites including tree hollows (n=2) and a rock overhang (n=1). All four roosts identified in anthropogenic structures occurred in roofs where large-spotted genets were active in the roost sites throughout the study. Genet presence was confirmed by fresh droppings and a midden within the roof space or sightings of large-spotted genets by the home owners (Fig. 2). Of the three natural roost sites, one was in the canopy of a *Kigelia africana* while the second was located in a large hollow in a *Ficus sur* tree. The third natural roost site occurred within a rock outcrop. Upon observation, all natural roosts showed recent signs of large-spotted genets. *i-Buttons*® were placed in areas of roofs where large spotted-genets appeared most active to record accurate roost site temperatures. Roost temperatures were recorded for a period of one year (August 2014–July 2015). Upon completion the *i-Buttons*® were removed and the data were downloaded using ColdChain Thermodynamics software (Fairbridge Technologies, Pretoria). Ambient temperature data were recorded by placing an *i-Button*® in a Stevenson's screen (a shelter used to shield meteorological instruments against direct precipitation and heat radiation, while allowing air to circulate around the instrument) in Kloof throughout the study period. This was placed in a central location among the seven roost sites.

2.3. Statistical analyses

We performed Analysis of variance (ANOVA) and Repeated Measures analysis of variance (RMANOVA) to determine whether there was a significant difference in temperatures between the seven roost sites. We used Tukey Post-hoc tests to determine among which sites significant differences in temperatures occurred. We calculated minimum and maximum temperature means for each month by averaging daily minima and maxima over the month. All statistics were performed using the Statistica 7 package (Statsoft Inc., Tulsa, OK, USA).

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