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NOTE AND RECORD

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Confirmation of black leopard (*Panthera pardus pardus*) living in Laikipia County, Kenya

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1 | INTRODUCTION

Observations of black leopards (*Panthera pardus*) primarily come from Southeast Asia, with few observations in Africa (da Silva et al., 2017; Sunquist & Sunquist, 2002). In the most extreme case, leopards in Peninsular Malaysia show melanism nearly to fixation in the population (Kawanishi et al., 2010). Melanism in leopards is associated with a mutation to the *Agouti Signaling Protein* gene that causes a loss of the normal function (Eizirik et al., 2003; Schneider et al., 2012, 2015) and is recessive in its inheritance (Robinson, 1969, 1970). The adaptive significance of melanism is not clearly understood, but most hypotheses suggest environment as a potential driver (Eizirik et al., 2003; Ortolani & Caro, 1996), with higher frequencies of black leopards found in tropical and humid environments (da Silva et al., 2017).

Gathering a broad array of melanistic leopard observations, da Silva et al. (2017) reported five sightings of black leopards in Africa (*P. p. pardus*), but could confirm only one. The confirmed report was from Addis Ababa, Abissynya, Ethiopia, in 1909, in the form of a photograph stored at the National Museum of Natural History in the United States (da Silva et al., 2017). In Kenya, reports of black leopard are known (da Silva et al., 2017; Sunquist & Sunquist, 2002), but none have been accompanied with photographic evidence. Here, we provide photographic evidence for the existence of black leopard in Laikipia County, Kenya. We also compare the habitat of these sightings to the expectations of melanism as an adaptive trait driven by environment.

2 | MATERIALS AND METHODS

Laikipia County is an 8,700 km^2 region of semi-arid bushland in central Kenya, with a mean annual temperature of 18.3°C (range: 13.0–25.2°C) and a mean total of 812 mm of precipitation annually (monthly mean range: 23–133 mm). Most rainfall occurs in two seasons (April–June to October–December), but can be highly variable year–year (Barkham & Rainy, 1976).

Unconfirmed reports of a black leopard were made to field staff September 2017–January 2018. To capture imagery, eight Bushnell 24MP Trophy Cam HD Low Glow Cameras (model: 119875C) were installed over a *c.* 0.5 km^2 area adjacent and to the south of Loisaba Conservancy, Kenya (centre: 0.517°N, 36.815°E; mean elevation: 1,735 m). The cameras were installed from February to April 2018 and focused on available water sources, including swimming pools and natural springs, as well as nearby animal trails. Except in public areas, cameras were on 24 hr/day and set to 15–30 s video capture with a 1-s interval between events. In public areas, cameras were on only at night. In addition, opportunistic enquires were sent to conservancies and ranches in Laikipia County for high-quality images of black leopard to provide historical context for these observations.

3 | RESULTS AND DISCUSSION

Cameras recorded a subadult female black leopard on February 16, February 28, March 11, March 15 and April 14, 2018 at five different camera locations. Four of the five videos were captured at night (Figure 1), with infrared illumination allowing for the confirmation of rosette patterns (Hedges et al., 2015). Videos on February 28 and March 11 were captured near artificial water sources (Figure 1b,c), including one video of drinking, suggesting that these points may be important during the dry season. In all of the night videos, the black leopard appeared alone. On April 14, she was carrying a prey item, likely to be impala (*Aepyceros melampus*) remains.

In the only daytime video, the black leopardess was following an adult female leopard (Figure 2). Unconfirmed observations from September 2017 of the two leopards together suggest that this

FIGURE 1 Four still frames from night videos of a female subadult black leopard on (a) February 16 (b) February 28 (c) March 11 and (d) April 14, 2018 in Laikipia County, Kenya. The timestamp in (a) malfunctioned and therefore is not displayed

FIGURE 2 A black subadult female leopard (L) follows an adult female leopard (R) on 15 March 2018 in Laikipia County, Kenya. The leopards did not occupy the same frame, but were separated by approximately 10 s from exiting and entering the same frame. Frames have been overlapped to display the size difference between the two

FIGURE 3 Photograph of a black leopard taken on 6 May 2007 at Ol Ari Nyiro Conservancy, Laikipia County, Kenya. Ol Ari Nyiro Conservancy is approximately 50 km west of Loisaba Conservancy. Photo credit: Mike Roberts

non-melanistic female may be the mother of the black leopard. In these previous sightings, the black leopard was smaller in size, and in closer proximity to her mother. Given her size (Figure 2), this black leopard is likely past the age of dispersal (Fattebert, Balme, Dickerson, Slotow, & Hunter, 2015; Fattebert, Dickerson, Balme, Slotow, & Hunter, 2003), which may be why most of the recent observations are of her alone. Females are more likely than males to be philopatric and establish territories close to their natal area, and mothers may accommodate daughter territories (Bailey, 2005; Fattebert et al., 2015). Philopatric behaviour may explain the close association between the two leopardesses in this video.

In addition to the observations from trail cameras, we received one other high-quality image of a black leopard from Ol Ari Nyiro Conservancy (Figure 3), taken 6 May 2007. Collectively these images are the first reported in nearly 100 years that confirm the existence of black leopard in Africa, and the first in Kenya (da Silva et al., 2017). Because the photograph is more than a decade older than the trail camera observations, it is likely that melanistic leopards are an established phenomenon in Laikipia County. These images confirm previous reports of black leopard living in the region, likely including the unconfirmed reports from the Aberdare Mountains in Nyandarua County (Sunquist & Sunquist, 2002), the next county south of Laikipia.

Melanism is hypothesised to be an adaption to environments in which a dark colouration provides camouflage from predators or prey (Eizirik et al., 2003; Majerus & Mundy, 2003). The climate of Laikipia is semi-arid, and the biome in which all observations were made is classified as Tropical and Subtropical Grasslands, Savannahs and Shrublands (Olson et al., 2001), which is novel for leopard melanism (da Silva et al., 2017). However, pockets of Tropical and Subtropical Moist Broadleaf Forest exist as close as 15 km from these observations, which aligns with the other confirmed sightings of leopard melanism globally (da Silva et al., 2017), and the suggested mechanism of adaptation to shaded habitat. Whether rates of melanism are higher in the surrounding biome and the observations documented here represent dispersal from source areas remains unknown. However, it is apparent that melanism can be displayed in semi-arid conditions as well, but the effect on predation success, survival and fitness is unknown and worthy avenues of future inquiry.

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REFERENCES

Bailey, T. (2005). *The African leopard: Ecology and behaviour of a solitary felid*, 2nd ed. Caldwell, NJ: Blackburn Press.

Barkham, J. P., & Rainy, M. E. (1976). The vegetation of the Samburu-Isiolo Game Reserve. *African Journal of Ecology*, *14*(4), 297–329. https://doi.org/10.1111/j.1365-2028.1976.tb00244.x

da Silva, L. G., Kawanishi, K., Henschel, P., Kittle, A., Sanei, A., Reebin, A., … Eizirik, E. (2017). Mapping black panthers: Macroecological modeling of melanism in leopards (*Panthera pardus*). *PLoS ONE*, *12*(4), e0170378. https://doi.org/10.1371/journal.pone.0170378

Eizirik, E., Yuhki, N., Johnson, W. E., Menotti-Raymond, M., Hannah, S. S., & O'Brien, S. J. (2003). Molecular genetics and evolution of melanism in the cat family. *Current Biology*, *13*(5), 448–453. https://doi.org/10.1016/S0960-9822(03)00128-3

Fattebert, J., Balme, G., Dickerson, T., Slotow, R., & Hunter, L. (2015). Density-dependent natal dispersal patterns in a leopard population recovering from over-harvest. *PLoS ONE*, *10*(4), e0122355. https://doi.org/10.1371/journal.pone.0122355

Fattebert, J., Dickerson, T., Balme, G., Slotow, R., & Hunter, L. (2003). Long-distance natal dispersal in leopard reveals potential for a three-country metapopulation. *South African Journal of Wildlife Research*, *43*(1), 61–67. https://doi.org/10.3957/056.043.0108

Hedges, L., Lam, W. Y., Campos-Arceiz, A., Rayan, D. M., Laurance, W. F., Latham, C. J., … Clements, G. R. (2015). Melanistic leopards reveal their spots: Infrared camera traps provide a population density estimate of leopards in Malaysia. *The Journal of Wildlife Management*, *79*(5), 846–853. https://doi.org/10.1002/jwmg.901

Kawanishi, K., Sunquist, M. E., Eizirik, E., Lynam, A. J., Ngoprasert, D., Wan Shahruddin, W. N., … Steinmetz, R. (2010). Near fixation of melanism

in leopards of the Malay Peninsula. *Journal of Zoology*, *282*(3), 201–206. https://doi.org/10.1111/j.1469-7998.2010.00731.x

Majerus, M. E., & Mundy, N. I. (2003). Mammalian melanism: Natural selection in black and white. *Trends in Genetics*, *19*(11), 585–588. https://doi.org/10.1016/j.tig.2003.09.003

Olson, D. M., Dinerstein, E., Wikramanayake, E. D., Burgess, N. D., Powell, G. V. N., Underwood, E. C., … Kassem, K. R. (2001). Terrestrial ecoregions of the world: A new map of life on Earth: A new global map of terrestrial ecoregions provides an innovative tool for conserving biodiversity. *BioScience*, *51*(11), 933–938. https://doi.org/10.1641/0006-3568(2001) 051[0933:TEOTWA]2.0.CO;2

Ortolani, A., & Caro, T. (1996). The adaptive significance of color patterns in carnivores: Phylogenetic tests of classic hypotheses. In J. Gittleman (Ed.), *Canivore behavior, ecology and evolution*. Ithaca, NY: Cornell University Press.

Robinson, R. (1969). The breeding of spotted and black leopards. *Journal of the Bombay Natural History Society*, *66*, 423–429.

Robinson, R. (1970). Inheritance of the black form of the leopard *Panthera pardus*. *Genetica*, *41*(1), 190–197. https://doi.org/10.1007/BF00958904

Schneider, A., David, V. A., Johnson, W. E., O'Brien, S. J., Barsh, G. S., Menotti-Raymond, M., & Eizirik, E. (2012). How the leopard hides its spots: ASIP mutations and melanism in wild cats. *PLoS ONE*, *7*(12), e50386. https://doi.org/10.1371/journal.pone.0050386

Schneider, A., Henegar, C., Day, K., Absher, D., Napolitano, C., Silveira, L., … Eizirik, E. (2015). Recurrent evolution of melanism in South American felids. *PLoS Genetics*, *11*(2), e1004892. https://doi.org/10.1371/journal.pgen.1004892

Sunquist, M., & Sunquist, F. (2002). *Wild Cats of the World*. Chicago, IL: University of Chicago Press.

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