

Note and record

Long-range migrations and dispersals of African buffalo (*Syncerus caffer*) in the Kavango–Zambezi Transfrontier Conservation area

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Introduction

Wildlife movements are increasingly constrained by anthropogenic transformation of landscapes (Harris *et al.*, 2009; Wilcove, 2009). Additionally, policy decisions such as the killing of wildlife for sport or to reduce predation/competition may render otherwise suitable habitat inhospitable (McGinnis, 2012; Thomson *et al.*, 2013). In this increasingly crowded world, long-range movements such as animal migrations and their associated functional role in shaping ecosystems are disappearing (Wilcove & Wikelski, 2008). Nevertheless, occasional discoveries of new wildlife migrations (Wilcove, 2009; Bartlam-Brooks, Bonyongo & Harris, 2011), or animals that have moved extraordinarily long distances in the face of seemingly insurmountable obstacles (http://www.nytimes.com/2011/07/27/nyregion/wild-cougar-traveled-east-1500-miles-tests-find.html?_r=0, http://www.thestar.com/news/canada/2010/04/17/lynx_makes_record_trek_only_to_die_in_trapline.html), continue to be reported. These discoveries demonstrate the capacity and resilience of large wildlife species to persist in the age of the Anthropocene and inform how multifunctional landscapes can benefit both biodiversity and humans (Nelson *et al.*, 2009). Here, we document multiple long-range movements of African buffalo (*Syncerus caffer*), a species not previously noted for its exceptional mobility, in the Kavango–Zambezi Transfrontier Conservation area (KAZA).

Methods

We have been monitoring movements of buffalo in Namibia and surrounding areas of Botswana and Angola since 2007. Our study area is the geographical heart of KAZA, the world's largest protected area complex, comprising parts of Namibia, Botswana, Angola, Zambia and Zimbabwe. The aim of the study was to examine movements, migrations and space use of buffalo in relation to anthropogenic features (roads, fences, settlements and agricultural areas) and natural spatial and temporal environmental heterogeneity (Naidoo *et al.*, 2012a,b; Epps *et al.*, 2013). To date, we have deployed satellite collars on 35 buffalo, with Global Positioning System (GPS) locations collected at 5-h intervals. Our dataset now includes ~80,000 locations for 30 females and five males. In addition, we have tagged ~150 animals with highly visible ear tags that carry unique identifiers.

Results and discussion

We report several long-range movements of buffalo that rank as the longest documented distances for this species. For migration (i.e., return movement between geographically separated seasonal home ranges), a female collared on the Kwando river floodplains in the dry season of October 2010 moved 87 km west down the Caprivi Strip before returning to her dry season range, a round trip journey of >170 km (Fig. 1, individual 94043). The next wet season (2012), she again moved ~87 km, but this time south into Botswana, before returning to the same dry season range for a different >170 km journey. Additionally, another female collared on the Kwando river floodplains in the dry season travelled over 100 km west down the Caprivi Strip, and despite being closer to the Kavango river, began returning to her Kwando dry season range, which when completed would have been a return trip of over 200 km (Fig. 1, individual AG275).

We also observed two long-range dispersal events (i.e., permanent movements to a new home range). A female collared in October 2010 on the Kwando river floodplains made an initial 220 km return trip down the Caprivi Strip

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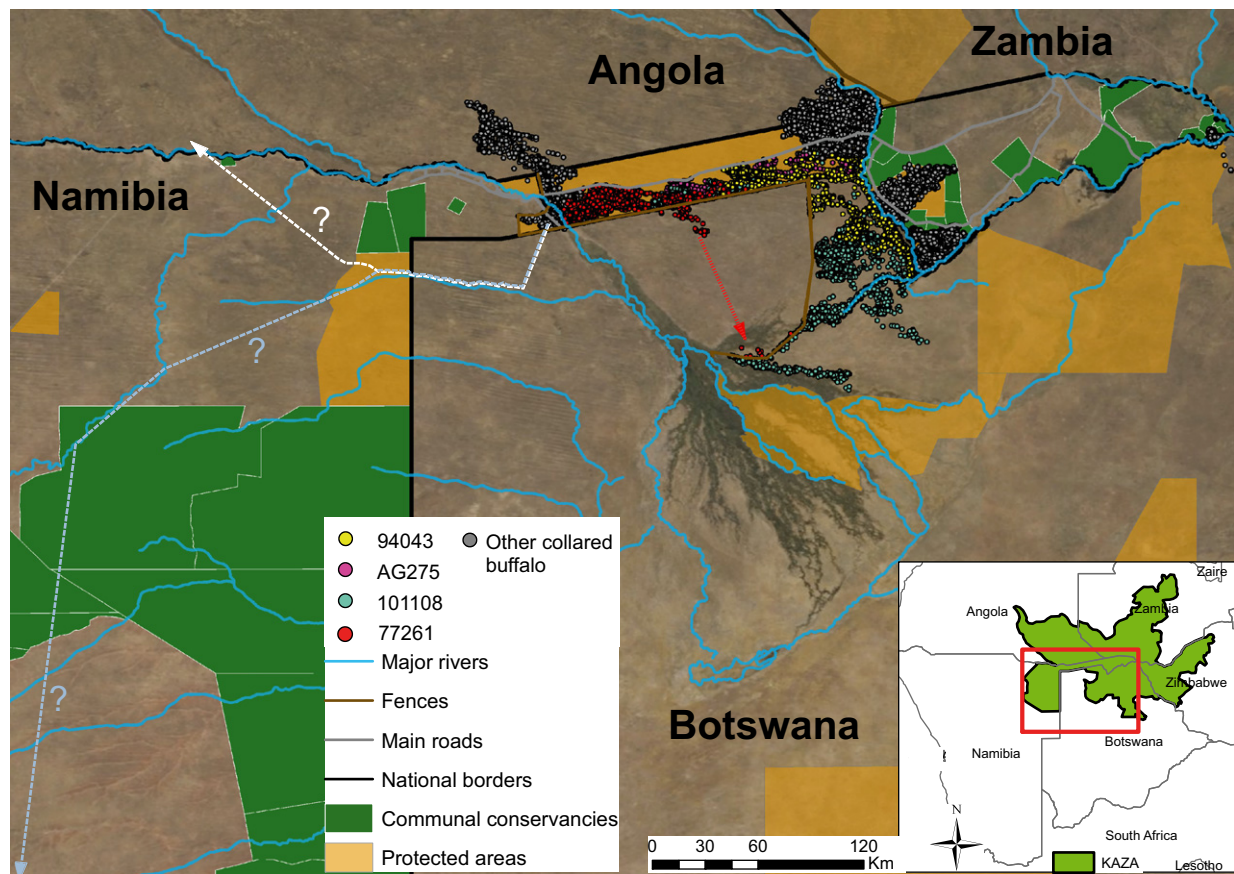


Fig 1 Long-range migratory or dispersal events of buffalo collared in the Kavango and Zambezi regions of Namibia. Circles represent GPS locations recorded for 35 adult buffalo during the 2007–2014 study period

in 2011, and the following wet season, moved throughout the NG14 concession area in northern Botswana before dispersing to a new dry season home range in 2012 along the Selinda Spillway (Fig. 1, individual 101108). During the next wet season (2012/2013) the animal wandered over a large chunk of northern Botswana, including the Okavango Delta, before her collar was finally removed in late 2013, 2.5 years after leaving Namibia. We estimate this animal walked over 7500 km in Namibia and northern Botswana in 3 years.

The second long-range dispersal involved a female collared in western Bwabwata National Park in October 2010 (Fig. 1, individual 77261). After a first year of small-scale movements, in 2012/2013, she moved over 100 km east down the Caprivi Strip before retracing her steps and finding a break in the Namibia-Botswana border fence. Penetrating into Botswana in February 2013, she

eventually made her way to the Okavango Delta, a further ~100 km (Fig. 1, dashed red line; approximate displacement since GPS unit malfunctioned). Total displacement of this buffalo is therefore >200 km from point of collaring in Namibia to current location in Botswana. These dispersals highlight a strong attraction of the Okavango Delta, and the connected Selinda Spillway, for animals collared along the Kwando and Kavango rivers in Namibia. Restoring this natural connectivity between the Delta and hinterlands in Namibia and beyond would be strongly facilitated by removal of the Namibia-Botswana border veterinary fence, a plan currently under discussion by both governments.

Perhaps the most remarkable long-range movements came from animals that were ear-tagged in Mahango National Park in October, 2010, but exited via a break in the park fence in 2011. Numerous sightings of these animals suggest they moved as a group from north-eastern



Fig 2 Photograph of a collared adult female buffalo from Mahango National Park in Namibia, with highly visible ear tag containing a unique identifier

Botswana into Khaudom National Park, which retains a tiny remnant buffalo population. From there, the animals split into two groups, with one group spotted in Angola near the Kavango river, around 250 km from where they had been ear-tagged (Fig. 1, white dashed line). Another ear-tagged animal was eventually shot in an agricultural area in the Otjozondjupa Region in central Namibia (Fig. 1, grey dashed line). This location was a staggering 500 km from where she was tagged, far outside what is considered current buffalo range in Namibia.

These distances are much greater than those previously documented for African buffalo movements. Buffalo are not typically considered long-distance migrants, and the species is not covered in a recent review of African migrations (Harris *et al.*, 2009). Studies that explicitly report directional movements include seasonal migrations of 10–40 km (Halley *et al.*, 2002; Cornelis *et al.*, 2011) and dispersals of 69–133 km (Halley *et al.*, 2002). These latter measurements are from Chobe National Park in Botswana, also part of KAZA, and while smaller than those we document, they support, along with related home range data (Ryan, Knechtel & Getz, 2006), the hypothesis that buffalo in this region tend to be more mobile than elsewhere.

Our research therefore suggests the capacity of African buffalo for long-range dispersals and migrations is underestimated and that despite physical barriers, significant areas in KAZA and beyond may have potential for recolonization if land use policies that reflect concerns on wildlife disease transmission to cattle are relaxed. We suspect that our continuing research on buffalo movements will provide further insights for transboundary management in the KAZA and beyond.

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References

- BARTLAM-BROOKS, H.L.A., BONYONGO, M.C. & HARRIS, S. (2011) Will reconnecting ecosystems allow long-distance mammal migrations to resume? A case study of a zebra *Equus burchelli* migration in Botswana. *Oryx* **45**, 210–216.
- CORNELIS, D., BENHAMOU, S., JANEAU, G., MORELLET, N., OUEDRAOGO, M. & DE VISSCHER, M.-N. (2011) Spatiotemporal dynamics of forage and water resources shape space use of West African savanna buffaloes. *J. Mammal.*, **92**, 1287–1297.
- EPPE, C.W., CASTILLO, J.A., SCHMIDT-KUNTZEL, A., DU PREEZ, P., STUART-HILL, G., JAGO, M. & NAIDOO, R. (2013) Contrasting historical and recent gene flow among African buffalo herds in the Caprivi Strip of Namibia. *J. Hered.* **104**, 172–181.
- HALLEY, D.J., VANDEWALLE, M.E.J., MARI, M. & TAOLO, C. (2002) Herd-switching and long-distance dispersal in female African buffalo *Syncerus caffer*. *Afr. J. Ecol.* **40**, 97–99.
- HARRIS, G., THIRGOOD, S., HOPCRAFT, G., CROMSIGT, J.P.G.M. & BERGER, J. (2009) Global decline in aggregated migrations of large terrestrial mammals. *Endanger. Species Res.* **7**, 55–76.
- MCGINNIS, H. (2012) Cougar mortalities in central North America and the evidence against recolonization east of the Prairie colonies. *Cougar Rewilding Foundation Newsletter* **June**, 1–9.
- NAIDOO, R., DU PREEZ, P., STUART-HILL, G., JAGO, M. & WEGMANN, M. (2012a) Home on the range: factors explaining partial migration of African buffalo in a tropical environment. *PLoS ONE* **7**, e36527.
- NAIDOO, R., DU PREEZ, P., STUART-HILL, G., WEAVER, L.C., JAGO, M. & WEGMANN, M. (2012b) Factors affecting intraspecific variation in home range size of a large African herbivore. *Landscape Ecol.* **27**, 1523–1534.
- NELSON, E., MENDOZA, G., REGETZ, J., POLASKY, S., TALLIS, H., CAMERON, D.R., CHAN, K.M.A., DAILY, G.C., GOLDSTEIN, J., KAREIVA, P.M.,

- LONSDORF, E., NAIDOO, R., RICKETTS, T.H. & SHAW, M.R. (2009) Modeling multiple ecosystem services, biodiversity conservation, commodity production, and tradeoffs at landscape scales. *Front. Ecol. Environ.* **7**, 4–11.
 - RYAN, S.J., KNECHTEL, C.U. & GETZ, W.M. (2006) Range and habitat selection of African buffalo in South Africa. *J. Wildl. Manage.* **70**, 764–776.
 - THOMSON, G.R., PENRITH, M.L., ATKINSON, M.W., ATKINSON, S.J., CASSIDY, D. & OSOFSKY, S.A. (2013) Balancing livestock production and wildlife conservation in and around southern Africa's transfrontier conservation areas. *Transbound. Emerg. Dis.* **60**, 492–506.
 - WILCOVE, D.S. (2009) *No Way Home: The Decline of the World's Great Animal Migrations*. Island Press, Washington, DC.
 - WILCOVE, D.S. & WIKELSKI, M. (2008) Going, going, gone: is animal migration disappearing? *PLoS Biol.* **6**, e188.
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