Status of buffalo in Akagera National Park

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The impact of the 1994 civil war on wildlife in Rwanda was dramatic, but most devastating in the Akagera NP. As a consequences of the Rwandan civil war two third of the park were devoted to grazing for around 0.7 million cattle of refugees returning from Uganda and Tanzania in 1995, reducing the park area from 2,500 to 732 km^2 (Kanyamibwa 1998). Information on wildlife in Akagera following the instability of the late 1990's is based on reports by Chardonnet (1995), Chardonnet & East (1995), Lorch (1995) and the comprehensive surveys of Williams & Ntayombya (1999,2001), Lamprey (2002) and Viljoen (2010). Total populations of larger herbivores had decreased by 75-80% between 1990 and 1998 (Williams & Ntayombya 1999, 2001). For about ten years the park rested in agony until in September 2010, a board consisting of Rwanda Development Board (RDB) and African Parks (AP) representatives was appointed and the Akagera Management Company (AMC) was founded. When the AMC took over, management and law enforcement were a challenge due to understaffed ranger force and a lack of resources. Since 2012, the AMC collaborated with RDB, police and Rwanda Defense Force (RDF) in improving the law enforcement of the park. This increased the number of arrested poachers and lead to the removal of thousands of snares.

During that period, the degazetted areas of the former Akagera NP were still frequently used by wild animals and human-wildlife conflict was increasing. People lost lives, crops were destroyed and domestic livestock was competing with wild herbivores for limited resources in a semi-arid environment. In an attempt to reduce human-wildlife conflicts around the new Akagera NP, RDB launched the park from cattle and poacher encroachment. The 110 km long fence along the western boundary of Akagera NP was completed in June 2013 and comprises of a 1.8 m high line of metallic posts crossed by 8 horizontal electrified wires. Before the fence was closed off, RDB and AMC, had to relocate the wildlife that remained outside the fence by driving mostly the larger species (buffalo, zebra, topi) into the park.

Prior to the civil war, buffalo numbers in Akagera NP were estimated to be around 10,000 individuals (Vande weghe & Dejace 1991). In 1998 Williams & Ntayombya (1999, 2001) reported a total of 2,260 buffaloes in the area, whereby only 680 were estimated for the new Akagera NP, but 1,580 for the degazetted parts, underlining the above mentioned human-wildlife conflict. Later, Lamprey (2002) estimated the number of buffalo in the new Akagera NP to be 309, and after launching the AMC in 2010, Viljoen (2010) established the population size of buffalo at 882 individuals. In 2010, Apio & Wronski (2011) counted the larger antelope species in the Park, but due to low encounter rates their study did not include the African buffalo. In 2011 and 2012, two further counts were conducted; also resulting in only a few buffalo encounters and no reliable estimate could be obtained. Thus, count results of all three surveys were pooled to achieve a robust estimate for the combined time period (2010-2013). The resulting estimate was based on road strip counts carried out along nine count routes following the existing park roads. Each route traversed only one of three habitat types (riverine forest, woodland slopes, open grasslands) defined by Williams & Ntayombya (1999). Flood plains were not surveyed using the road strip method, but instead two point counts were carried out to cover the northern flats (*i.e.*, Kilala Valley). Route length varied between 13.0 and 27.7 km, covering all terrestrial areas of the park. For each buffalo encounter the perpendicular distance was determined, using a range finder. All surveys were carried out by two observers during the early morning from 06:00 h to 11:00 h and in the late afternoon between 15:00 h and 18:30 h.

Using the software DISTANCE 6.0, nine different detection function models were tested, *i.e.* a combination of three key functions (uniform, half-normal, hazard-rate) and three adjustment terms (cosine, simple polynomial, hermite polynomial; Thomas et al. 2010). Choosing the best fitting detection function model was based on i) the shape of the curve describing the probability of detecting animals in relation to the recorded perpendicular distances, ii) the lowest AIC (Akaike Information Criteria) value, and the highest chi-square goodness-of-fit (Thomas et al. 2010). To further explore the data set, perpendicular distances were truncated at 200 m and 300 m, and detection function models were rerun. All models truncated at 200 m had the lowest AIC

values, but bad detection function fits. Best fitted detection function model was cosine/half-normal, truncated at 300 m with an effective strip width of 70 m.

Additionally, an aerial survey was carried out from 16 to 18 August 2013 (total flight time: 20.3h; MacTherson, 2013), using a Robinson R44, four seat, helicopter with one observer on each side and one additional front seat observer. The basic method applied was a transect count, running east-west across the new Akagera NP with transects spaced at 750 m intervals. A strip width of about 375 m to each side of the transect line was assumed, attempting a minimum total count of the protected area. In total 98 transects of varying length were used to cover all terrestrial parts (app. 405 km^2), excluding lakes and swamps, adding up to a total length of roughly 700 km. Particularly in the northern part of the Park it was often required to divert from the transect route due to uneven terrain (MacTherson, 2013). The helicopter was flown at an altitude of 60-90 m above ground, with a mean speed of 74 km/h. To reliably establish the size of large herds, spot photographs were taken and individuals were counted later. Due to the nature of the count (minimum total count), no methods of analysis were used to further explore the data. Both surveys (ground, aerial) did not include the parts of the former Akagera NP and therefore represent population estimates for the new Akagera NP only.

The estimate obtained from three ground surveys (31 encounters) resulted in a population size of 5,395 buffaloes with a 95% confidence interval of 2,053. This translates into a buffalo density of 13.3 individuals/km^2. Mean group size was determined as 31.7 (95% CI: 12.4) animals. The aerial count resulted in a total of 2,093 buffaloes encountered in 94 groups, plus three herds (120 animals) not seen but known to occur in a forest area not visible from the air. This corresponds to a buffalo density of only 5.48 individuals/km^2 and a mean group size of 22.3 individuals.

Population estimates obtained from aerial and ground survey differed considerably. This may be attributed to the low encounter rate of buffaloes during the ground counts (and the pooling of three consecutive years), resulting in a general overestimation of population size. On the other hand aerial surveys tend to underestimate true population sizes due to the relatively high speed, the flight height and observer fatigue. The application of DISTANCE 6.0 and the random generation of the best fitted model generate reliable data if ground survey assumptions are met. Since this was not guaranteed, a bias towards a higher population size is likely and the true value may be found between the aerial count (2,213 individuals) and the estimate obtained from ground counts (5,395 individuals). In summary, to date population size of buffalo inside the new Akagera NP is as high, or higher than that estimated in 1997/98 by Williams & Ntayombya (1999, 2001) for settled area and new park combined. In 2010, after the AMC was founded the number of buffaloes inside the park was estimated to be 882 animals (Viljoen, 2010). This implies that herds previously inhabiting the degazetted parts have been depleted while numbers inside new Akagera NP have recovered to a level as high as that established in 1997/98 for the entire area. However, a total of about 350 buffalos were driven into the current Park area after the western boundary fence was put in place in June 2013. Improved management, decreased poaching and a lack of lion as an apex predator in the Park coupled with adequate food, water and cover led to near-perfect breeding conditions for the species and therefore steadily increasing numbers.

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