The re-emergence of African White-backed Vultures (*Gyps africanus*), White-headed Vultures (*Trigonoceps occipitalis*) and Lappet-faced Vultures (*Torgos tracheliotos*) in Liwonde National Park, Malawi.

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http://dx.doi.org/10.4314/vulnew.v74i1.2

Introduction

Over the past few decades vulture populations across Africa have experienced devastating declines. In 2015, six of Africa's 11 vulture species were up-listed on the IUCN Red List of Threatened Species, of which four were up-listed as critically endangered (IUCN 2018). The cause of this drastic decline has been attributed to several factors: direct and secondary poisoning events, interaction with energy infrastructure, a decrease of food sources, habitat loss and habitat degradation (Roxburgh & McDougall 2012, Ogada *et al.* 2012, Botha *et al.* 2017). Although efforts are being made to conserve remaining populations and protect them from these threats, there are still parts of the continent where records of vulture populations are sparse and little is known of their status, such as Malawi.

Malawi is a small landlocked country with a high human population density (197.5 people/km^2; United Nations Statistics Division 2017). Although 22% of the country's total land area is protected (Munthali 1993), human population outside these protected areas is dense and buffer zones are scarce. Thus, many communities have become dependent on nearby national parks and reserves causing unsustainable resource off-take from these areas (Munthali 1993). This has been the case for Liwonde National Park (540km^2).

Liwonde National Park (LNP) is home to over 380 different species of birds and is therefore designated an Important Bird Area (BirdLife International 2011). Historically LNP contained five vulture species: African White-backed Vulture (*Gyps africanus)*, White-headed Vulture (*Trigonoceps occipitalis*), Lappet-faced Vulture (*Torgos tracheliotos*), Hooded Vulture (*Necrosyrtes monachus*) and Palm-nut Vulture (*Gypohierax angolensis*) (Convention on Migratory Species 2017, Roxburg & McDougall 2012). Over the years, poaching and poisoning events caused a significant decline in park fauna. Although long-term records of vulture populations in LNP do not exist, it is believed that multiple species were present in the park in the 1980s, but by 1996 all species, with the exception of the Palm-nut Vulture, were extirpated (Roxburgh & McDougall 2012). Despite the drop in large mammal numbers over the years, LNP maintained its large woodland, 70% of which consist of mopane (*Colophospermum mopane)* with scatterings of other species

including baobabs (*Adansonia digitata*) and fever trees (*Vachellia xanthophloea*) (Bhima & Dudley 1996) which are important tree species for nesting of the White-headed Vulture and African White-backed Vulture (Pennycuick 1976). This along with consistent levels of snaring, gin-trapping and elephant poaching is thought to have provided ample habitat and large volumes of food capable of sustaining a vulture population. Their disappearance from LNP is therefore a strong indicator of secondary poisoning events or direct persecution (Ogada *et al.* 2015). Interviews conducted in 2012 with LNP staff further supported poisoning events as the main cause of the vulture population decline (Roxburgh & McDougall 2012). Unfortunately, improper record keeping of poisoning events made it difficult to determine what species of vulture were affected and at what rate. However, vulture sightings were rarely documented between 1996 and 2014.

On the 13th of May 2017 four cheetahs (*Acinonyx jubatus*) were reintroduced into LNP, with further reintroduction of three cheetahs on the 11th of December 2017. Apart from a small population of Spotted Hyena (*Crocuta crocuta*) these cheetahs are the sole large carnivores in the park. During these reintroductions, a boma period of one month took place, at which time vultures were seen circling the boma. Cheetahs were fed sections of Waterbuck *(Kobus ellipsiprymnus).* Old carcasses were removed from each individual boma and discarded nearby. This allowed an opportunity to camera trap a consistent location with a food source that was replenished every 3-4 days, over a 56 day period. Similarly, post-release monitoring of the cheetahs has allowed for the camera trapping of kills and opportunistic visual surveying for vultures in areas with high cheetah activity.

Here, we describe vulture sightings from camera trap and opportunistic data (Table 1) that were collected by the cheetah monitoring team between May 13 2017 and February 1 2018, and also associated images. We also report sightings of African White-backed, White-headed, Palm-nut and Lappet-faced Vultures.

During the 56 days of camera trapping at the carnivore boma, five vulture sightings took place. Furthermore, during post-release cheetah monitoring six fresh cheetah kills and two natural ungulate mortalities were camera trapped. Camera traps were left at carcasses until they were completely scavenged; this took up to three days with the exception of a Buffalo *(Syncerus caffer)* which was camera trapped for one week. These camera traps yielded the five vulture sightings on three carcasses. Opportunistic visual surveying for vultures while tracking cheetah also took place and yielded an additional 12 vulture sightings.

1) African White-Backed Vulture

The most commonly recorded species of the three, the African White-backed Vulture has been seen both on and nearby kills throughout the monitoring period with a total of 19 recorded sightings. Of these sightings, four had 30 or more individuals present (Figure 1a) with the largest group of African White-backed Vultures being recorded on August 11, 2017 when 57 individuals were documented on a Waterbuck carcass. From the use of camera traps it was determined that the majority of African White-backed Vultures sighted during this time were juvenile or first year birds.

On June 5 2017 camera traps at the carnivore boma captured images of a wing-tagged White-backed Vulture (Figure 1b). AB was later able to identify this individual as H031. H031 came from Imfolozi Game Reserve, KwaZulu-Natal, South Africa and was in the nest when tagged in 2015. This is the first wing-tagged vulture reported from Malawi.

Figure 1a: Over 30 African White-backed Vultures photographed on the Chinguni floodplain of Liwonde National Park, August 11, 2017.

Figure 1b: A camera trap image of tagged African White-backed Vulture H031 feeding at the carnivore boma in Liwonde National Park, May 22, 2017.

2) White-Headed Vulture

The White-headed Vulture is the second most documented species, with eight sightings recorded. From camera trap images it was determined that female and male birds have been present on kills as well as both juvenile and adults. Although only two have been caught on camera trap at the same time (Figure 2), the largest grouping was reported by Park Manager (CR) and comprised three individuals circling with African White-backed Vultures south of the Mwalasi River.

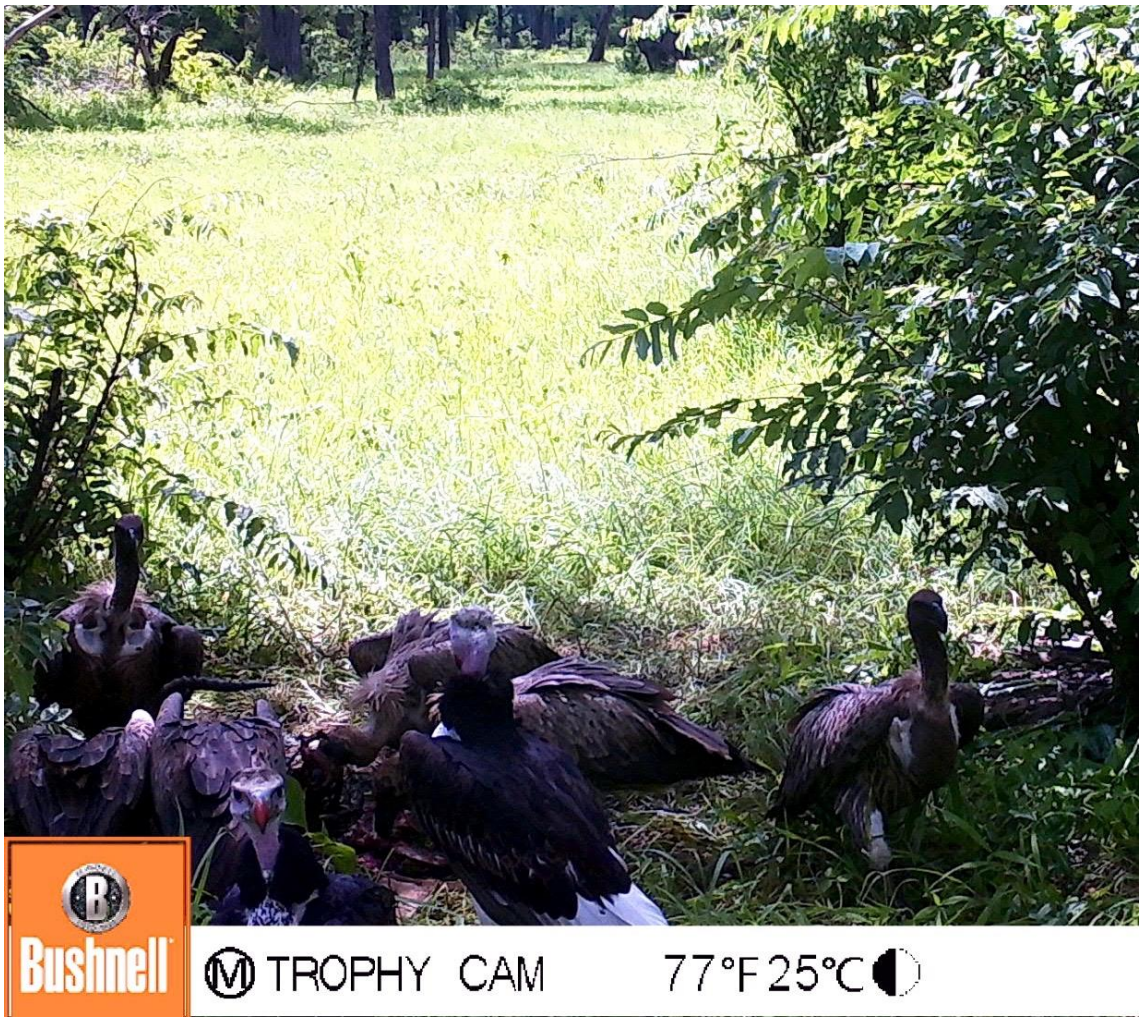

Figure 2: A camera trap image of two White-headed Vultures (female and unknown sex) and seven African White-backed Vultures on a cheetah kill in the seven-dams area of Liwonde National Park, January 8, 2018.

3) Lappet-Faced Vulture

Lappet-faced Vultures were the least common vultures sighted during the monitoring period with only two records during May 2017 and one record in October 2017. Although age was not determined for the October sighting, it was determined through camera trap images that both sightings in May were of an adult. Only one individual was recorded at each sighting all of which took place within the Chinguni area.

Figure 3: A camera trap image of an adult Lappet-faced Vulture at the carnivore boma with a large group of African White-backed Vultures, May 22, 2017.

4) Palm-nut Vulture

Palm-nut Vultures were commonly recorded on cheetah kills during the monitoring period. Although Palm-nut Vultures were found scavenging on these carcasses with other vultures including a Lappet-faced Vulture and White-headed Vulture (Figure 4a) it was more common for them to be found alone prior to the arrival of other scavengers.

Figure 4a: A camera trap image of a Palm-nut Vulture scavenging on a Waterbuck carcass at the carnivore boma, May 22, 2017.

Figure 4b: A camera trap image of a Palm-nut Vulture scavenging on an Impala *(Aepyceros melampus)* that was killed by a cheetah near Chinguni Hill, August 19, 2017.

Table 1: Summary of vulture sightings made by the cheetah monitoring team in Liwonde National Park, Malawi between May 13, 2017 and February 1, 2018.

Date	Location	Habitat	White-backed Vulture	White-headed Vulture	Lappet-faced Vulture
20-05-17	Carnivore boma	Open mopane	0	1	1
22-05-17	Carnivore boma	Open mopane	30	1	1
16-07-17	Kombe Island	Floodplain	50	0	0
11-08-17	Chinguni Floodplain	Floodplain	57	0	0
13-08-17	Spine Road - Chinguni	Floodplain	10-15	0	0
21-08-17	Chinguni Floodplain	Floodplain	12	0	0
23-08-17	Chinguni Hill	Open miombo	5	0	0
28-08-17	Cheetah Kill	Palm forest	0	1	0
31-08-17	Mvuu Floodplain	Floodplain	1	0	0
05-09-17	Chinguni Floodplain	Floodplain	1	1	0
12-09-17	Chinguni Floodplain	Floodplain	4	0	0
18-09-17	Cheetah kill	Floodplain	30	0	0
30-09-17	Near Kombe Island	Floodplain	17	0	0
03-10-17	Spine Road - Chinguni	Open mopane	12	0	0
04-10-17	Spine Road - Chinguni	Open mopane	12	1	0
20-10-17	Chinguni Floodplain	Floodplain	0	0	1
06-01-18	Carnivore boma	Open mopane	5	1	0
08-01-18	Cheetah kill	Open mopane	11	2	0
08-01-18	Cheetah kill	Open mopane	4	1	0
26-01-18	Kombe Island	Floodplain	6	0	0
27-01-18	Carnivore boma	Open mopane	5	0	0
28-01-18	Carnivore boma	Open mopane	3	0	0

With few long-term studies or surveys having been conducted on the status of vultures in LNP, further investigation into the re-emergence of vultures led to interviews being conducted with two staff members of Central African Wilderness Safari's MVUU camp; Samuel Chihana, a guide in LNP for eight years, as well as Richard Chimwala, MVUU Camp Manager since 1995. According to both Samuel and Richard, MVUU guides did not document any vulture sightings from 1995-2007. Vulture sightings began again in 2007, with African White-backed Vultures being the dominant species reported. By the dry season of 2015, vulture sightings by MVUU guides became more common and have continued to increase since, most notably three separate Hooded Vulture sightings being recorded in 2016.

While it is clear vultures began arriving in LNP in 2007, it is possible that poisoning events led to no resident population becoming established. A study on the effect of waterhole poisoning events in LNP on the Lillian's Lovebirds (*Agapornis lilianae*) population was able to uncover a total of 31 reported waterhole poisonings that had effected their study species between 2000 and 2012, of which only eight did not report other species being affected (Mzumara *et al.* 2015). While vulture carcasses were not documented near these waterhole poisonings, one event list "birds" as an affected species (Mzumara *et al.* 2015). Furthermore, no mention was made of scavenging on carcasses found near poisoned waterholes. Whereas this study highlighted the high prevalence of poisoning for bushmeat and song bird poaching, it does not detail additional poisoning events that did not affect Lillian's Lovebirds, such as retaliatory poisonings that have been known to occur along the LNP boundary, as well as sentinel poisoning which has been documented in Malawi (Roxburgh & McDougall 2012).

In August 2015, African Parks Network took over management of LNP. They succeeded in securing funds and began the process of fencing the park. By early 2017, the 140km perimeter of the park was completely fenced and patrolled day and night by a team of 90 staff members. This has led to a level of access control that was previously unseen, thereby reducing poisoning and poaching events within the park, such as the reduction from 27 elephants poached in 2015/2016 to one in 2017 (African Parks unpublished data). Furthermore, fence line patrols have succeeded in the quick discovery of suspected poisoning incidents along the boundary allowing cases to be dealt with and carcasses disposed of immediately. As a result, according to Lawrence Munro, LNP's Field Operations Manager, only three poisoning events have occurred within LNP since 2016, none of which have affected vultures. Of these three poisoning events, two occurred on the park fence line and were consequently labeled as retaliatory poisonings; the other was a waterhole poisoning for poaching purposes. These poisoning events affected a total of three mammals and two reptiles, all of which were discovered and properly disposed of prior to any visible scavenging (L. Munro pers. comm.).

With the completion of the park fence and increased anti-poaching activities, LNP has seen a rise in large mammal numbers. An example of this is a 71% and 64% increase in waterbuck and impala respectively since 2006 (Leroux & Reid 2016). This has allowed for further restocking of carnivores with lion (*Panthera leo*) and leopard (*Panthera pardus*) reintroductions commencing in 2018. It is anticipated that, with the decrease in poisoning events and the increase in available carrion due to growing predator and prey populations, LNP will continue to see an increase in vulture populations and thereby become an important area for vultures within Malawi. It is recommended that long-term monitoring of vulture populations in the LNP be initiated and that data contribute to filling the current lack

of knowledge regarding vultures in Malawi, a country that has been identified as a significant gap-area in the CMS Vulture Multi-species Action Plan for African-Eurasian Vultures (Botha *et al* 2017).

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