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The changing sizes of Critically Endangered White-backed Vulture breeding colonies around Kimberley, South Africa

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Introduction

The White-backed Vulture (*Gyps africanus*; WbV) is critically endangered (BirdLife International 2017) and has declined by up to 90% across parts of its range over the last 30 years (Ogada *et al.* 2016). It is a tree-nesting species that tends to congregate in groups for breeding (Mundy, Butchart, Ledger & Piper 1992) and aerial surveys of these breeding areas offer a reliable and repeatable means of assessing local population changes (Howells & Hustler 1984) that can complement results from road transect surveys (Herremans & Herremans-Tonnoeyr 2000).

Near Kimberley in central South Africa, breeding WbVs have been at least partially monitored since the 1960s (Forrester 1967). The only aerial survey of this population in 2001 yielded an estimated breeding population of 240 pairs (Murn, Anderson & Anthony 2002) across six colonies. The 2001 estimate was more than double the previous estimate of 110 pairs (Anderson & Maritz 1997); at that time, the breeding colonies at Kimberley represented nearly 7% of the national population estimate of 3,500 pairs (Anderson 2000). Since 2001, however, the population status of all the breeding colonies of WbVs near Kimberley is unknown.

There are no published studies that describe trends longer than 10 years for WbV populations in South Africa. Numbers of breeding WbVs appear to have declined in some areas (Murn *et* *al.* 2013) but increased in others (Hitchins 1980; Bamford *et al.* 2009). Thus, there is a need for long-term (> 10 years) data to assess population trends of endangered vultures. Here we present results from aerial surveys of the WbV breeding colonies at Kimberley in 2014 and compare the results to those from 2001.

Methods

Study area

The vulture breeding colonies occur across an area of approximately 4,000 km^2 (from S28.50 E24.08 to S29.16 E25.00) around Kimberley in central South Africa (Figure 1). WbVs use camel thorn (*Vachellia erioloba*) and umbrella thorn (*Vachellia tortilis*) for nesting (Mundy 1982; Murn & Anderson 2008), although there are cases of WbVs nesting on powerlines (Anderson & Hohne 2007).

Aerial survey

Colonies were surveyed in July when most birds are at their nests, following a peak egg-laying period in late May (Anderson 2000a). Before June/July, vultures around Kimberley can still be preparing for nesting and from late July some early-breeding birds may have already hatched and lost chicks (Murn *et al.* 2002), which results in fewer vultures being seen at their nests.

A Robinson R66 Turbine helicopter was used to survey the six vulture breeding colonies. Pre-survey flight paths were created that traversed the same, or slightly larger, areas than the 2001 survey. Survey flights were conducted with a pilot and two observers at an altitude of 80-120 m a.g.l. (above ground level); airspeed was maintained between 120 - 140 km/h. All flights were completed between 09h00 and 16h30 during conditions of good visibility. The maximum distance between transects was limited to 1000 m (500 m either side of the helicopter).

Nest positions and flight routes were logged with a GPS and a PDA/Smartphone running CyberTracker (http://cybertracker.org). A nest was recorded as active if it contained an adult in an incubating posture, a nestling, an egg or egg remains. Inactive nests were recorded separately.

Analysis

Despite optimum survey timing, a small but unknown number of breeding attempts will still remain unrecorded or nests known from the ground will be missed during the aerial survey. To account for this, a correction factor was applied to the aerial survey counts, which was calculated as the difference between the aerial survey count (227) in 2001 and the combined aerial and ground count of all active nests recorded in 2001 (244) (Murn *et al.* 2002). The correction factor we used was 1.075 (244/227).

In both 2001 and 2014, colony areas were determined as minimum convex polygons (MCP). For each colony, the most dispersed nests were used as the MCP points. Density (nests km^{-2}) was calculated as the number of nests occurring within the MCP divided by its area.

Results

A total of 165 active nests was recorded across all six colonies, compared with 227 in 2001 (Table 1). Applying the correction factor to account for missed nests, we estimate the breeding population across the six colonies to be approximately 177 pairs (165 x 1.075). The total of all WbV nests (both active and inactive) counted was 219. Across all six colonies, fewer (26%) nests were estimated compared with the 2001 estimate of 240 nests.

Although nest density decreased at colonies that had reduced in numbers of nests since 2001, average density across all extant colonies was 1.66 nests km^{-2}, more than three times higher than the average nest density across all colonies in 2001 (0.46 nests km^{-2}).

Discussion

Breeding colony numbers

Since 2001, the number of WbV nests across the six breeding colonies around Kimberley has decreased. One potential explanation for this change is that the birds have moved; investigations are needed across a wider area to determine if new colonies have been established.

However, the Dronfield colony increased by over 50% between 1993 and 2014 (A. Anthony, personal communication); from 2001 to 2014 there was a smaller increase. Regardless of the reasons for its growth, if the Dronfield colony had been used as an indicator for the Kimberley WbV breeding population overall, it would have been an inaccurate reflection of the local trend, which was spatially variable and downwards overall.

The increase of the Secretarius colony from two to 25 nests and the concomitant disappearance of nearly the same number of nests from the Paardeburg colony makes it tempting to assume that the birds moved from one location to the other, but these colonies changing in number by similar amounts is likely to be coincidental. In 2001, the colony at Paardeburg had grown from three to 27 pairs over the preceding five years (D. Du Toit, farm owner, personal communication), whilst the two nests and embryonic colony at Secretarius had just re-established. At the time, nest densities at these two colonies were lower than the other colonies and studies highlighted that sufficient food existed for the birds (Murn & Anderson 2008); factors supporting a conclusion that the WbV breeding population around Kimberley was growing (Murn *et al.* 2002). It now appears to have decreased. Land use change offers a potential explanation. For example, the development of a mining operation near the Paardeburg colony and land ownership/tenancy changes at the Rivermead colony may be reasons for breeding birds moving away. Conversely, at the Dronfield colony, there has been stable land management over recent decades and the site is a proclaimed nature reserve. These differences in setting for each of the colonies and the potential for breeding birds to move highlights the need for surveys across a wide area and also coordination between fieldworkers at different sites.

If the results across the surveyed colonies are representative of a decline in the number of breeding vultures, there are implications for other parts of southern Africa. It is possible that other breeding populations of WbVs have undergone significant change over the same period. For example, the current red data book account for WbVs (Allan 2015) highlights the ‘uneven coverage and outdated nature of some estimates’ (p 63) and by necessity reports population figures and estimates that are 10 or more years old. There is clearly a need for updated breeding population estimates to be published from a variety of survey efforts across southern Africa.

Threats to vultures

Electrocution by powerlines and drowning in farm reservoirs are important causes of mortality for vultures in the Kimberley area (Anderson & Kruger 1995; Anderson 2000b) and elsewhere (van Rooyen 2000), but compared to other areas where poisoning kills large numbers of vultures, the severity of these threats is relatively low. For example, poison-related mortalities have occurred historically (van Jaarsveld 1987) and remain a continuing threat to vultures in Kruger National Park (Murn & Botha 2017) and other parts of southern Africa (Ogada, Botha & Shaw 2015). The absence of a poisoning threat and a positive opinion of vultures amongst landowners (Murn & Anderson 2008), makes the Kimberley area an important breeding site for WbVs in southern Africa. However, various threats such as land use change from diamond mining and tree clearance for agriculture adjacent to Mokala colony, unsafe electrical powerlines and the development of concentrated solar thermal power (CSP) plants remain.

WbVs move across large areas that can consist of several countries (Phipps, Willis, Wolter & Naidoo 2013) and some of these countries have seen high poisoning rates that have resulted in vulture populations being reduced (Roxburgh & McDougall 2012) or where large numbers of vultures continue to be killed (Groom, Gandiwa, Gandiwa & van der Westhuizen 2013). Vultures from the Kimberley area travel as far as Namibia (authors' unpublished data); at least two birds from Kimberley died in the Caprivi Strip in Namibia, where approximately 500 birds were poisoned (Hartman 2013). Many of the birds killed at poisoning events are breeding adults and, as a result, we speculate that any local declines may be due in part to increased mortality of vultures in other regions that are far from Kimberley.

Recommendations

Continued monitoring of the Kimberley WbV breeding population is essential because it is important regionally and may reflect vulture mortality elsewhere. In addition, monitoring changes in breeding populations across southern Africa is fundamental for coordinating conservation management efforts. A better understanding of the ranging patterns of adult WbVs throughout the year is important because wide-ranging birds like vultures are exposed to a variety of threats and the severity of this exposure for non-breeding adults is currently unknown for WbVs. Finally, there are no published road transect data for the Kimberley and surrounding areas. Such data would provide a valuable complement to survey data focused on numbers of nests and should therefore be a research priority.

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Table 1: Aerial survey counts of six White-backed Vulture breeding colonies near Kimberley, South Africa, between 2001 and 2014

Colony name	Aerial survey count		% change	Area (km^2)/density (nests km^{-1})	
	2001	2014		2001	2014
Dronfield	28*	74	+264%	135/0.32	162/0.46
Mokala	69	55	-20%	120/0.58	134/0.41
Rivermead	24	5	-79%	50/0.48	1.6/3.12
Susanna	79	9	-88%	130/0.61	55/0.16
Paardeburg	27	0	-100%	66/0.41	0/0
Secretarius	ns (2)#	25	+1250%	5/0.4	5.8/4.14
Total	**227**	**167**	**-26%**	**-**	**-**

*Aerial survey count lower than ground survey count (48) conducted in 2001

#Not surveyed by air in 2001; two nests found during ground surveys

Captions for Figure:

Figure 1: Location of six White-backed Vulture breeding colonies around Kimberley, South Africa.

Figure

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