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Cape Vulture *Gyps coprotheres* breeding status in southern Africa: monitoring results from 2010–2014

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Monitoring of eight Cape Vulture *Gyps coprotheres* breeding colonies in South Africa and Botswana took place between 2010 and 2014 using standardised counting methods. Counts of breeding pairs, nestlings and fledglings were used to calculate breeding success and general population trends. While our data suggests multiple colonies are stable or increasing, the extinction of peripheral colonies and contraction of the species' range is alarming and gives evidence for unsustainable population declines. Monitoring efforts chronicled the extinction of the previously large core colony at Roberts' Farm, which was abandoned as a breeding site in 2013. Standardised monitoring is urgently needed across the entire species range to better understand current population dynamics.

Keywords: breeding colony, breeding success, Cape Vulture, extinction, monitoring

Introduction

The Cape Vulture *Gyps coprotheres* is a southern African endemic vulture that has been the centre of research and monitoring for many decades (Mundy et al. 1992 and references therein). Despite this focus, the global population is declining from numerous threats (Naidoo et al. 2009; Phipps et al. 2013; Wolter et al. 2013; BirdLife International 2015). The global range of the species has previously undergone contractions (ca. 1900; Boshoff and Vernon 1980) and expansions (1950 to 1975; Boshoff and Vernon 1980). The species is currently in another cycle of contraction as is evident from the extinction of numerous large peripheral colonies in recent years (Piper 2004; Wolter et al. 2014). The species no longer breeds in much of its traditional range, i.e. Namibia, Zimbabwe and Swaziland (BirdLife International 2015). Patterns of range contraction, i.e. peripheral population extinctions, have been witnessed alongside population declines in multiple avian species (Wilcove and Terborgh 1984; Channel and Lomolino 1999, 2000), including the southern African Bearded Vulture *Gypaetus barbatus meridionalis* (Krüger et al. 2014). Rodriguez (2002) provides a 'melting range' theory where a decline in species abundance accompanies, if not exceeds, contraction in a species' range.

Currently, the Cape Vulture breeds in two core populations, one north and one south of 27° S latitude. The colonies discussed here are all found in the northern core population in South Africa and Botswana (see Figure 1). The southern group is centred on the Drakensberg Massive in South Africa (Piper 2004). In addition, there is a small breeding population in the Western Cape, South Africa. All Namibian breeding colonies have been abandoned (Wolter et al. 2014; Piper 1994). Bush encroachment is also suspected to be a cause of declines in the region (Piper 1994). Historically, there were multiple nursery areas around the subcontinent, the northernmost being at Wabai Hills, Zimbabwe, which also at one stage hosted a breeding population (Piper 1994). The use of the Wabai Hills roosting site declined markedly in 2000 after government land reforms and was entirely abandoned in 2012 (Chiweshe and Mabhikwa 2014).

A standardised monitoring protocol was developed and implemented in 2006 (Benson et al. 2007; see Wolter et al. 2007 and Whittington-Jones et al. 2011 for implementation with the Magaliesberg colonies). This is a common census methodology already employed for decades worldwide with the similar Eurasian Griffon *Gyps fulvus* in Spain (SEO 1981; Arroyo et al. 1990; del Moral and Martí 2001; del Moral 2009). Cliff-nesting Griffon vultures *Gyps* spp. are easy to census. Their large bodies and long breeding period of nearly six months makes them highly visible during counts. In addition, they are gregarious and chick rearing requires a high degree of parental involvement, meaning one adult remains at the nest for most of the rearing period (Mundy et al. 1992).

The colonies monitored here have been monitored in the past, though not consistently nor with standardised methods (Borello and Borello 1987, 1992; Piper 1994). The goal of this study was to estimate population numbers and breeding success of all these colonies in the same breeding seasons using standardised methodology.

Materials and methods

We censused the following colonies: Magaliesberg (Skeerpoort, Nooitgedacht and Roberts' Farm), Manutsa, Kransberg, Soutpansberg, Moletjie and Mannyelanong

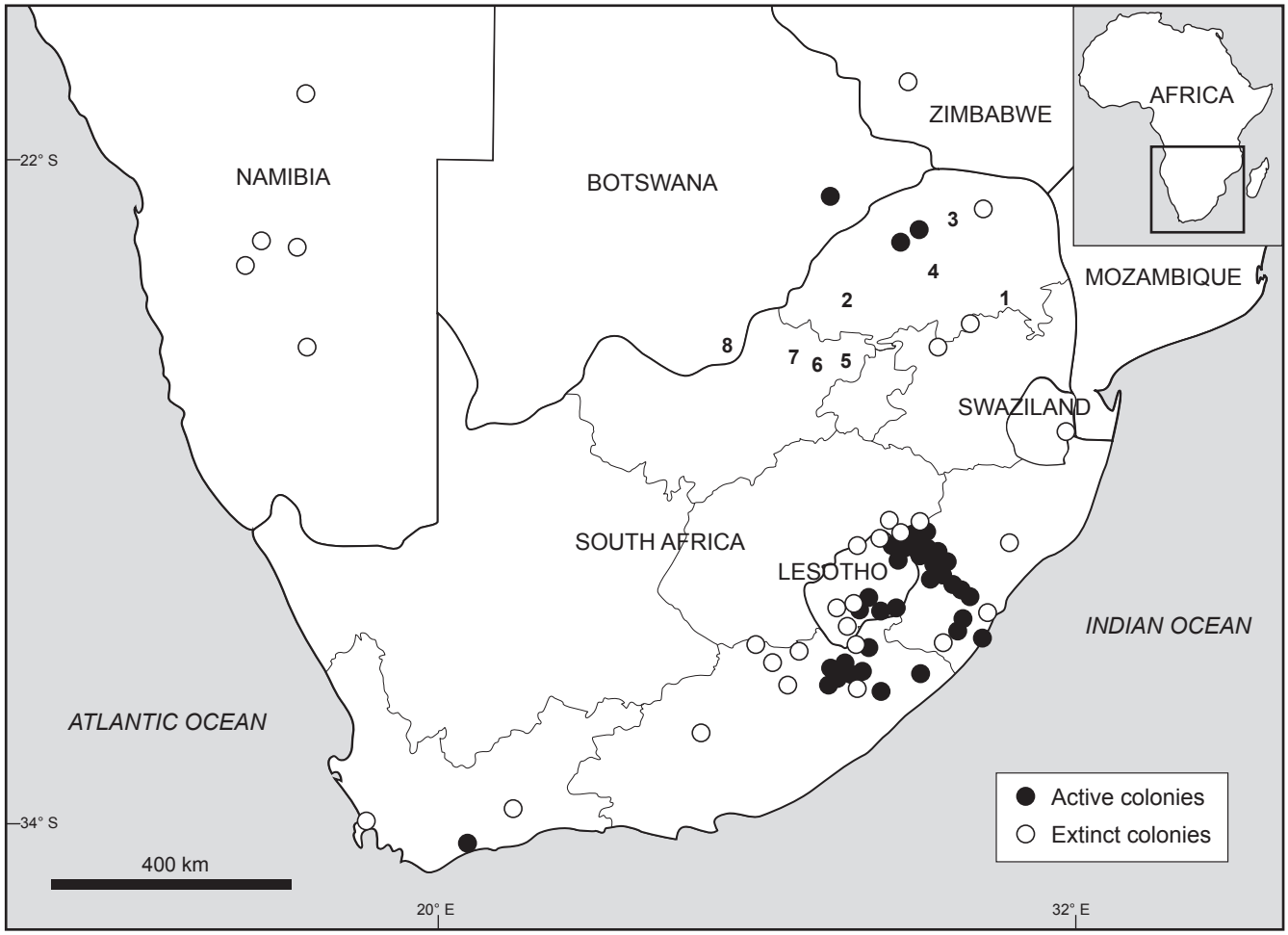

Figure 1: Map of southern Africa with national boundaries showing all known Cape Vulture colonies. Colonies monitored and reported here are marked with the corresponding numbers: 1, Manutsa; 2, Kransberg; 3, Soutpansberg; 4, Moletjie; 5, Skeerpoort; 6, Nooitgedacht; 7, Roberts' Farm; 8, Manyelanong

(Figure 1). Monitoring protocols followed the methods developed by the Vulture Study Group and are summarised below (Benson et al. 2007). Each colony was visited three times during the breeding season when possible.

Breeding pairs were counted during the first visit from May to June. Pairs were considered actively breeding if they were seen nesting, incubating, copulating or tenanted, i.e. present and displaying behaviour suggesting the ledge is being used as a nest. Colonies were visited again between July and August to count nestlings and pairs still incubating. Fledglings were counted during the final visit from late August to October. Nestlings and fledglings were confirmed when visually verified. Nestling presence was inferred based on adult behaviours: incubating or tenanted nests. Fledgling presence was inferred only when a younger chick was visually confirmed on the nest. Due to lack of resources some colonies were not visited three times.

Each count was conducted within three days. Nest locations were referenced from marked high-resolution digitised photographs of each cliff face. The same photos were used every year and nest markings were continually added to reflect recent nesting activity. Counts always occurred from the same observation point at the base of the cliff using spotting scopes (minimum 60× magnification). Distances from the observation point to the cliff varied by site between 700 m and 1 600 m.

We measured breeding success as the ratio of the number of fledglings/adults that attempted to breed as a percentage for each colony (see Arroyo et al. 1990 and del Moral and Martí 2001 for the Eurasian Griffon). We also calculated the annual growth rate (Fernandez et al. 1998).

Results

Active breeding pair, nestling and fledgling counts from 2010–2014 are summarised in Table 1. The total number of breeding pairs ranged from a minimum of 1 464 in 2011 (when no data were available for Mannyelanong, Soutpansberg and Moletjie) to 1 776 in 2014 when all colony censuses were completed. Detailed counts are available for the Magaliesberg colonies for a longer period (Whittington-Jones et al. 2007; Wolter et al. 2011). The Mannyelanong colony was monitored only once early in the 2014 breeding season.

Table 1: Summary of breeding pair, nestling and fledgling counts (inferred numbers in parentheses) for all colonies from 2010–2014. Dashes indicate incomplete or no data

Location	Colony name and GPS coordinates	Survey	2010	2011	2012	2013	2014
South Africa	Manutsa	Active pairs	–	539	433	446	561
	24°27′ S, 30°45′ E	Nestlings	–	–	358 (59)	457 (14)	458 (20)
		Fledglings	–	–	319 (8)	–	–
	Kransberg	Active pairs	–	628	662	608	632
	24°28′ S, 27°36′ E	Nestlings	–	–	385 (168)	488 (90)	561 (58)
		Fledglings	–	456 (0)	323 (99)	–	–
	Soutpansberg	Active pairs	–	–	181	168	187
	23°01′ S, 29°35′ E	Nestlings	–	–	177 (5)	189 (3)	–
		Fledglings	–	–	119 (3)	–	120 (1)
	Moletjie	Active pairs			20	13	16
	23°44′ S, 29°19′ E	Nestlings	–	–	9 (4)	12 (2)	–
		Fledglings	–	–	7 (3)	–	11 (3)
South Africa, Magaliesberg	Skeerpoort	Active pairs	221	199	197	209	221
	25°44′ S, 27°45′ E	Nestlings	219 (29)	73 (96)	156 (30)	207 (17)	187 (23)
		Fledglings	159 (1)	179 (0)	113 (4)	190 (14)	120 (111)
	Nooitgedacht	Active pairs	122	93	73	–	97
	25°51′ S, 27°32′ E	Nestlings	59 (27)	44 (38)	33 (21)	82 (7)	85 (5)
		Fledglings	66 (0)	89 (0)	66 (16)	71 (1)	75 (8)
	Roberts′ Farm	Active pairs	9	5	3	0	0
	25°49′ S, 27°18′ E	Nestlings	4 (0)	4 (0)	–	–	–
		Fledglings	4 (0)	2 (0)	–	–	–
Botswana	Mannyelanong	Active pairs	–	–	–	–	62
	25°03′ S, 25°45′ E	Nestlings	–	–	–	–	–
		Fledglings	–	–	–	–	–

All colonies monitored from 2011 declined to a minimum count in 2012 or 2013 with negative annual growth rates. The Magaliesberg vultures recovered slightly between 2011 (−15.62) and 2012 (−8.08) with subsequent positive growth rates in 2013 and 2014 (4.5 and 5.74, respectively). However, this was not the trend of the other colonies (Manutsa, Kransberg, Soutpansberg and Moletjie), which showed average annual negative growth rates of −7.13 and −11.82 in 2012 and 2013, respectively. In 2014 the average growth rate was positive at 13.67.

Regarding breeding success, the numbers reported here (Table 2) account for confirmed fledglings only. Inferred fledglings, i.e. large chicks not yet at fledge age, are reported (Table 1) but are not included in this analysis. Therefore these numbers should be considered minimum values. Confirmed breeding success ranged from 35% to 96%.

Table 2: Confirmed breeding success noted as a percentage, i.e. the ratio of fledglings counted late in the season compared to the number of active breeding pairs counted upon the first visit

Colony	Confirmed breeding success (%)				
	2010	2011	2012	2013	2014
Manutsa	–	–	74	–	–
Kransberg	–	73	49	–	–
Soutpansberg	–	–	66	–	64
Moletjie	–	–	35	–	69
Skeerpoort	72	90	57	91	54
Nooitgedacht	54	96	90	80[1]	77
Roberts' Farm	44	40	–	–	–
Mannyelanong	–	–	–	–	–

[1] Active pairs were counted from the number of active nests in August; monitoring did not occur earlier in the season

Discussion

Monitoring results 2010–2014

The declines seen across all colonies between 2012 and 2013 suggest pressures on the breeding birds or mortalities were high between these seasons. We do not believe these declines are explained by translocations because population decreases were witnessed in all neighbouring colonies. However, emigration to further colonies cannot be ruled out.

We believe that the Magaliesberg colonies show positive growth in 2013 and 2014, contrasting with the trend of the other colonies, because of the high number of vulture feeding sites in the region (six in total) and the increasing regularity and amount of food provided. VulPro NPO, a vulture conservation organisation located 20 km east of the Skeerpoort breeding colony, started a vulture restaurant in 2011. Since its inception the regularity of feedings has increased to approximately five times weekly and the numbers of wild vultures visiting the site has increased from a maximum of 50 to 400 individual birds. Between all six restaurants in the region we estimate food is available daily, attracting birds to the region and increasing the breeding population. Other colonies do not have regular and/or active feeding sites in close proximity.

The Magaliesberg colonies have historically undergone drastic fluctuations. The now extinct Roberts' Farm colony

contained approximately 155 breeding pairs from the mid-1970s up to 1988 (Verdoorn et al. 1998). It is suspected that many pairs relocated to the nearest neighbouring colony at Nooitgedacht following the initiation of a supplemental feeding site located on top of the cliff (Verdoorn and Becker 1992). The colony declined drastically when up to 400 Cape Vultures were electrocuted 75 km southwest of the colony in 1995. Our 2010 to 2014 monitoring documents the final abandonment of Roberts' Farm colony, which was a previously stable colony in the core of the species' range. It is now only used as an occasional roost site.

In 2010 the Nooitgedacht colony supported 125 breeding pairs, the highest population recorded historically (Verdoorn 1998; Wolter et al. 2007; Whittington-Jones et al. 2011), but has since declined. The supplementary feeding site at Nooitgedacht is still active, but feedings have steadily declined from 20 years ago when an average of one ton of meat was fed per week. Currently, the restaurant provides on average one carcass of varying size per week (C Saunders pers. comm.).

Our 2014 observations of the Mannyelanong colony suggest the colony is stable from the last published breeding census (range 49–64 pairs between 1992 and 1999; Borello and Borello 2002). However, there is a lack of information about recent trends on vulture breeding numbers in Botswana. This requires the immediate implementation of a breeding survey and capacity building for ornithologists to do so covering all suitable sites (Borello 2004).

Breeding success

Breeding success varied by colony and year. Excluding the Roberts' Farm colony, 16 of the 18 available measures of breeding success fall within the range seen in other Cape Vulture studies (69–100%, Wolter et al. 2007; 53–100%, Whittington-Jones et al. 2011) or similar species such as the Eurasian Griffon (Arroyo et al. 1989; del Moral and Martí 2001; del Moral 2009). The Eurasian Griffon vulture population has greatly recovered over past decades and a regular census occurs every 10 years. Average values of breeding success around 68% have been recorded for growing populations (Arroyo et al. 1990; Xirouchakis 2010 and references therein). We report values lower than this average especially in 2012 for Skeerpoort, Moletjie and Kransberg.

Due to lack of observers, it was not possible to monitor all colonies at the optimal time, i.e. just after egg-lay, hatching time, and just prior to fledging. Temporal observation biases may have created these observed fluctuations. For instance, if the third count occurred after many fledglings have flown out of the nest, actual breeding success would be under-represented. This is a possible explanation for the low breeding success reported at Moletjie in 2012 as the final count was conducted in late October. However, Moletjie's breeding success increased to within the expected range (77%) when inferred fledglings were included in the calculation.

The Magaliesberg colonies were always monitored only in the early mornings when visibility was best and birds were more likely to be roosting. Other colonies were monitored in the early morning and throughout the day. Poor visibility could have influenced low recorded fledgling numbers at Kransberg in 2012. Thus these figures need to be seen as minimum values.

The general recovery trend seen in 2014 is widespread and promising. This trend may be attributed to increased localised conservation efforts, including supplementary feeding stations and rehabilitation programmes. Overall, but except the Magaliesberg, there is a lack of continuous data regarding breeding pair counts across the entire breeding range. Information is widespread and scattered over different periods and years, making it impossible to determine accurate population numbers (Borello 2004; Wolter et al. 2013). The results of this paper highlight how a trained and skilled team may increase the likelihood of providing good estimations. This is especially a challenge in southern Africa where colonies and roosting sites are often located in remote areas and are far spread, requiring well planned long-distance travel.

Cape Vulture global status

Our monitoring efforts in 2014 counted 1 776 breeding pairs. Compared with the global breeding population estimate of under 4 000 breeding pairs in 2012 (Wolter et al. 2012), these colonies contain approximately 44% of the global breeding population. We recommend other Cape Vulture researchers implement these standardised monitoring methods to allow for comparison and compilation of data.

There is a need for a transnational, coordinated Cape Vulture breeding census over a single breeding season using the same methodology as employed here. A good number of trained ornithologists is required for this task. The need of such a global survey is reinforced by the recent extinction of Cape Vulture colonies on the periphery of the range, i.e. the Waterberg, Namibia (Wolter et al. 2014) and Wabai Hills, Zimbabwe (Piper 1994), as well as the extinction of the previously stable core colony at Roberts' Farm. All are an indication that the population is undergoing unsustainable declines. The current trend of the Cape Vulture distribution agrees with the prediction of extinctions. When a species becomes endangered, its geographical range should contract inwards with the core populations persisting until the final stages of decline (Channel and Lomolino 1999, 2000).

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