Short papers

Tracking data suggest that Oman's Egyptian Vulture population is much larger than expected

Abstract We tracked 12 adult Egyptian Vultures *Neophron percnopterus*, captured at a landfill near Muscat, Oman, in January 2018. By 31st May 2018, none had migrated, although one had moved to southern Iran. Assuming that the tracked birds were representative, it seems likely that the majority of Egyptian Vultures found in Oman in winter are resident. Together with findings from other studies, including counts at landfill sites and surveys of breeding birds on Masirah Island, tracking suggests that the Omani population must greatly exceed the published estimate of 100 pairs. This, and the apparent low level of current threats in Oman, is welcome news for a species suffering steep declines across most of its range.

Introduction

The Egyptian Vulture *Neophron percnopterus* is a medium-sized scavenger that qualifies as globally Endangered, owing to recent and rapid population declines in virtually all parts of its range (Botha *et al.* 2017; BirdLife International 2018). It has suffered long-term declines in Europe (>50% over the last three generations – around 40 years), and there was an approximate 50% decrease in the Balkan population during 2000–03. In India it has declined by >90% in the last decade (Naoroji 2006; Galligan *et al.* 2014; IUCN 2018), presumably due mostly to poisoning by the veterinary drug diclofenac (Cuthbert *et al.* 2006). Breeding populations across Africa have also decreased and its breeding range there has contracted (Botha *et al.* 2017). A relatively healthy breeding population is thought to exist in the Horn of Africa (especially Ethiopia and Djibouti; I. Angelov, V. Arkumarev and H. Reyaleh pers. comms.), although detailed data are lacking. The densest breeding population in the world occurs on Socotra, in Yemen (Porter & Suleiman 2012), while the population on Masirah Island, Oman, has increased about four-fold in recent decades (Angelov *et al.* 2013).

Egyptian Vultures are most often observed singly or in small groups but huge communal roosts (of up to 1,000 birds) have been recorded on Socotra (J-M. Thiollay pers. comm.), and large numbers at rubbish dumps in Turkey (120, V. Arkumarev pers. comm.), Somalia (around 200; Jama 2010) and Oman (100–640; Eriksen & Victor 2013; Al Fazari & McGrady 2016; J. Eriksen pers. comm.), especially during winter. The many vultures visiting dumps in Oman during winter have been assumed to comprise both resident birds and migrants (Al Fazari & McGrady 2016).

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297. Egyptian Vultures *Neophron percnopterus* over Muscat's main landfill, at Al Multaquaa, November 2014.

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298. Egyptian Vultures at the Al Multaquaa landfill site, Oman, November 2015.

We present data from Egyptian Vultures tracked using Global Positioning Satellite (GPS) technology; this, together with other published information, suggests that the population of breeding Egyptian Vultures in Oman is much larger than the most recent estimate of 100 pairs (Jennings 2010). Against a backdrop of regional population declines, this would be a rare piece of good news for an endangered species whose global population is declining.

Methods

In January 2018 we captured 12 adult Egyptian Vultures using padded leg-hold traps (Bloom *et al.* 2007) at Al Multaquaa (23.34°N 58.47°E), the main landfill site for Muscat. This landfill receives the vast majority of the waste from the city and surrounding villages. The birds were fitted with solar-powered GPS tags as backpacks (Meyburg & Fuller 2007). Table 1 provides an overview of the tag types and data collected. Data collection rates varied depending on tag type, the way they were programmed, available solar-generated power, and view of satellites. Programming generally aimed for at least one location (nominal GPS accuracy = 15 m) per hour during the day, and at least one during the night; however, during some periods, some tags were collecting up to one location per second.

We tracked the vultures during January–May, a period which should include both northward migration of non-residents and nesting by resident breeders, and mapped their movements within a Geographical Information System (QGIS Development Team 2018). The median number of locations recorded per vulture between capture and the

Table 1. Summary details of the 12 GPS tags deployed on adult Egyptian Vultures *Neophron percnopterus* in Oman in January 2018.

tag ID	manufacturer/type	deployment date, January 2018	no. locations to 31st May 2018	status as of 31st May 2018
16095	Ornitela 25 g solar GPS-GSM	19th	11,635	transmitting
171325	Ornitela 25 g solar GPS-GSM	14th	12,148	transmitting
171326	Ornitela 25 g solar GPS-GSM	19th	24,050	transmitting
171327	Ornitela 25 g solar GPS-GSM	16th	36,048	transmitting
171328	Ornitela 25 g solar GPS-GSM	20th	28,431	transmitting
171329	Ornitela 25 g solar GPS-GSM	19th	17,920	transmitting
171330	Ornitela 25 g solar GPS-GSM	19th	12,921	transmitting
171318	Ornitela 25 g solar GPS-GSM	20th	30,668	transmitting
139	Aquila 33 g solar GPS-GSM	23rd	1,267	transmitting
95784	Microwave 30 g solar GPS-Argos	20th	1,346	transmitting
47638	Microwave 30 g solar GPS-Argos	20th	1,798	transmitting
52027	Microwave 30 g solar GPS-Argos	22nd	97	transmitting intermittently

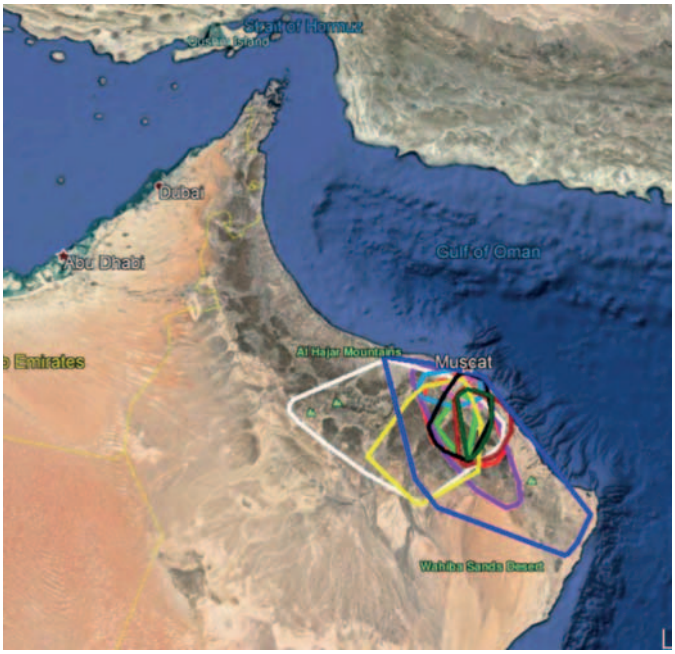

Fig. 1. Minimum convex polygons (95%, see Mohr 1947) of 11 adult Egyptian Vultures *Neophron percnopterus* tracked during January–May 2018 in Oman (see table 1 for tag details). Tag number and associated colour track: 47638 – red, 52027 – green, 139 – blue, 95748 – pink, 171325 – purple, 171326 – white, 171327 – light blue, 171328 – dark red, 171329 – yellow, 171330 – black, 16095 – dark green.

end of May 2018 was 12,535. We continued to track the birds after May 2018, but did not recalculate their home ranges. After May 2018, vulture ranging behaviour varied, and seemed to reflect territoriality and probably the rearing of young for most of the tracked birds. After August, those seemingly territorial birds ranged away from their presumed territories more often. At least one bird (171326) seemed to wander more than the others, and may have been a floater or a territory holder that did not breed in 2018. The egg-laying period for Egyptian Vultures breeding in northern Oman is not known precisely, but Angelov & Yotsova (2012) working on Masirah Island, about 300 km south of our study area, found that eggs were laid between October and April, but mostly in January and February. However, the protracted time of our study meant that even very late migration would have been detected. In Africa and India, Egyptian Vultures lay eggs mostly during January–May (Brown & Amadon 1968; Brown *et al.* 1982; Mundy *et al.* 1992).

Results

All the tagged adult Egyptian Vultures, except one (171318), remained in northeastern Oman during our study, in the Muscat, Ash Sharqiyah North, Ad Dakhiliya and Ad Dahahirah Governates (east of 56.8°E, north of 22°N; figs. 1 & 2). After release and until 22nd April, 171318 moved almost continuously back and forth from Musandam in northernmost Oman to Sur in the east (a distance of about 600 km), almost entirely north of the Hajar Mountains. On

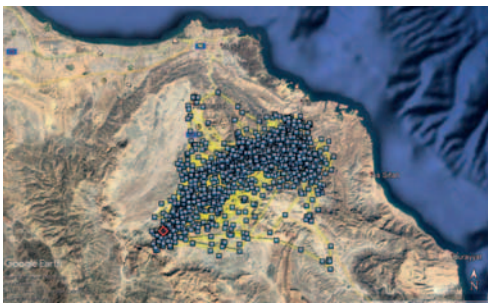

Fig. 2. Movements of a presumed territory-holding adult Egyptian Vulture (tag no. 171325) satellite-tracked during January–May 2018. The presumed territory is in the northeast cluster of locations, and the Al Multaquaa landfill is in the southwest (denoted by the red diamond).

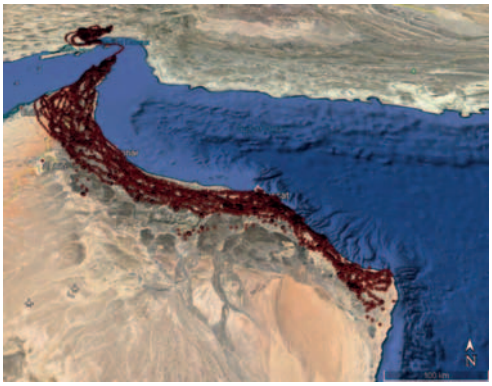

Fig. 3. GPS locations and track from an adult Egyptian Vulture (tag no. 171318) tracked during January–May 2018 (n=30,668 locations), which crossed the Strait of Hormuz and entered Iran.

23rd April it crossed the Strait of Hormuz and entered Iran, and settled there (c. 520 km from the capture location; fig. 3).

Discussion

Some young birds from migratory populations return to breeding areas and some do not (Cramp & Simmons 1980; Yosef & Alon 1997; Meyburg *et al.* 2004; Grande *et al.* 2009; Oppel *et al.* 2015). It is unclear what proportion return, and whether this varies among different populations. However, since Egyptian Vultures are in decline in most areas, there are likely to be vacant territories in many breeding populations, and we anticipate that most sexually mature vultures from migratory populations would migrate back to their breeding areas. This supposition is supported by reports of subadult Egyptian Vultures attempting to breed in the Canary Islands (Donázar *et al.* 2002).

None of the adult vultures that we tracked migrated, although one did eventually leave Oman and settled in southern Iran. Most of the vultures occupied rather restricted home ranges (fig. 1), although we were unable to conduct fieldwork to determine categorically whether or not they were breeding. Nonetheless, the tracking data were highly indicative of most birds holding territories and laying eggs, while results after May suggested that a large proportion of those that were suspected of laying eggs continued to rear offspring. There is no reason to believe that our capture technique was biased towards resident birds, so the tracking data suggest that the large majority of Egyptian Vultures, at least among adults at our capture site where sometimes over 400 birds have been observed in January, are resident (Al Fazari & McGrady 2016; M. McGrady & B. Meyburg unpublished data). Individual tag characteristics, behaviour of the birds and effects of variable solar radiation resulted in some differences in data collection rates, but did not affect our conclusion that the vultures did not migrate.

In addition to the tracked adults reported here, we tracked three juveniles and immature birds captured in Oman during the spring migration period (January–May, in 2016, 2017 and 2018). None of these were seen to migrate: one died from electrocution and two disappeared and their fate is unknown (McGrady *et al.* 2018; Meyburg & McGrady unpublished data).

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299. Michael McGrady and Hamed Al Gheilani (Community Outreach Manager, Environment Society of Oman) releasing a juvenile Egyptian Vulture fitted with a GPS satellite tag, Al Multaquaa, Oman, January 2016.

The large aggregations of Egyptian Vultures observed in Oman, mostly concentrated at rubbish dumps and landfills, are globally remarkable, matched only by large communal roosts on Socotra, where they are year-round residents (R. F. Porter and J-M. Thiollay pers. comms.). Some observations of large groups in Oman pre-date the recent population declines (e.g. 260+ in 1976; Mundy *et al.* 1992), and were generally made during the northern winter (Eriksen & Victor 2013; Al Fazari & McGrady 2016). The numbers using rubbish dumps in winter may indicate that particularly high densities of breeding territories exist in the immediate vicinity, and/or that vultures, including breeding adults, will move long distances to forage, especially in winter.

Until now, the large numbers of Egyptian Vultures in Oman in winter were assumed to be mainly migrants from breeding sites elsewhere, and this is reflected in the national estimate of 100 breeding pairs (Jennings 2010). However, the increase in breeding numbers since 1987 on Masirah Island alone (from 12 to 65–80 pairs; Rogers 1988; Angelov *et al.* 2013) calls into question that estimate. As on Socotra (Porter & Suleiman 2012), it seems likely that numbers of Egyptian Vultures in Oman have increased over the last 50 years (Al Bulushi *et al.* 2013). The country's rapid development and growth in human population during this time has created locally abundant food resources (especially rubbish dumps) and – so far at least – relatively few active threats, although electrocution is known to occur (Tauler-Ametller *et al.* 2017; https://egyptianvultureoman.blogspot.com). Hence, the tracking data from this study, combined with tracking of immature birds (McGrady *et al.* 2018; Meyburg & McGrady unpublished) and observations at rubbish dumps (Al Fazari & McGrady 2016; Environment Society of Oman unpublished data), suggest that resident Egyptian Vultures of all ages use landfill sites in winter, and that the number of breeding pairs in Oman exceeds the national estimate of 100 pairs, perhaps considerably.

A stronghold for breeding Egyptian Vultures is hugely welcome, both in its own right and for its potential to support wider population recovery. Migrant Egyptian Vultures appear to be mostly philopatric, returning to breed close to their own natal sites (Carrete *et al.* 2007, 2009), and this may be true for dispersing vultures from non-migratory populations like that in Oman. Nevertheless, some dispersal to other areas may take place. A healthy population also provides a potential source of birds for conservation projects involving the supplementation of recovering populations (Ceccolini *et al.* 2009; Arkumarev *et al.* 2018) or reintroduction to areas from which the species has been lost.

Assuming that most of the Egyptian Vultures in Oman are indeed resident, their use of waste disposal sites provides opportunities for monitoring the overall population and age-specific trends, their annual productivity, and learning more about their ecology. In addition, the globally large numbers of Egyptian Vultures that can be reliably seen on almost any given day at sites in Oman provide great opportunities for education and conservation, and such opportunities should be seized (McGrady *et al.* 2019).

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Bernd-Ulrich Meyburg, BirdLife Germany (NABU), PO Box 330451, 14199 Berlin, Germany; e-mail BAG-Greifvogelschutz@NABU.de
Michael McGrady, International Avian Research, Am Rosenhügel 59, 3500 Krems, Austria
Maia Sarrouf Willson and Asma Al Bulushi, Environment Society of Oman, Ruwi, Sultanate of Oman