

Short Note

Alarming decline and range reduction of the highly threatened Great Bustard *Otis tarda* in Morocco

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A Great Bustard *Otis tarda* survey carried out in spring 2015 in Morocco confirmed the decline of this highly endangered population. Bustards were only seen at two of the seven leks occupied ten years ago. The total number of birds counted was 40–44, which represents a 40% decline over the last decade. The sex-ratio was still strongly female-biased (1 male: 3 females), but less than in previous surveys, which suggests that trophy hunting has not been the major mortality cause in recent times. The productivity was 0.29–0.33 juveniles per female, the highest ever recorded in this population, suggesting that breeding success doesn't represent the main problem for the survival of this population. Based on the recent development of the power line network at some areas, the main threat today is probably collision with power lines. Reducing this mortality cause should be considered a high conservation priority.

Déclin alarmant et réduction de l'aire de répartition de la Grande Outarde *Otis tarda* au Maroc, une espèce hautement menacée

Une étude chez la Grande Outarde (aussi appelée Outarde barbue) *Otis tarda* menée au printemps 2015 au Maroc confirme le déclin de cette population hautement menacée. Les Outardes n'ont été observées que sur deux des sept leks occupés 10 ans plus tôt. Le nombre total d'oiseaux comptés est de 40–44, soit un déclin de 40 % au cours de la dernière décennie. Le sexe ratio, toujours fortement biaisé en faveur des femelles (1 mâle : 3 femelles), l'est toutefois moins que lors des études précédentes, suggérant que la cause majeure de mortalité n'est pas liée à la chasse aux trophées. La productivité, de 0.29–0.33 descendants par femelle, est la plus forte jamais enregistrée pour cette population, suggérant que le succès reproducteur ne représente pas le problème majeur pour la survie de cette population. En considérant le récent développement des lignes électriques dans certaines zones, la collision avec celles-ci constitue probablement la principale menace. La réduction de cette cause de mortalité devrait être considérée comme une priorité absolue de conservation.

Keywords: conservation, endangered species, Great Bustard, *Otis tarda*, population decline

Between 9 and 13 March 2015, a team of Moroccan and Spanish observers carried out a census of the Moroccan population of Great Bustards *Otis tarda*, currently the world's most endangered population of this species, and the only surviving in the African continent. The objectives were to (1) update its status, (2) confirm whether the population had declined as predicted one decade ago when the last spring surveys were carried out (Alonso et al. 2005a), and (3) provide the baseline for a rigorous definition of

the urgent conservation measures to save this highly threatened population from extinction.

We concentrated the survey effort on the seven zones (lek areas, where Great Bustards aggregate for mating) defined in Alonso et al. (2005a). The good weather conditions, with light winds and temperatures of 8–25 °C, and the absence of heavy rain in the preceding weeks allowed access to all breeding sites without major difficulties. As a rule, two teams worked simultaneously in the same lek area, in order to

survey it within the minimum time possible. Both teams were in contact via mobile telephones to avoid double counting. Each team consisted of 3–4 observers, operating from a 4 × 4 vehicle, and using binoculars and 20–60× telescopes, GPS, aerial photographs and 1:50 000 maps to locate the birds. Surveys were carried out during the morning (06:30–11:00 GMT) and evening (16:00–18:30 GMT), when the birds are active. Three age classes were distinguished in males: juveniles, those hatched in the previous year; immatures, aged 2–3 years; and adults, aged >4 years (Alonso et al. 2006). Female ages cannot be distinguished in the field. In the areas where no birds were found, farmers and shepherds were interviewed about recent and past sightings of the species. With the exceptions of Mrhitane and Had-Kourt, all other lek areas were visited more than once on different days, to confirm numbers.

As an index of annual productivity of the species, we used the number of juvenile birds per non-juvenile female. To calculate this number, juvenile males were counted and juvenile females were estimated multiplying the number of juvenile males by 1.67, the mean sex-ratio of a large sample of juveniles counted in September each year between 1995 and 2014 in the Madrid region, Spain (JCA, CP et al. unpublished data). The sex-ratio did not change significantly between September and the following March in a sample of 328 radio-tagged juveniles tracked between 1991 and 2003 (JCA et al. pers. obs.). The sum of male and female juveniles was then divided by the number of non-juvenile females (i.e. total females counted minus the estimated number of juvenile females).

Great Bustards were seen only in two lek areas (Araoua and Tleta-Rissana), but not in the other five leks identified in Morocco in previous years (Table 1). The total number of birds counted was 40–44 (7–8 adult males, one immature male, three first-year males and 29–33 females; Table 1). Allowing for a few females that could have remained unnoticed in Tleta-Rissana (see details under 'Tleta-Rissana' below), the number of Great Bustards in Morocco could be estimated at a maximum of 50 birds. This is 30 individuals less than those estimated in 2005 (Alonso et al. 2005a), and represents a c. 40% decline in only 10 years, confirming the critical conservation status of the

species in Morocco. The current survey also updates the estimate for Morocco given in the Red List of Threatened Species (BirdLife International 2013). Over the last decade, Great Bustards have strongly decreased or disappeared in leks where numbers of birds, particularly of males, were already small between one and two decades ago, whereas Araoua, the lek where numbers were highest, has increased. This pattern of lek extinction and reorganisation follows the conspecific aggregation trend observed in other regions subjected to human pressures (Alonso et al. 2004).

The sex-ratio is still strongly female-biased, with 11–12 males and 29–33 females (up to 40 females if we add some possibly undetected females in Tleta-Rissana). This sex-bias remains within the range of values recorded in 1999–2005 (Alonso et al. 2005a). It shows that, in spite of the higher male mortality typical of this species, the number of males has remained unchanged since 2005, suggesting that trophy hunting, which concentrates on males, has not been the major mortality cause in recent times.

Three first-year males were observed and five first-year females estimated, according to the average sex-ratio among juveniles obtained from a large sample of birds in Spanish populations (see details above). This represents a productivity of 0.29–0.33 juveniles per female in 2014 (i.e. eight juveniles produced by the 24–28 non-juvenile females estimated), which is much higher than the average for Spanish areas (c. 0.15; Morales et al. 2002; Alonso et al. 2003, 2005b; JCA, CP et al. unpublished data), and also higher than values recorded in Morocco in previous years (0.04–0.27 for 1998–2013; Alonso et al. 2000a; Hellmich and Idaghdour 2002; Alonso et al. 2005a). Juvenile productivity in Morocco is particularly high compared with that in Andalusia (Alonso et al. 2005b), reflecting a fundamental difference between these two neighbouring populations. In Andalusia, the cause of such a poor annual recruitment was the lack of food for chicks (mostly invertebrates, but also weeds) due to the intensive agricultural regime, but this doesn't seem to be the case in Morocco. Contrary to the Andalusian situation, the reasonably high annual recruitment of juveniles in Morocco (Alonso et al. 2005a; this study) doesn't represent the main problem for the survival of the population. Although we do not rule out that a number

Table 1: Results of the Great Bustard census carried out in Morocco in March 2015, compared with the last published spring count (last column, see Alonso et al. 2005a). In parentheses is the maximum number estimated (see footnotes for details)

Lek	Males			Females	Total	Total counted in 2005
	Adults	Subadults	Juveniles			
Kanouat	0	0	0	0	0	5
Araoua ^a	6 (7) ^a	–	3	28–32	37–41 (42)	16
Chekbouchan	0	0	0	0	0	15
Tendafel	0	0	0	0	0	17
Tleta-Rissana	1	1	0	1 ^b	3 ^b	17
Mrhitane	0	0	0	0	0	0
Had-Kourt	0	0	0	0	0	1
Total	7 (8)	1	3	29–33	40–44 (45)	71

^a The seventh adult male was seen displaying at a new site during a second visit to the lek, when all other males were already out of sight; in January 2015 seven non-juvenile males were seen here (AO pers. obs.), suggesting that seven could also be the true number of males attending this lek

^b In Tleta-Rissana we may have missed a flock of females, not yet arrived at the lek from its wintering area (see text for details)

of nests and chicks are destroyed every year either by humans, feral dogs or other predators, and that low productivity in certain years and leks might have contributed to some local extinctions, immediate efforts should be directed nowadays with higher priority towards decreasing adult mortality (collision with power-lines and poaching).

Below we briefly describe the main survey results at each lek area (see locations of each lek in Alonso et al. 2005a).

Kanouat: We surveyed this area twice and observed no Great Bustards. This site is probably abandoned as a permanent display site, confirming the trend observed between 1999 and 2005 (Alonso et al. 2005a). The small size of this lek, its marginal location and its proximity to Tangier, where new developments were recently started (highway and high-speed rail line between Rabat and Tangier), made bustards particularly vulnerable to collision with power lines and poaching.

Araoua: With the exception of three new power lines and a new asphalt road, this area has remained in a good state, and currently offers adequate habitat and breeding conditions for the species. It can be considered the last sanctuary for Moroccan Great Bustards, and conservation efforts should be concentrated with highest priority in this area.

Chekbouchan: No bustards were seen in this area, which might have been abandoned as an independent lekking area due to its proximity to Araoua.

Tendafel: No birds were seen here during two morning surveys, which suggests that it has been abandoned. The constant traffic of heavy vehicles starting some years ago to build the highway and continuing today for the high-speed train has probably contributed to make this area less attractive to the bustards.

Tleta-Rissana: We could have missed here a female flock not yet arrived from an unknown wintering area. This reasonable suspicion is based on the following facts: (1) in most Spanish populations females are partial migrants, using wintering areas at variable distances from their breeding areas, and most frequently southwards from them, returning to mate at the leks sometimes as late as early April (Palacín et al. 2009, 2012); (2) numbers of females at Tleta-Rissana varied between five and 14 in 2001–2005, and it is improbable that all these females and their successors have disappeared or moved to other leks in just 10 years, given their strong philopatry (Alonso et al. 2000b; Magaña et al. 2010, 2011); (3) it is improbable that the increasing female-bias recorded in the sex-ratio during 1999–2005 has reverted its trend in the last decade, and therefore one should expect more than 33 females in a population currently with 11–12 males; (4) as a general rule females more readily go unnoticed during surveys due to their lower detectability, higher mobility and lower fidelity to the lek centre compared with males; and (5) in spring 2016, a local farmer observed a flock of 11 birds including undetermined numbers of males and females just 200 m north of where we observed the two males and the female in March 2015 (Mr Benaïssa, pers. comm. to REK, April 2016).

Mrhitane and Had-Kourt: Both teams surveyed these areas and saw no bustards. The absence of birds here was confirmed by interviews to various farmers and shepherds who told us that no bustards had been seen in recent years.

The intensive cultivation regime established here some decades ago has surely contributed to the disappearance of the species.

Moroccan Great Bustards have declined from 71 birds counted (c. 80 estimated) in 2005 to 40–44 counted (c. 50 estimated) in 2015. This 40% decline in only 10 years follows the negative trend observed in previous decades, and confirms the extremely critical situation of the species in the country (Palacín et al. 2016). Urgent conservation measures are needed in order to prevent the extinction of this highly threatened population, the only extant population of Great Bustards in Africa. Although measures reinforcing breeding success are desirable, the consistently high productivity values recorded suggest that adult mortality represents currently the main threat in Morocco, and thus any human-induced adult mortality cause should be eliminated or reduced. Adult mortality was already identified a decade ago as the main factor causing the demographic decline, but based on the rapid development of the power line network in recent years at some areas, we think this represents now a much more serious threat than poaching, confirming predicted trends (Alonso et al. 2005a; Palacín et al. 2016).

Marking all power lines with anti-collision devices at the most important lek areas should be considered a high conservation priority. Even burying some of them should be regarded as a necessary measure to reduce adult mortality. In addition, an intensive and permanent surveillance of all existing breeding areas by full-time, specialised guards is highly recommended, in order to further reduce illegal hunting, and contribute to the awareness of the local population about the critical situation of the species. Finally, some agri-environmental measures directed to improve habitat quality would help maintain or even enhance a successful breeding. These measures have recently been compiled in an Action Plan 2015–2025 (IUCN and HCEFLCD 2016). Numbers of Great Bustards in Morocco are at present similar to the minimum numbers reached two decades ago in Germany and Austria (in both countries, c. 60 individuals in the 1990s; Förderverein Grosstrappenschutz 2015; Raab 2015), which shows that extinction of the species could theoretically be avoided in Morocco, provided the necessary conservation measures are urgently implemented.

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References

- Alonso JC, Lane SJ, Dawson R, Idaghdour Y. 2000a. Great bustards *Otis tarda* in Morocco: status in spring 1999 and evidence of a decline in recent decades. *Oryx* 34: 141–146.
- Alonso JC, Magaña M, Martín CA, Palacín C, Alonso JA. 2006. Field determination of age in male great bustards (*Otis tarda*) in spring. *European Journal of Wildlife Research* 52: 43–47.
- Alonso JC, Martín CA, Alonso JA, Palacín C, Magaña M, Lane SJ. 2004. Distribution dynamics of a great bustard metapopulation throughout a decade: influence of conspecific attraction and recruitment. *Biodiversity and Conservation* 13: 1659–1674.
- Alonso JC, Martín CA, Palacín C, Magaña M, Martín B. 2003. Distribution, size and recent trends of the great bustard *Otis tarda* population in Madrid region, Spain. *Ardeola* 50: 21–29.
- Alonso JC, Martín CA, Palacín C, Martín B, Magaña M. 2005b. The Great Bustard *Otis tarda* in Andalusia, southern Spain: status, distribution and trends. *Ardeola* 52: 67–78.
- Alonso JC, Morales MB, Alonso JA. 2000b. Partial migration, and lek and nesting area fidelity in female great bustards. *Condor* 102: 127–136.
- Alonso JC, Palacín C, Martín CA, Mouati N, Arhzaf ZL, Azizi D. 2005a. The Great Bustard *Otis tarda* in Morocco: a re-evaluation of its status based on recent survey results. *Ardeola* 52: 79–90.
- BirdLife International. 2013. *Otis tarda*. In: The IUCN Red List of Threatened Species. Version 2015.2. Available at <http://www.iucnredlist.org> [accessed 23 June 2015].
- Förderverein Grosstrappenschutz. 2015. Förderverein Grosstrappenschutz e.V. Available at <http://www.grosstrappe.de> [accessed 26 March 2015].
- Hellmich J, Idaghdour Y. 2002. The great bustard *Otis tarda* population in Morocco in 1998–2001. *Bird Conservation International* 12: 19–33.
- IUCN and HCEFLCD (International Union for the Conservation of Nature and Natural Resources and Haut Commissariat aux Eaux et Forêts et à la Lutte Contre la Désertification). 2016. Conservation strategy and action plan for the Great Bustard (*Otis tarda*) in Morocco 2016–2025. Malaga: IUCN/HCEFLCD.
- Magaña M, Alonso JC, Alonso JA, Martín CA, Martín B, Palacín C. 2011. Great bustard (*Otis tarda*) nest locations in relation to leks. *Journal of Ornithology* 152: 541–548.
- Magaña M, Alonso JC, Martín CA, Bautista LM, Martín B. 2010. Nest-site selection by great bustards *Otis tarda* suggests a trade-off between concealment and visibility. *Ibis* 152: 77–89.
- Morales MB, Alonso JC, Alonso JA. 2002. Annual productivity and individual female reproductive success in a great bustard *Otis tarda* population. *Ibis* 144: 293–300.
- Palacín C, Alonso JC, Alonso JA, Martín CA, Magaña M, Martín B. 2009. Differential migration by sex in the great bustard: possible consequences of an extreme sexual size dimorphism. *Ethology* 115: 617–626.
- Palacín C, Alonso JC, Martín CA, Alonso JA. 2012. The importance of traditional farmland areas for steppe birds: a case study with migrant Great Bustard *Otis tarda* females. *Ibis* 154: 85–95.
- Palacín C, Martín B, Onrubia A, Alonso JC. 2016. Assessing the extinction risk of the great bustard *Otis tarda* in Africa. *Endangered Species Research* 30: 73–82.
- Raab R. 2015. Grosstrappe – *Otis tarda*. Die Grosstrappe und die Bemühungen zu ihrem Schutz. Available at <http://www.grosstrappe.at> [accessed 26 March 2015].