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The Great Bustard *Otis tarda* population of the Acıgöl Basin and its northern surroundings, Türkiye

ŞAFAK ARSLAN & LİDER SİNAV

Summary: In 2020 and 2021 we undertook a study of the Great Bustard population of the Acıgöl Basin and its northern surroundings, western Türkiye. Peak numbers were recorded in December 2020, when at least 102 and perhaps as many as 129 birds were observed in the basin. During summer only females were observed, suggesting that males move out of the area after mating. No birds were found in the northern surroundings of the basin, where the species was recorded as recently as 15 years ago. The recent arrival of solar power farms in the region represents a new and potentially severe threat to the remaining population of Great Bustards.

INTRODUCTION

Great Bustard *Otis tarda* is classified as globally Vulnerable on the IUCN Red List (BirdLife International 2023). It prefers large mosaic agricultural areas, where habitat fragmentation and anthropogenic disturbance can decrease habitat suitability (Palacín *et al* 2012). A further threat is the increased use of agricultural chemicals (Zhuo *et al* 2021), which can cause direct mortality and reduce the availability of insect food and the diversity and availability of weed plants eaten by Great Bustards (Moreby & Southway 1999, Gao *et al* 2008).

Türkiye contains important habitats for Great Bustards (Eken *et al* 2006), and 21 of the 184 Important Bird Areas (IBAs) in Türkiye meet, or met, IBA criteria on the basis of their Great Bustard populations. The species is nationally classified as Endangered (Kılıç & Eken 2004). The global population was estimated by Alonso (2014) at 43 847–56 695 individuals (Alonso 2014), and more recently by Kessler (2022) at 29 000–32 500 individuals. By 2004, 70–77% of the Great Bustard population in Türkiye had disappeared due to habitat loss, agricultural intensification and illegal hunting (Goriup & Parr 1985, Özbağdatlı *et al* 2004). The Great Bustard population in Türkiye has been variously estimated at 200–300 breeding pairs (Karakaş & Akarsu 2009), 400–1000 individuals (Alonso & Palacín 2010) and 764–1250 individuals (Collar & Garcia 2020). Özgencil *et al* (2021) suggested that the species' breeding population had shrunk by 20–29% in just five years, and that there are now only 559–780 breeding Great Bustards in Türkiye distributed in two discrete subpopulations. Additionally, Özgencil *et al* (2022) highlighted the marginal and unusual habitat choices of some Great Bustard populations in Türkiye, citing records from islands on a hypersaline lake, an island on a river, a semi-desert plain and a pine forest location. The Great Bustard exhibits highly variable migratory behaviour across populations, including obligate winter migrants (Asia, Russia), facultative migrants (central European populations), and partial winter and summer migrants with differential migratory patterns by sex (Iberian populations) (Morales *et al* 2000, Alonso *et al* 2000, 2001, Palacín *et al* 2009, 2011). Although the exact migration movements in Türkiye are not known (Özgencil *et al* 2021), the breeding populations in Central Anatolia are mostly resident or perform short-distance migrations mainly in response to harsh weather conditions (Kasperek 1989, Özbağdatlı *et al* 2004). The population in Türkiye consists of two subpopulations, separated by the Anatolian diagonal (Ekim & Güner 1986, Özbağdatlı *et al* 2004, Gür 2016, Usta *et al* 2016, Özgencil *et al* 2021).

By researching the breeding and wintering population of the Great Bustard in western Türkiye in 2020 and 2021, we aim to assess the size of the population in the Acıgöl Basin and its northern surroundings, on the western edge of the Great Bustard's distribution in Türkiye, and to identify the threats it faces.

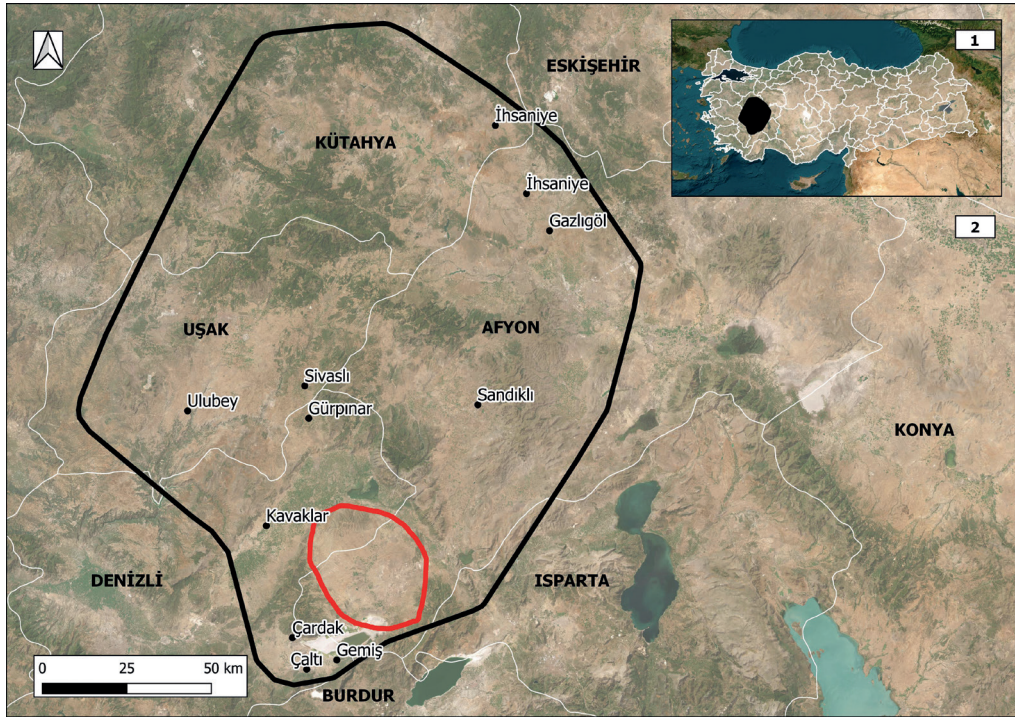


Figure 1. The black polygon shows the study area, the red polygon shows the Acıgöl Basin. Visited village areas in the surroundings of the Acıgöl Basin are shown. Lake Acıgöl itself lies between the cities of Gemiş and Çardak.

METHODS

Study area

Surveys were undertaken in Acıgöl Basin and its northern surroundings, which fall within the provinces of Afyon, Denizli and Uşak in western Anatolia (Figure 1). The area is predominantly steppe grassland within which are areas of arable and pastoral agriculture and fallow areas.

Great Bustard survey

Great Bustard road transect surveys were conducted over 39 days between early April and late December in 2020 and 2021, largely from agricultural roads. Transect routes are shown in Figure 2. Stops were made every 500–750 m according to the field of view (Casas *et al* 2019). Birds seen were marked on the map and their sex recorded. Observations were made in early morning (from dawn to around three hours later) and late afternoon (the last three hours before dusk) when the species is most active (Alonso *et al* 2005). Double counting among consecutive points was avoided by cross-checking maps. In addition to field observations, questionnaire surveys were conducted in village coffeehouses and headmen's offices to gather information on the approximate dates of observations of the species made by local people and on the agriculture of the area. Threats were recorded in the field using the standardised codes of the IUCN threat list (IUCN 2023).

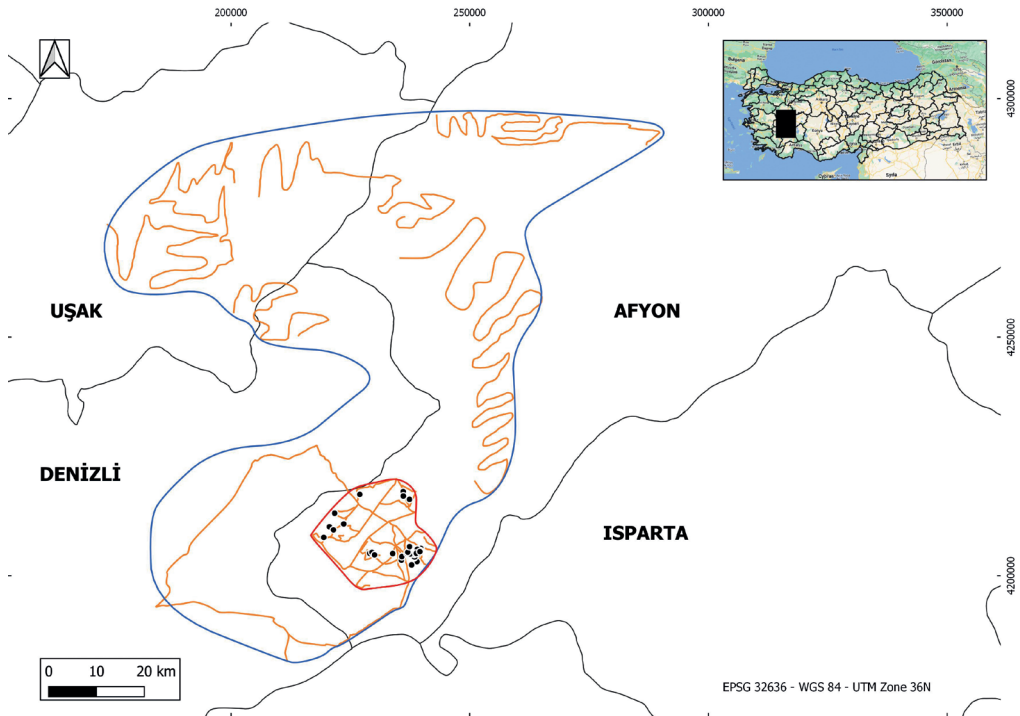


Figure 2. Transect routes driven during Great Bustard surveys. Black dots in the Acıgöl Basin indicate the locations of Great Bustards recorded during field surveys. These are not shown at higher resolution for fear they could be used by hunters. No Great Bustards were recorded outside the Acıgöl Basin.

RESULTS

The location of the road transects and of the Great Bustards recorded are shown in Figure 2. Detailed information on the location of Great Bustards has been withheld due to fears it could be used by hunters. Since the field studies were carried out in different seasons and locations, the survey results are given separately by month.

Survey results

16 July 2020

The field research started in the easternmost region of the Acıgöl Basin (Figure 1, red polygon). Three Great Bustards were observed in pasture area and five in fallow areas, then eight female birds in a wheat field (Plate 1). Farmers also confirmed the presence of the species in this area. There are large pastures and fallow regions around these villages. Our survey continued in the area to the southwest of the Acıgöl Basin. No Great Bustards were recorded in this region. Agricultural products such as cowpea, wheat, corn and sunflower were recorded in the area. The presence of pasture areas was less than around the easternmost region of the Acıgöl Basin. We conducted fieldwork in agricultural fields near the southwest corner of the Acıgöl Basin around midday. Sunflowers and wheat are produced in the plain, and pasture areas are on the hills. The survey continued near the easternmost region of the Acıgöl Basin at around 4:00 pm, where we had found the birds in the morning. Five female birds were recorded resting in the shade of a pear tree *Pyrus*. Later, four female birds were seen near the spot where five birds had been recorded in the morning. Other individuals were seen but we could not be sure if they were birds that



Plate 1. Great Bustards *Otis tarda*, Acıgöl Basin, July 2020. © Lider Sinav

had previously been counted. The last surveys of the day were made in agricultural fields near the southwest corner of the Acıgöl Basin. Sunflowers and wheat are produced in the plain, and pasture areas are on the hills. No Great Bustards were recorded in this region.

Data from the interviews conducted with farmers in the region and the results of the fieldwork data were consistent regarding the presence of birds. We assessed that a minimum of 14 and a maximum of 18 birds were present in this area during the day.

17 July 2020

Field research started in the southwest of the Acıgöl Basin. This is known to be a lek area (previous research of Doğa Derneği). A female Great Bustard was seen in a harvested field in the early hours. During interviews, we learned that the previous year eggs of Great Bustard were found in the region, suggesting that the region retains a breeding population.

The survey continued near the southwestern-most part of the Acıgöl Basin, but no Great Bustards were seen. As a result of interviews held in the south of the Acıgöl Basin, two new locations of Great Bustards were identified. We therefore surveyed these areas southeast of the Acıgöl Basin, recording three female birds in pasture. The same area was visited later in the day and the same three birds were still present. Later the survey continued in the hilly area south of the Acıgöl Basin, where 10 female birds were observed; when we returned later in the day the number had risen to 15 birds. Thus there was a minimum of 19 birds in this area, one in the south-western part of the Acıgöl Basin and 18 birds in the south-eastern part.

18 July 2020

Fieldwork started in the hills south of the Acıgöl Basin, where five birds were recorded. The area in the southwest of the Acıgöl Basin was investigated, but no birds were seen. The area is heavily cultivated with sunflowers, corn and wheat. There is intense grazing in pasture areas in the southern part of the Acıgöl Basin and no Great Bustards were recorded there. Three female Great Bustards were seen in the southeastern part of the Acıgöl Basin in a wheat field. In addition, the Baklan and Çardak Plains were surveyed

by the team. Interviews with villagers in the tea houses of the villages in these two plains suggested that Great Bustard is present on the Baklan Plain.

9 October 2020

Fieldwork started in the southeast of the Acıgöl Basin. First, eight birds and then four birds were recorded at the border of a cornfield and fallow field, the latter perhaps part of the initial group of eight. Later, 13 birds were recorded on the hills southeast of the Acıgöl Basin. Including one bird that was recorded far away from these birds, at least 14 and at most 21 Great Bustards were recorded in the pasture area, all females. According to interviews with the villagers, male birds leave the Acıgöl Basin after the mating season. Another area in the southeast of the Acıgöl Basin was also defined as the lek area (previous research of Doğa Derneği), but no Great Bustards were recorded there. In the afternoon, no birds were recorded along the southern part of the Acıgöl Basin. The statements of the villagers of the southern part in the basin about the number of Great Bustards sighted were consistent with our observations.

10 October 2020

Fieldwork started in the southwest of the Acıgöl Basin, but no birds were recorded. Later, we continued in the direction of the south-westernmost part of the basin, but no birds were found. Ten birds were later recorded in the southwestern part of the basin at the border of a sunflower field. Later in the day, we again found this flock in the same place. Later, nine birds were recorded close to the original group, thus a total of 19 birds was recorded in the area. During meetings with the locals, we were informed that Great Bustards occur in the northern part of the Acıgöl Basin. Later, we visited the western part of Lake Acıgöl in the province of Denizli, but no birds were recorded there.

11 October 2020

Fieldwork started on the saline plains and extended towards Lake Acıgöl, in the north-eastern part of the lake. No Great Bustards were seen and the habitat and livestock pressure suggest that it is not a suitable area for the species. Later, the southern part of the Acıgöl Basin was investigated, but no birds were seen. Field research continued to the easternmost of the Acıgöl Basin, where opium poppies are planted, but no birds were recorded. According to the villagers, Great Bustards favour fields of opium poppies. We learned that there are Great Bustards in the fields in the northern part of the Acıgöl Basin, and three birds were recorded there during the field studies by locals. Later, we recorded four birds near the opium poppy field, with possibly up to seven birds in the area.

In October, the population size in the Acıgöl Basin was estimated at between 28 and 47 birds.

23 December 2020

Fieldwork started in the south-eastern part of the Acıgöl Basin, later moving to the southern part, but no birds were recorded. In the afternoon, 12 birds were recorded in a fallow area, in the southeast part of the Acıgöl Basin, and 45 birds were recorded in the pasture area, close to the south-easternmost edge of the basin. Later, observations were made in the southern part of the Acıgöl Basin, where stray dogs were seen. Intense irrigation activities were detected in the plain south of the basin.

24 December 2020

The field survey started in the morning in the western part of the Acıgöl Basin. Later, the south-western part of the basin was visited, and 30 birds were recorded in flight. 15 birds

were recorded below the hill on the way towards the north-western part of the village. Later, 27 birds were recorded near the northern part of the basin in the pasture area, four of them males.

We estimated that at least 102 and at most 129 Great Bustards were present in the Acıgöl Basin in December 2020.

1–8 April 2021

Field surveys moved into the northern surroundings of the Acıgöl Basin, with the aim of finding new breeding colonies in the west of Türkiye. The first surveys were therefore carried out during the Great Bustard lek period. Field observations and interviews with local people were conducted in suitable habitats in Uşak, Denizli, and Afyon Provinces (Figure 1). The districts of Ihsaniye, Gazlıgöl, Sivaslı, Ulubey, Sandıklı, and Gürpınar were visited. However, no birds were recorded. Later, from the local interviews, it was learned that Great Bustards used to live in the region but had not been seen for many years. It was noted that the name Great Bustard (Turkish name: Toy) is used in local place names; there are local areas called 'Toy Plain' in Sivaslı and 'Toy Found' in Gazlıgöl. Breeding activities and eggs were found in these areas up to around 15–20 years ago. Recently, it has been reported that the bird is now seen here only during migration periods. Extensive field studies were conducted in the mentioned areas, but no birds were seen. Production patterns in the region have changed, and legumes have been replaced by products such as opium poppies.

8–15 July 2021

In the study area in the northern surrounding of the Acıgöl Basin, searches were carried out in July for the presence of the Great Bustard, and the regions of Sivaslı, Gazlıgöl, Gürpınar were visited but no birds were found. The interviewees questioned in April were questioned again but no further information was forthcoming.

20–27 December 2021

The northern surroundings of the Acıgöl Basin were visited during the winter period. Due to the lack of human activities in the area during winter, it was thought that Great Bustards might use the area, but no birds were recorded. As a result of further interviews, we learned that no sightings had been made by local people during the year.

Agricultural production in the study area and habitat use by Great Bustards

Of the 14 encounters with Great Bustards (single birds or flocks) in the Acıgöl Basin for which we could confidently ascertain which habitat they were using (excluding birds seen in flight), five were in pastures, three on fallow land, three in wheat, and one each in fields of corn, sunflowers and opium poppy. Other habitat types recorded in the Acıgöl Basin that were not occupied by Great Bustards included barley, safflower and cowpea, but some of these were minority crops. Most of the same habitat types were recorded in the northern surroundings of the Acıgöl Basin, where no Great Bustards were recorded, with the exception of barley, safflower and cowpea.

DISCUSSION

The results of our survey indicate that a viable population of Great Bustards survives in the Acıgöl Basin but that populations that previously occupied the areas to the north of the Basin disappeared around 15–20 years ago. It appears that the area is used differently by the sexes, with only females being recorded during the summer. The first sightings of males were made in December, when Great Bustard flocks reached their greatest size

in the study year. The seasonal disappearance of males has also been noted in central Spain, where males move up to 167 km from their breeding sites immediately after mating (Alonso *et al* 2001).

Several threats in the Acıgöl Basin area are likely to affect the Great Bustard population. Industrial farming is viewed as the main threat in the Acıgöl Basin. The potential benefits to Great Bustards of wheat farming on a broad scale are reduced by the disturbance caused by mechanical harvesting, which might also cause chick or fledgling mortality in the area. Therefore, fallow lands are likely to be of crucial importance for Great Bustards. Plots of fallow lands left within the continuous cereal fields may benefit Great Bustard populations, allowing Great Bustard families to use these habitat patches as refuges when cereals are harvested (Magana *et al* 2010). According to our surveys, fallow lands in the Acıgöl Basin continue to cover a significant area. The existing habitat structure should be preserved to help the Great Bustard persist in the basin.

Across the basin, there are hunting activities for species such as Common Quail *Coturnix coturnix* and European Hare *Lepus europaeus*. This might lead to illegal hunting of Great Bustards. Unintentional or intentional effects of hunting are an important potential threat that may cause loss of individuals and disturbance. Further disturbance is caused by the establishment of irrigation systems and ploughing. In addition, we found evidence of eggs being collected by local people. Smallholder grazing, ranching or farming may pose another threat in the area; shepherds with large herds of sheep may cause significant disturbance to Great Bustards in the Acıgöl Basin. Also, overgrazing has a serious negative impact on pasture lands. Overgrazed pastures have poor vegetation cover, negatively impacting the species' nesting preferences. Females probably avoid these overgrazed pastures because the level of protection is low when they have chicks, as shown elsewhere (Magana *et al* 2010). Smallholder farming may be another threat in the area because it causes habitat transformation and fragmentation by establishing habitat patches unsuitable for the Great Bustard, such as maize and sunflower farmland (Spakovszky *et al* 2020).

Roads and railways cause habitat fragmentation and noise pollution in the Acıgöl Basin and its northern surroundings, and the area is fragmented by paved and unpaved roads. This enhances the negative effects of disturbance and other human-related threats (Lopez-Jamar *et al* 2011). Utility and service lines, such as electrical and phone wires, are a well known threat to the species (Janss & Ferrer 2000). Moreover, groundwater abstraction for agricultural use causes new boreholes, which require the construction of new power lines. The new construction of power lines involves a significant risk of collision (Palacín *et al* 2016). During our fieldwork at the start of 2024, we recorded three solar power farms south of the Acıgöl Basin, close to the hilly areas where Great Bustards were recorded. These were installed in one of the species' known gathering areas, and during fieldwork we recorded eight Great Bustards flying very close to the solar farms. These solar power farms will cause not only fragmentation and loss of habitat but also pose a collision risk for Great Bustards because of their associated power lines (Bennun *et al* 2021, Silva *et al* 2023). Solar farms are becoming widespread in the basin, and pose what could become one of most severe threats to Great Bustards in the area.

There is only one airport in the western part of Lake Acıgöl, near the district of Çardak. As the villagers and local bird photographers have stated, Great Bustards used to live in the airport area. This airport probably caused a loss of habitat for the species. Herbicides and pesticides are also a threat to Great Bustards in the Acıgöl Basin area. There are no records of direct poisoning of the species, but indirect effects from the use of herbicides and pesticides are possible. Shepherds and stray dogs live in the villages, roaming where Great Bustards occur and presenting an additional potential threat (Sastre *et al* 2009). However, such records were not frequent during our field studies.

Although there are now no Great Bustards in the northern surroundings of the Acıgöl Basin, we found from questionnaire surveys of local people and by identifying place names relating to the species that the area was used extensively in the past. Its disappearance is likely to have resulted from a change in agricultural production patterns in this area. Agricultural crops such as chickpeas, alfalfa, safflower and wheat have been replaced by opium poppy under political incentives. This change may have reduced the quality of the area for Great Bustards because they consume green plants such as alfalfa and chickpea as well as invertebrates in these areas (Lane *et al* 1999). Since the opium poppy is heavily watered, dependent on high human activity, and chemical poisons are used in many stages of production, Great Bustards may avoid them. Thus, promoting traditional products and production methods may have great benefits for the species.

Karataş *et al* (2021) emphasised that the Acıgöl Basin is one of the most important areas of the Great Bustard in Türkiye. In that study, the numbers recorded were similar to those recorded during our survey. Regular monitoring of the population is required, together with the development of an action plan. Restoration and reintroduction may be required in areas with suitable habitats that are no longer inhabited by Great Bustards. Otherwise, there may be a sharp decline in the number of Great Bustards in the coming years.

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