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Research Article

# A survey on current distribution and habitat suitability of the Great Bustard in West Azerbaijan, Iran

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## Abstract

Great Bustard (*Otis tarda*) as a vulnerable species is exposed to the extinction risk mainly due to habitat destruction and hunting pressure. This study was conducted to assess the species current geographical range and its habitat suitability in north western parts of Iran. Based on previous investigations and observations, I mapped current habitats of the species using GIS and the important ecological variables affecting the species habitat usage were modeled by Ecological Niche factor Analysis (ENFA). The results show that the species geographical range is limited to the areas habitats like Sutav, Yngijeh, Alblagh, and Qazelian Plains. ENFA analysis indicated that Great Bustard tends to live in marginal habitats and is a very sensitive species in the study area. The suitability map depicts that 6.5% of the study area is the suitable for the species, however, this value is not consistent with the current habitats in terms of area and location.

**Keywords:** Habitat Assessment, GIS, *Otis tarda*, Remote Sensing.

## Introduction

Animal species are facing a serious threat due to climate change, population growth, illegal hunting, and habitat destruction (Pinto *et al.* 2005, Starkovich and Ntinou 2017).

Great Bustard (*O. tarda*) has been recently categorized as a vulnerable species on the IUCN Red List (BirdLife International 2016) while it can be regarded as critically endangered species in a national scale (Naderi 2017). Distribution of O. tarda starts from Spain and extends to the East Asia (Alonso *et al.* 2003). In the majority of Iranian reports, O. tarda has been categorized as a species posed to the extinction risk. At present habitat loss due to agricultural intensification, very low abundance, leaving the nests by the females and predatory pressure is the most important cause in the declined *O. tarda* population (Pinto *et al.* 2005, Ambarli and Bilgin 2014, Naderi 2017).

Since habitat is one of the most important factors in species protection, identifying the habitat characteristics is inevitable for biodiversity conservation (Kneib *et al.* 2011, Corbane *et al.* 2015). The destruction of natural habitats due to human activities is one of the most important factors that threaten the survival of many species (Ansari 2017).

Information on the extent, distribution, and condition of natural habitats are essential for maintaining a favorable conservation status (Bell *et al.* 2015, Corbane *et al.* 2015). One of the major requirements to understand the ecology of species is the knowledge of habitat characteristics (Naderi *et al.* 2014). ENFA is one of the current methods for assessment of habitat suitability (Engler *et al.* 2004, Rupprecht et al. 2011, Yesson *et al.* 2012). Habitat suitability modeling helps wildlife managers, with spending less time and cost, to identify threatening factors on habitat (Bahadori *et al.* 2010).

In this regard, Geographical Information System (GIS) and Remote Sensing (RS)

techniques are combined with field works to map the spatial variables (Jacqain *et al.* 2005, Choi *et al.* 2011, Fattahi *et al.* 2014). RS provides opportunities for cost-effective, rapid, and repeatable habitat mapping (Nagendra et al. 2013, Bell *et al.* 2015). Therefore, it is necessary to assess the status and distribution of the species habitats using new technologies for preserving this endangered bird.

## Material and methods

### Study Area

Bukan county, located in West Azerbaijan province in the northwest of Iran, has an area of 249,077 hectares and a population of 224,628 people (Iranian Census Report of 2011). The study area is mountainous and has a temperate climate with cold winters and hot summers. Annual rainfall in this area is about 500 mm. Figure 1 depicts different habitats of O. tarda and their position in the province and Iran.

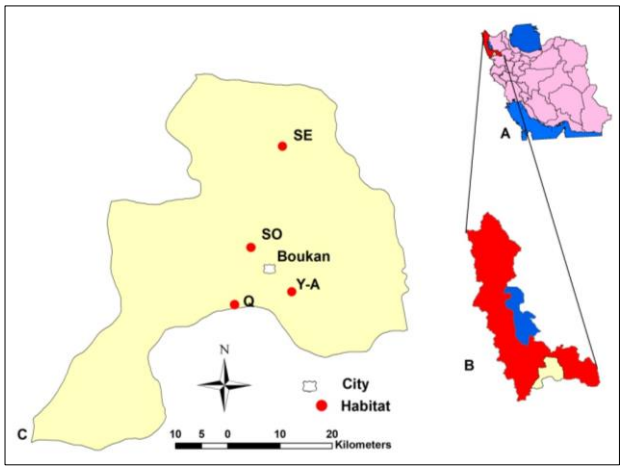


**Figure 1.** Different habitats and locations of Great Bustard in the study area (Sekanian, SO: Sutav, Y-A: Yngijeh-Alblagh, and Q: Qazlian)

As the first step, the needed data and maps were collected and the current habitats of the bird were mapped using the visual interpretation of satellite images analysis, and fieldwork by a GPS device. The area of current habitats was calculated in the GIS environment. ETM+ images of Sutav plain, as the main habitat in the study area, were analyzed for a better understanding of habitats distribution, particularly in relation to the natural, residential, and infrastructure area such as land use/cover, roads, villages, and topography. Moreover, the images were used for mapping the sensitive areas. The biological aspects of the bird were assessed in different habitats and seasons by collecting data from the previous studies, reports, and observations. In the second step, ENFA modeling approach was implemented to summarize all the environmental variables into a few uncorrelated and standardized factors. For this purpose, by studying the bird behavior and literature review, the environmental factors effective on the distribution of the species were selected and then mapped using accessible data, GIS, and satellite data analysis. The county land use map was produced using Landsat 8 images and distribution map of the species was prepared using the presence point coordinates of the species presence recorded by GPS in the past years. To prepare the map of environmental variables, both types of distance and frequency calculation were used. The correlation between variables was calculated and, subsequently, the correlation matrix was obtained. The habitat suitability map was prepared and divided into desirable and undesirable classes, followed by comparing the maps of habitat suitability and habitat itself.

## Results

My data indicated that the habitat of *O. tarda* has been seriously reduced and limited to the Bukan County, Iran (Fig. 2). The area of different habitats is given in Table 1. The total area of habitats is approximately 21365 ha, with Yngijeh-Alblagh as the largest habitat (Area = 9178 ha). The main land use in this area is dry farming with wheat, peas, alfalfa, and sunflower as the main crops. This habitat has a particular importance because it is a fall and winter habitat. The Sekanian as the second large habitat of the

species in the study area with 7308 ha wide. The lands in this habitat are majorly cultivated with wheat, grain, pea, lentil, and alfalfa. Dry farming and traditional cultivation methods with a low human density increase the importance of this habitat. The Qazlian (with an area of about 1000 ha) and other seasonal habitats are located at 4 km southwest of the border of Simineh river.

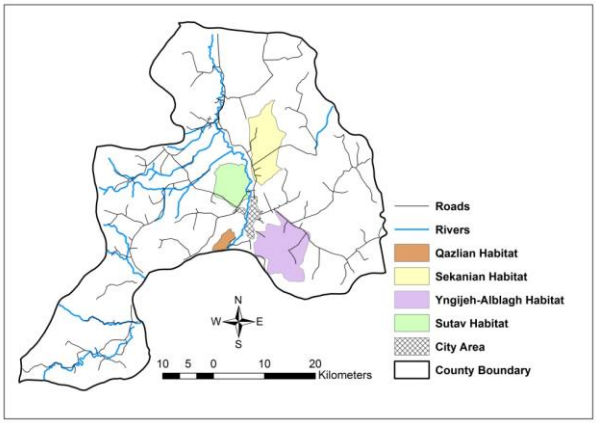


**Figure 2.** The map of roads, main rivers, current habitats, county, and city boundaries

The Qazlian is a winter habitat because of its lower elevation, surrounding by mountains, the existence of plains and different farms, and a moderate temperature. Other low, seasonal, and immigrant lands with an area of about 4000 ha can be regarded as a suitable habitat to the species reproduction considering the areas topography, vegetation cover, and lands farmed with wheat and peas.

**Table 1.** Main presently occupied habitats by the Great Bustard and their area

| Habitat | Area (ha) | Area (%) |
|---|---|---|
| Sutav | 4879 | 18.5 |
| Sekanian | 7308 | 27.6 |
| Yngijeh-Alblagh | 9178 | 34.8 |
| Qazlian and others | 5000 | 19.1 |

About 65% and 32% of the area is located at elevations below 1600 and 1600-1900 m, respectively. Approximately, 62%, 27%, and 11% of the area is in the slope classes of less than 15%, 15-30%, and more than 30%, respectively. The northern and eastern slopes compared to the western and southern slopes occupy a greater area of the county. The number of villages is 173, the length of the road equal 570 km, and the city area is about 1,550 ha. According to the prepared land use map, the main land uses of the study area are residential (4%), irrigating farming (7%), ranges (47%), and dry farming (42%).

## Habitat suitability

The total marginality (1.28) showed that the bird tends to live in marginal habitats and choose higher environmental conditions than the average conditions in the study area. A low tolerability (0.1) and high specialization (9.2) in this study also indicate that *O. tarda* is a special species in the county (Fig. 3). In other words, this species has a low tolerance and a narrow ecological niche. In this study, according to the broken stick model, five factors explained 97% of the total species information.

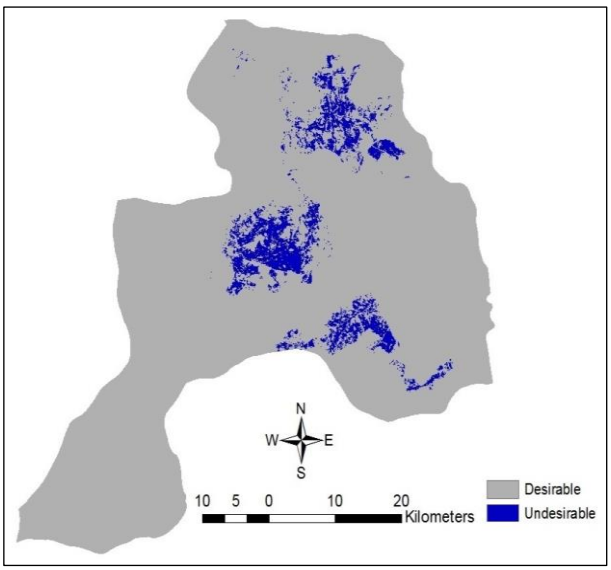


**Figure 3.** The species habitat suitability map

According to the suitability threshold of 35%, the map was divided into two desirable and undesirable classes including 93.5% and 6.5% of the county, respectively.

**Discussion**

As emphasized in the Iran Great Bustard conservation action plan (Naderi 2017) the species abundance has been declined to lower than 30-40 individuals and it can be regarded as critically endangered category in a national scale. The species is completelt dependent to the farmlands with the cultivation of Poaceae and Fabaceae families. As mentioned in previous studies (Abdulkarimi and Ahmadi Sani 2012, Naderi 2017), Sutav plain is the most important habitat of *O. tarda* in the northwest of Iran. Although Sutav Plain has the smallest area in this study, it was determined as the most important habitat because it is a productive habitat in the spring. Furthermore, despite the fact that Yngijeh-Alblagh habitat is the greatest habitat with an area of 9178 ha, it is less important compared to other habitats.

The main cause of this phenomenon might be the destruction taken place in the past few years including the changes in land use due to its proximity to the city and a shift from traditional agriculture to mechanized one. Regarding the higher number of adult birds and reproduction, the Sutav Plain habitat is the most important habitat also in terms of birds' population (Abdulkarimi and Ahmadi 2012).

This study, in line with other works (Phua and Minowa 2005, Dong *et al.* 2013), showed the efficiency of GIS in the mapping of ecological resources and edition, management, processing, and analyzing large amounts of data in habitat assessment. As noted in some studies (Gibson 2003, Hirzel *et al.* 2006, Braunisch *et al.* 2008), ENFA analysis has the ability to compare the variables together in all presence points of species and present the best habitat for species as a map. According to previous studies (Pinto *et al.* 2005, Ambarli and Bilgin 2014), one of the major problems of *O. tarda* is a decline of its habitat area. Not paying attention to this problem in the near future would make the habitat of the species even smaller. The spatial and size incompatibility of the current habitats area with the suitability map indicates that the current habitats map were not properly surveyed. Moreover, for some reason, the birds are not safe and do not live in some areas, despite the ecological suitability. According to the results, the distribution of this species in these habitats has been wider in the past due to several reasons including hunting, climate and land use changes, roads construction, developed residential and industrial areas, and increasing agricultural activities such as machinery traffic, plowing, irrigation, and excessive use of pesticides and herbicides.

This work shows the potential use of GIS and RS technologies to assess habitats suitability and status in the future works. Considering the increasing threats and population decline of O. tarda in Iran, it is necessary to employ new technologies in the evaluation of habitats, and also develop and protect of NGOs and local peoples to preserve the species. Moreover, it is suggested investigating habitat status and suitability in environmental studies and conservation processes for wildlife protection.

## References

Abdulkarimi R., Ahmadi Sani N. 2012. Warning to the Status of Critically Endangered Great Bustard. Journal of American Science 8 (1): 68-72.

Alonso J.C., Palacin C., Martin C.A. 2003. Status and recent trends of the Great Bustard (Otis tarda) population in the Iberian peninsula. Biological Conservation 110(2): 185-195.

Ambarli D., Bilgin C.C. 2014. Effects of landscape, land use and vegetation on bird community composition and diversity in Inner Anatolian steppes. Agriculture, Ecosystems and Environment 182: 37-46.

Ansari A. 2017. Habitat evaluation for Persian Gazelle in the Southern half of Markazi

province, Iran. Journal of Wildlife and Biodiversity 1(1): 19-23.

Bahadori F., Alizadeh A., Kaboli M., Karami M., Atarod P., Mitra Sh. 2010. Habitat suitability modeling of *Sitta europaea* in northern Alborz. Journal of natural environment 63(3): 225-236.

Bell G., Neal S., Medcalf K. 2015. Use of remote sensing to produce a habitat map of Norfolk. Ecological Informatics 30: 293-299.

BirdLife International 2016. "*Otis tarda*". IUCN Red List of Threatened Species 2016.

Braunisch V., Bollmann K., Graf R.F., Hirzel A.H. 2008. Living on the edge- modelling habitat suitability for species at the edge of their fundamental niche. Ecological Modelling 214(2): 153-167.

Choi J.K., Oh H.J., Koo B.J., Ryu J.H., Lee S. 2011. Crustacean habitat potential mapping in a tidal flat using remote sensing and GIS. Ecological Modelling 222(8): 1522-1533.

Corbane C., Lang S., Pipkins K., Alleaume S., Deshayes M., Millan V.E.G., Strasser T., Borre J.V., Toon S., Michael F. 2015. Remote sensing for mapping natural habitats and their conservation status–New opportunities and challenges. International Journal of Applied Earth Observation and Geoinformation 37: 7-16.

Dong Z., Wang Z., Liu D., Li L., Ren C., Tang X., Jia M., Liu C. 2013. Assessment of habitat suitability for water birds in the West Songnen Plain, China, using remote sensing and GIS. Ecological Engineering 55:94-100.

Engler R., Guisan A., Rechsteiner L. 2004. An improved approach for predicting the distribution of rare and endangered species from occurrence and pseudo-absence data. Journal of Applied Ecology 41(2): 263-274.

Fattahi R., Ficetola G.F., Rastegar-Puyani N., Avci A., Kumlutas Y., Yousefkhani S.S. 2014. Modelling the potential distribution of the Bridled Skink, Trachylepis vittata (Olivier, 1804), in the Middle East. Zoology in the Middle East 60(3): 208-216.

Gibson L.A., Barbara A., Wilson D.M., Hill J. 2003. Modeling Habitat Suitability of the Swamp Antechinus (Antechinus minimus maritimus) in the costal heathlands of soutern Victoria. International Journal of biological Conservation 117(2): 143-150.

Hirzel A.H., Laya G.L., Helfera V., Guisana A. 2006. Evaluating habitat suitability models to predict species presences. Ecological Modeling 199(2): 142-152.

Jacqain A., Cheret V., Denux J.M., Mitcheley J., Xofis P. 2005. Habitat suitability modeling of capercaillie (*Tetrao urogallus*) using observation data. Journal of Nature Conservation 13(2): 161-169.

Kneib T., Knauer F., Kuchenhoff H. 2011. A general approach for the analysis of habitat selection. Environmental and Ecological Statistics 18(1): 1-25.

Naderi G.H., Mohammadi S., Imani A., Karami M. 2014. Habitat selection of Williams' Jerboa in Ardabil Province. Turkish Journal of Zoology 38: 432-436.

Naderi M. 2017. Great Bustard Action Plan, Iranian Department of Environment and (DOE) Arak University, 277 p.

Nagendra H., Lucas R., Honrado J.P., Jongman R.H., Tarantino C., Adamo M., Mairota, P. 2013. Remote sensing for conservation monitoring: Assessing protected areas, habitat extent, habitat condition, species diversity, and threats. Ecological Indicators 33: 45-59.

Phua M.H., Minowa M. 2005. A GIS-based multi-criteria decision making approach to forest conservation planning at a landscape scale: a case study in the Kinabalu Area, Sabah, Malaysia. Landscape and Urban Planning 71(2): 207–222.

Pinto M., Rocha P., Moreira F. 2005. Long-term trends in Great Bustard populations in Portugal suggest concentration in single

high quality area. Biological Conservation 124(3): 415-423.

Rupprecht F., Oldeland J., Finckh M. 2011. Modelling potential distribution of the threatened tree species *J. oxycedrus*: how to evaluate the predictions of different modelling approaches? Journal of Vegetation Science 22(4): 647–659.

Starkovich B.M., Ntinou M. 2017. Climate change, human population growth, or both? Upper Paleolithic subsistence shifts in southern Greece. Quaternary International 428: 17-32.

Yesson C.H., Michelle L.T., Derek P.T., Andrew J.D., John G., Amy B., Julie B., Jason M.H., Alex D.R. 2012. Global habitat suitability of cold-water octocorals. Journal of Biogeography 39(7): 1278–1292.