



ORIGINAL ARTICLE

An avifaunal survey of mesic manmade ecosystems “Oases” in algerian hot-hyperarid lands

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Abstract Man made ecosystems of dry lands are key habitats due to their ecological characteristics to survey biodiversity. This study investigated bird diversity in three oases of the Northern Algerian Sahara (i.e., Biskra in 2006, Oued Souf in 2008 and Ouargla in 2009), by using the spot-mapping method. Bird density “*D*” (pairs/10 ha), species richness “*S*” (number species), diversity (Shannon index) “*H*” (in bits), and evenness “*E*” varied from one oasis to another (Biskra: $D = 98.5$, $S = 47$, $H' = 4.49$, $E = 0.81$; Oued Souf: $D = 96$, $S = 33$, $H' = 3.9$, $E = 0.77$; Ouargla: $D = 91.5$, $S = 44$, $H' = 4.39$, $E = 0.80$). Differences in bird diversity between the monitored palm groves are due to the ecological characteristics of each environment. Documented literature outlined close taxonomic similarities between bird assemblages of the study area with many Northern Saharan oases. The Hybrid Sparrow *Passer domesticus* x *Passer. hispaniolensis* and some Columbidae species including *Columba livia*, *Streptopelia turtur*, *Streptopelia senegalensis*, and *Streptopelia decaocto* were the abundant species throughout surveyed oases in which they represented more than half (55.6%) of the sum of species densities ($D = 286$ pairs/10 ha). These synanthropic species have known a huge expansion of their distribution range throughout Algerian oases. The correspondence analysis allowed the aggregation of both families and species into oasis they belong to. One-way ANOVA was tested to analyse variations of both family and species densities between studied oases. The ANOVA revealed there was no significant variation either in family densities ($p = 0.937$) or in bird densities ($p = 0.622$) between the surveyed oases because of the small size of bird populations.

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1. Introduction

Biodiversity has captured the world’s attention since its conservation maintains several ecosystem services and impacts on human wellbeing (MEA, 2005; Harrington et al., 2010). Preserving biological diversity in arid lands, which have severe ecological characteristics; infers deliberate human action to

conserve the diversity of species, populations and ecosystems (Darkoh, 2003). Achieving this goal and implementing this intention means adopting the best possible strategies, which must be based on reliable scientific knowledge (Child, 2003).

Dry lands have been considered as areas of limited interest for biodiversity. However, this perception has changed since researches have now revealed that arid ecosystems are (i) the home to unique species with special characteristics, (ii) the origin of many important crops, and (iii) a significant resource of genes (Shachak et al., 2005). Moreover, the Sahara Desert is the largest and harshest desert worldwide that is characterized by severe edaphic and climatic conditions against the survival of living beings. However, this ecosystem has a very peculiar flora and fauna, which live harmoniously and efficiently by using the limited-resources at their disposal (WWF-World Wildlife Fund, McGinley, 2007).

Man made ecosystems are of high importance in reception and refuge of diverse life forms (C er ghino et al., 2008), including birds, particularly in habitats of hot and arid regions (Roshier et al., 2001; Mwaura, 2010; Chenchouni, 2012). Furthermore, date palm oases are key agrosystems due to their mesic and ecological characteristics for monitoring and assessing faunal diversity in hot-arid lands (Sellami, 2008). It should be noted that oases are considered a type of inland wetlands according to the Ramsar Convention (Ramsar, 2007).

The early data on birds of Saharan oases were published by (Heim de Balsac and Mayaud, 1926; 1962; Etchecopar and H ue, 1964, 1964; Dupuy, 1966). Updated and synthesised data for Algerian avifauna were presented by some workers (Ledant et al., 1981; Isenmann and Moali, 2000; Samraoui and Samraoui, 2008). However, the detailed monitoring, of one to three years, at local scale has been carried out by Boukhemza (1990) and Chenchouni (2012). Similar studies on birds at the oases of southern Tunisia have been undertaken by Selmi (2000). So, the current researches on wildlife animals, including avifauna of Northern Sahara, remain insufficient and often limited to qualitative-fragmentary and/or occasional observations. Therefore, this approach comes as a large-scale regional synthesis on bird assemblage diversity. This study also provides an updated assessment of bird diversity in the oases of Oued Souf, Ouargla and Biskra (Algeria) located at the northern Sahara Desert.

2. Materials and methods

2.1. Study area

Birds' fauna was surveyed in several oases-agrosystems of three regions in the Algerian Northern Sahara i.e., Biskra, Oued Souf and Ouargla. All these oases, either modern (well maintained) or traditional (not maintained), were mainly composed of date palm grove plantations (*Phoenix dactylifera*), which are cultivated on sandy-saline soils. Climate is typically hyper-arid where the drought spreads throughout the year (Chenchouni, 2012). The coldest month is January in both Biskra and Oued Souf, and December in Ouargla with an average temperature of 10.2  C, 11.6  C and 11.4  C, respectively. The hottest month is August in Biskra (37.0  C) and July in Oued Souf and Ouargla with average temperatures of 35.7  C and 38.2  C, respectively. Precipitation occurs in the

winter that extends over almost two months per year. Rainfall amount is characterized by a large interannual irregularity.

- The oasis of Biskra is bordered at the north by the foothills of the southern Saharan Atlas Mountains (Aures Mountains). Birds were sampled from a modern and well-maintained palm grove plantation in the Filiach region (34 50'N, 5 45'E), located 5 km southeast of Biskra city and at an elevation of 87 m above the sea level (Fig. 1). The sampled palm grove included 24 ha of palm trees interspersed with fruit trees including olive, apricot and lemon trees and cereals. There are also green-windbreaks represented by *Casuarina torulosa*, *Eucalyptus* sp. and *Tamarix gallica* (Souttou et al., 2004).
- Oued Souf Region (33 12'N to 33 35'N and 6 50'E to 6 51'E) is located between the southeast limit of Saharan Atlas Mountains and the northern borders of Oriental Erg (Fig. 1). This large sandy region is surrounded by large Saharan wetlands on the three sides; by large salt Lakes "Chotts" of Oued-Righ region in the west, by Chotts Merouane and Melrhir from the north, and by the large Tunisian Chott of El-Jerid from the east. Birds were surveyed in the traditional date palm cultivation system "Ghout" that is well known in Oued Souf, wherein palm trees are grown in large excavation-plots (1–12 ha) that enable palms to directly reach near aquifers without any further irrigation (Remini and Hallouche, 2008).
- Oases of Ouargla (31 58'N, 5 20'E) are located in the southeast of Algeria at 800 km from Algiers (Fig. 1), at a mean elevation of 134 m above the sea level. This area is located at the bottom of Oued Mya Valley and is bordered on the north by Bour El-Haicha. Birds were sampled from traditional (not maintained) oasis of 100 ha of area.

2.2. Bird sampling and data analysis

Census of bird species in each oasis was carried out from February through July, including the breeding season (mid February–May). The spot-mapping method, also known as territory-mapping (Bibby et al., 1992), was used. Birds were sampled in Biskra in the year 2006, in El Oued in 2008, and in Ouargla in the year 2009, where a set of twelve counts were carried out in each oasis (about two counts per month). Sampling duration was 120 min for each count. Within each palm-grove, a plot of 10 ha of area was chosen to record all individual birds seen or heard on a gridded map. The territory-mapping method is considered the most accurate method for measuring species densities (*di*) and then abundance of avian communities (*D*), particularly in open habitats; provided it is applied under favourable weather conditions (Bibby et al., 1992).

2.3. Data Analysis

Relative abundance (RA) was calculated for families by the number of species included in that family/the total number of species recorded in a given area. Species richness (*S*) was estimated by the total number of species or sub-species identified in a given oasis. Shannon index ($H' = -\sum pi \times \log_2 pi$) and evenness ($E = H'/\log_2 S$) were applied for the measurement of bird diversity (α -diversity) in each oasis on the basis of the

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