

## Ecological Diagnosis and Diversity Structure of the Forest Birds Community in Machroha Forest (Souk Ahras – Northeastern Algeria)

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### Cover Page Footnote

The authors of this article are very grateful to all persons assisted us during this study. We also thank all residents of Machroha forest. This article was supported by MESRS (ministère de l'enseignement supérieur et la recherche scientifique) and DGRSDT (direction générale de la recherche scientifique et le développement technologique).

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## ECOLOGICAL DIAGNOSIS AND DIVERSITY STRUCTURE OF THE FOREST BIRDS COMMUNITY IN MACHROHA FOREST (SOUK AHRAS – NORTHEASTERN ALGERIA)

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### ABSTRACT

Machroha forest is a large hot spot of biodiversity of northeastern region of Algeria. It is dominated by several species of oak tree that can contribute to the conservation of many animals such as birds. Our study was carried out from February 2019 to July 2021, in order to diagnosis the ecological status of forest birds and their dynamics. Our results reported that this forest was including 19.21% of the Algerian avifauna diversity. We recorded 78 species of birds classified in 32 families. The main species were sedentary with an insectivorous trophic categories and terrestrial guild. Three species observed in this forest were threatened, the Dartford warbler, the European turtle dove and the Egyptian vulture. We reported many factors that affected bird's population dynamics "such as population isolation and habitat structure". So, in the future the monitoring of the bird's population must follow a management plan and proposing a new national classification status "wildlife refuge".

**Keywords:** Machroha, guild, management, diagnosis, diversity.

### INTRODUCTION

The diversity and composition of forest birds is determined by many factors related to habitat, patch size population dynamics and phenology (Maseko et al., 2020). Currently, the forests all over the world facing many selective and deterministic factors, such as: intensive agriculture, bioresources overexploitation, hunting or poaching and forest urbanization (Morante-Filho et al., 2015). Further, abusive harvesting of species, introduction of exotic species, pollution and climate change also contribute to this alarming phenomenon.

The main target in the Mediterranean forest is safeguarding these natural resources and ecosystem functioning (Matuoka et al., 2020). Venier and Pearce (2004) reported that birds can be used as an indicator of sustainable forest management. But, to maintain birds' richness in forest, it does not necessary

involving the upkeep of ecological function (Mayfield et al., 2010). At this moment, studying guild and trophic behavior of birds allowing distinction between this assemblages (De Coster et al., 2015). Guilds are viewed as one of the basic structural units or building blocks of communities (Korňan and Adamík, 2007). These guilds or functional groups seem to be the main approaches in animal sciences in order to grips with community structure and dynamics (Nally, 1994).

A lot of data on the diversity studies demonstrated that species extinction or change on phenology status is related to a nonlinear function between many factors (Pardini et al., 2010). For example, there is a framework of units that investigate the effectiveness of protected areas at retaining bird diversity. This framework associated at least three units, 1) the protected area (with all law and decree), 2) bird diversity (forest dependant species, endemic species, threatened and

near threatened species), and 3) forest factors (such as deforestation rate, canopy high, forest contiguity, wilderness) (Cazalis et al., 2020).

Notwithstanding, many scientists says that birds migration is depending on temperature and climatic variation (Haest et al., 2018; Haest et al., 2019). This pattern and relationship has been intensively studied in birds' activities at biogeography area around the world. But, little information is given in eastern forest of Algeria.

Our study takes as model fourth approaches concerning the ecological function of Machroha forest on birds' population. The fourth approaches were: 1) richness and diversity, 2) phenology, 3) guild and trophic categories and 4) conservation status. We aim to diagnose the ecological situation in this forest according to birds' composition.

## MATERIAL AND METHODS

Mechroha forest (Figure 1 - 36° 21' 26" N, 7° 50' 08" E) "northeast Algeria - Souk Ahras district" extends over an area of 222 ha and situated between 400 and 1200 m above sea level with an afforestation rate of 73 %. This forest is dominated by cork oak *Quercus suber* and zean oak *Quercus canariensis*, also we observed Eucalyptus trees, Oleaceae and atlas pistachio tress *Pistacia*. It is exposed to a mean temperature varied between 5 °C in January and 38 °C in July and a mean rainfall about 880 mm/year (classified as Algerian humid forest). A stony relief leveled between 218 and 1315 m formed this forest.

This bird survey was carried from February 2019 to July 2021 in Machroha forest. Sampling was done in early morning, rainy or windy days were avoided (Shackleton et al., 2016). Identification of species was done by visual, singing or warning call of each individual. Progressive frequency sampling method was applied; it gives

faster inventory and richness of bird's population (Blondel, 1975). To avoid bias sampling, we established a fragment-transect by selecting a 190 listening sampling points separated by 300 m and covering all forest area (Sekercioglu, 2002). Each listening remains 10-minutes per sampling point in order to avoid disturbance.

We performed four ecological indices: 1) relative abundance of bird species which is calculated using the expression  $n/N \times 100$ ; Where n is number of recorded bird species and N is total number of birds observed. 2) Species richness (S). 3) Shannon-Weaver indices:  $H' = (\sum P_i \times \log P_i)$ . 4) Equitability (E) which is the ratio of the observed diversity (H') to the maximum diversity (H max);  $E = H'/H \text{ max}$  (Shannon and Weaver, 1949; Dustan and Fox, 1996). We also established: the phonological status, the guild association and trophic categories of all birds observed (Bara et al., 2020). The conservation status of all birds inventoried in this forest is listed according to annual IUCN redlist (see IUCN website /update 2022).

Four sites were selected according to the dominance of the vegetation stratum and the homogeneousness of the environment: (CK) cork oak stratum, (ZK) zeen oak stratum, (MX) mixed stratum "cork and zeen" and scrub stratum (Shb).

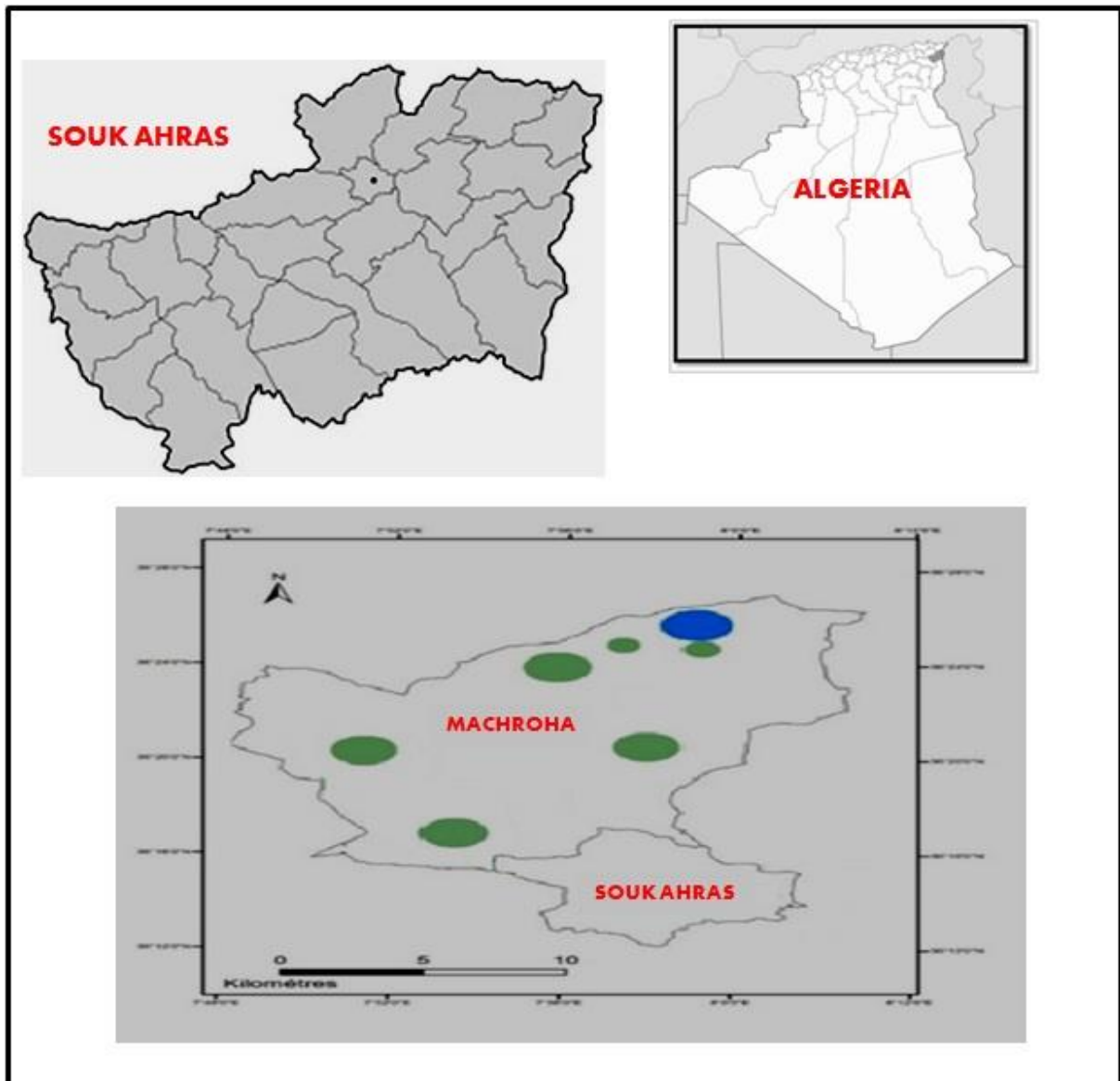
## RESULTS

### *Diversity Distribution*

Figure 2 shows the variability in birds' relative abundance during our survey. We recorded 78 species classified in 32 families. The main family was Muscicapidae (11 species). Followed by Accipitridae (9 species), Fringillidae (7 species), Columbidae, Picidae and Sylviidae (4 species each one), Motacillidae, Paridae, Passeridae and Phylloscopidae (3 species of each one) Corvidae, Hirundinidae, Laniidae,

Pycnonotidae, Sturnidae and Turdidae (2 species of each) Acrocephalidae, Ardeidae, Ciconiidae, Certhiidae, Cettiidae, Cisticolidae, Ciconiidae, Cuculidae, Emberizidae, Falconidae, Meropidae, Oriolidae, Phasianidae, Regulidae, Strigidae, Troglodytidae, Upupidae (1 species of each). The peak number of species was recorded in April and May, but in winter the species richness was decreasing consequently (mainly in December, January and February) (Figure

3). Shannon index ( $H'$ ) values in all biotopes, range in number from 3.627 to 3.981 bits (Table 1). Pielou Equitability index ( $E$ ) fluctuates from 0.853 to 0.933 (Table 1). The occurrence analysis indicated that 64 % of the species are ubiquitous, 24 % of the species are constant, 8 % of the species are regular, just two species are incidental and one species is accidental / rare.



**Figure 1: Geographical location of the study area (Machroha forest – Northeast of Algeria).**

### Phenology Distribution

In Machroha forest, 42 species had a sedentary status, 36 species were observed as migratory: 9 species migrating during winter and 24 species migrating during summer. Three species the whistling warbler (*Phylloscopus sibilatrix*), the common buzzard (*Buteo buteo*) and the collared flycatcher (*Ficedula albicollis*) were recorded as passenger.

### Trophic Distribution

During our survey, the relationship between forest birds' species and their forest plots exploitation describing four ecological guilds; terrestrial guild, arboreal guild, aerial guild and shrub guild. The dominate guild was the terrestrial guild presented by 39 species, followed by the arboreal guild with 18 species, the shrub guild with 11 species and the aerial guild with 10 species.

The forest birds trophic categories shown off six (06) categories. The

insectivorous category dominated by 42 species giving back 54 % of the total richness followed by the granivorous and the carnivorous with 14 species for each category. The omnivorous showed with 4 species, the polyphagous with 3 species and the frugivorous with one category.

### Conservation Status

The most of birds observed in Machroha forest had a least concern status according to the IUCN red list. We recorded three species with a particular status and cited in the IUCN red list, the Dartford warbler *Sylvia undata* as a near threatened species (according to criteria A2b+3b+4b), the European turtle dove *Streptopelia turtur* as a vulnerable species (according to criteria A2bcd+3bcd+4bcd), and the Egyptian vulture *Neophron percnopterus* as endangered species (according to criteria A2abcde+3bcde+4abcde) (see IUCN RedList / update 2022).

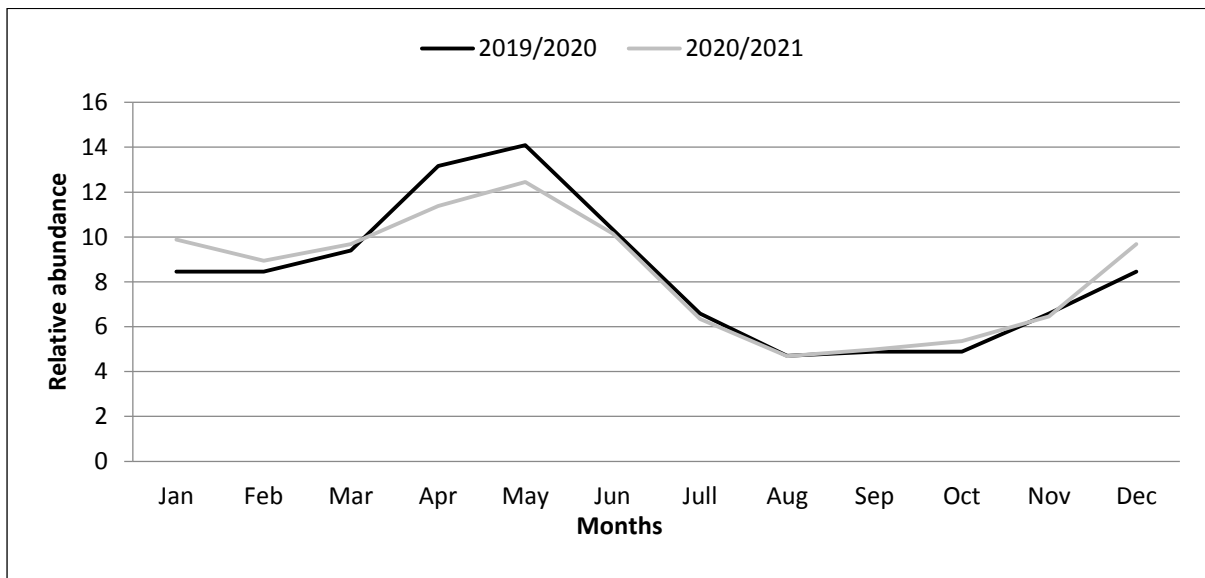


Figure 2: Trend of birds' relative abundance in Machroha forest during 2019 to 2020 and 2020 to 2021.

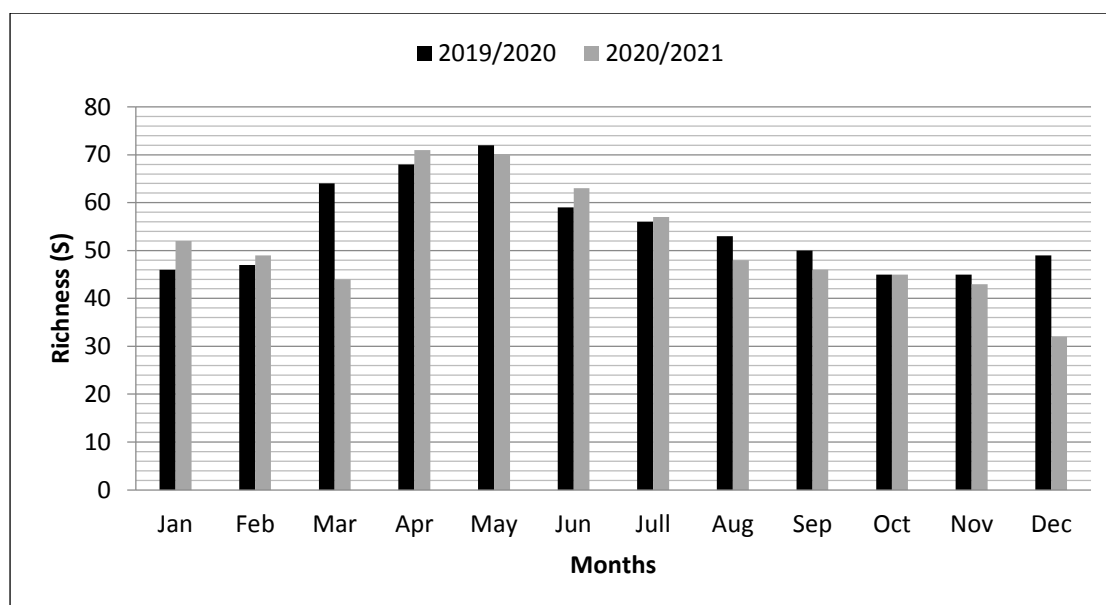


Figure 3: Variability of birds' richness in Machroha forest during 2019 to 2020 and 2020 to 2021.

Table 1: Trend of diversity indexes between 2019 and 2021 in Machroha forest

	2019-2020				2020-2021			
	CK	ZK	MX	Shb	CK	ZK	MX	Shb
Richnes (S)	70	64	74	69	71	66	75	70
Shannon_H'	3.871	3.667	3.847	3.659	3.981	3.759	3.921	3.627
Pielou Equitability_E	0.911	0.881	0.893	0.864	0.933	0.897	0.908	0.853

CK: cork oak, ZK: zean oak, MX: mixed forest, Shb: shrub stratum

## DISCUSSION

We used birds as a biological indicator in ecosystems mainly in forest ecosystems. These can inform us about the ecological diagnosis model in this area. Ecological monitoring of birds allows quickly and instantaneously reacts to all modifications.

This forest was including 19.21 % of the Algerian avifauna. Passeriformes was the dominant taxa with 21 families and 53 species. The most species were insectivores (corresponding to 54 % of the total richness).

This forest seem to offer food, climate and habitat optimum conditions, that allow the stability of a large number of nesting species and the availability of vacant niches for migratory species. Indeed, despite the great capacity of birds to move indicate that the proportion of mature or post mature forest in the

landscape significantly influences the movement patterns of several species (Gobeil and Villard, 2002; Robichaud et al., 2002).

Many data of bird phenology are available for the investigation, particularly that relating to migration (Sparks, 1999). This forest responded positively to the requirements of 78 bird's species that were classified as sedentary or breeding. 53.84 % of the population observed in this forest was sedentary. High migration intensity of non-specific-species indicated strong relationship with weather conditions (Nilsson et al., 2019). Biogeography position of this forest justifies food resources and interesting capacity of our environment that allow important migratory species (e.g. high number of sedentary species).

We supposed that a complexity of habitats availability can change ecological

indication in forest. In this study, we observed a greater level of specific richness (78 species) and trophic guild dominated almost by terrestrial and arboreal guild (57 species). At the landscape scale generally offer a variety of potentially suitable niches than forests with homogeneous characteristics (Gil-Tena et al., 2007). Some bird species selected shrubs during their life cycle in this forest (11 species). These shrubs can offer food, foraging and nesting for many birds. However heterogeneity forest structure may also reduce predation risk (Martin, 1993). Our results showed that insectivorous category is the dominant guild in these forests. In this case we supposed that: the isolation of bird's population, the habitat association and the structural traits of Machroha forest were the basic factors that increasing this causality "insectivorous category". In general, insectivores declined after disturbance, these broad categories ignore many differences among species within the same guild, such as differences in habitat associations, behaviors, and ecological traits (Gray et al., 2007).

The position of these forests in ultra meridional Palearctic allows sedentary birds in the proportion of breeding species remain throughout the year, it is due to low contrast of food resources available between the summer and winter. Campron and Brotons (2006) reported that at the scale of the Mediterranean region, the oak stands are positively correlated with bird's richness. In our study area, oak stratum receive the highest values of richness (cumulative richness: 208 species for 2019 to 2020 and 212 species in 2020 to 2021) than shrub stratum.

## CONCLUSION

Machroha forest does not statues as a national conservation area and missing all forms of classification in the Algerian list of nature reserve. The forest

department in Souk Ahras district must propose a conservation plan and management approaches. Many future studies need to be done in this forest mainly on the other animal communities such as reptiles and mammals and the quick proposition and classification of this forest as a nature reserve or wildlife refuge is urgently pronounced.

## ACKNOWLEDGMENTS

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## CONFLICT OF INTEREST

The authors declare the absence of conflict of interest.

## AUTHORS CONTRIBUTION

This manuscript is approved by all authors. Boucif Abdelhak: sampling and editing, Bara Mouslim: conception of the study, analysis of data and editing, Houhamdi Moussa: conception of the study and reviewing.

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