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Research Article

WATER QUALITY PARAMETERS AND BIRD DIVERSITY IN OUED CHAREF DAM, (SOUK AHRAS, NORTHEASTERN ALGERIA)

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ABSTRACT. The present study deals with the interactions between Water quality parameters and water bird numbers of wetland in Souk Ahras province, North-east of Algeria. Direct count method detected a total of 15 bird species belonging to 9 families of which 10 species were passage visitor, 4 winter visitors and one species migrand breeder**.** Species richness ranged from 5(summer) to 10 species (winter). Our results showed that: White *Stork, Fulica atra, Yellow legged gull, Phalacro coraw, Podiceps cristatus, Aredea cinerea, Melanitta nigra, Anas crecca, Gavia arctica are* influenced by abiotic factors which favor their presence.

Keywords: *Water quality parameters, bird numbers, North-east of Algeria, abiotic factors.*

INTRODUCTION

In Throughout the world, avian community are abundant, conspicuous and diverse components of freshwater ecosystems and of the wetlands around them. [1]. Birds are good indicators of environmental health because they occur in almost all habitats and are sensitive to environmental change. They are often common denizens of the ecosystem and they have been considered as indicator species of inhabited areas [2]. Wetland supports congregation of large number of migratory and resident bird species as it has high nutritional value as well as productivity [3]. Availability of food, detestability and capture, location of nesting sites, availability of nesting materials, presence of predators and competitors are the major factors influencing the foraging and breeding of birds and subsequently their population [4]. Wetlands being integrated systems are affected by the changes in the key physical as well as chemical parameters of hydrosphere. These in turn affect the wetland dependent communities as well as the ecosystem attributes such as species richness, its distribution and density [5]. Selection of wetlands by waterfowl is influenced by a complex of characteristics including water chemistry, aquatic vegetation, invertebrate fauna and physical features [6]. The physical and chemical characteristics of water bodies affect the species composition, abundance, productivity and physiological conditions of aquatic organisms [7]. The study of interactions between biotic and abiotic factors becomes essential to understand the community structure of an ecosystem [8]. No systematic work has been done in Algeria on the distribution of birds (biotic) in relation to physico-chemical parameters (abiotic) of a water body. This study was undertaken to examine relationship between water quality parameters and bird numbers and species richness. Knowledge on the composition of the bird community in Oued Charef dam

facilitates to manage programs aiming at protection and conservation of bird species and their habitats.

MATERIALS AND METHODS

Study Area

This study was carried out in Oued Charef dam (36° 5'22.91"N 7°23'20.78"E, alt. 920 m, area: 1010 ha), located in souk Ahras province, North-east of Algeria. Even though the wetland is comprised of aquatic plants, it is surrounded by cereal crops consisted of Chenopodiaceae (*Atriplex halimus, Atriplex patula, Salicornia fruticosa, Salsola fruticosa, Suaeda fruticosa*), Brassicaceae (*Mauricandia arvensis, Matthiola fruticolosa, Diplotaxis éricoïdes, Capsella bursa pastoris*). This wetland harbours an important avifauna. Among the common species there are the *Larus argentatus*, *Chroicocephalus ridibundus*, *Phalacrocorax carbo*, *Podiceps cristatus*, *Tachybaptus ruficollis*, *Anas acuta*, *Anas clypeata*, *Anas platyrhynchos*, *Anas penelope*, *Tadorna tadorna, Aythya ferina* and *Vanellus vanellus*. [9].

Bird Surveys

Bird surveys were carried out at seasonal intervals (winter, spring, summer & autumn) at Oued Charef dam during year (2018 -2019). Direct count of the birds was carried out by using the binoculars. The methodology was followed as described by [10]. The counts were conducted between (06:00 & 16:00hrs).

Analysis of Bird Community

For the analysis of bird community, Shannon – Weiner diversity index [11], Index of dominance, [12]. Evenness index [13] and Relative abundance [14] were employed in the present investigation.

Statistical Analysis

The significant difference if any in the mean values of water quality parameters bird number was performed by statistical software SPSS (version 16.0). PCA methods were calculated to evaluate the parametric relationships between the abiotic (i.e., physico-chemical parameters) and biotic factors (i.e., bird) supposedly in interaction.

RESULTS AND DISCUSSION

Water Quality Analysis

The annual mean values of various physico-chemical parameters of Oued Charef dam are presented in Table 1.

Table 1. *Physico-chemical parameters of Oued Charef dam during 2018-2019*

Physico-chemical parameters	Mean ± S.D
Ph	8.21 ± 0.41
Conductivity (µS/cm)	180.13 ± 29.40
Salinity (mg/l)	134.13 ± 27.30
Chlorides (mg/l)	6.20 ± 7.39
Nitrate (mg/l)	14 ± 0.41
Nitrite (mg/l)	0.2 ± 0.01
Phosphate (mg/l)	0.03 ± 0.01
Temperature(C°)	9.63 ± 3.61
Dissolved oxygen (mg/l)	9.8 ± 0.41

Bird Diversity

A study in Oued Charef dam reported 15 species of birds during 2018-2019 survey, belonging to 9 families (Table 2). Highest number of species (6 species) belonged to family Anatidae followed by 2 species to family Ardeidae, and one species to family Scolopacidae, Ciconidae, arideae, Rallideae, Podicipedideae, phalacrocoracidae and Gavideae each. Of 15 bird species, 10 species were Passage visitor; 4 winter visitors and 1 Migrant breeder.

Seasonal Variation

Migrants began to congregate in numbers (52) with a variety of species in winter. Bird numbers reached a peak in winter (2373) and began to decline as birds left the dam in spring (778) and summer (61). Bird numbers showed strong negative correlation with seasons (r = - 0.89).

The highest number of species (10 species) was observed in winter followed by 8 species in spring, 7 species in autumn and lowest (5 species) in summer. Five of these were present in all sampled seasons suggesting a relatively low level of residency over the study period. A positive correlation was found between species richness and seasons (r = 0.64).

Diversity Indices

The highest Shannon -Wiener diversity index was in autumn **(**1.2), whereas the lowest was in summer (0.8). The dominance indices showed a maximum value in winter (0.15) and a minimum value in autumn (0.07). The evenness indices showed a maximum evenness in autumn (0.85) when the highest Shannon-Wiener diversity index value was noted and minimum evenness in winter (0.61) (Table 3).

Table 2. *Ecological status and relative abundance of water birds occurring at Oued Charef dam during 2018-2019*

Scientific name (abbreviation)	Phenological status [a]	Conservation status [b]	Local status [c]	Annual relative Abundance %
Little egret (LIEG)	WV	LC	UC	15.36812009
Mallard duck (MADU)	WV	LC	O	52.75196569
Northern pintail (NOPI)	PV	LC	R	1.14367405
Eurasian wigeon (EUWI)	PV	LC	R	1.85847034
Northern shoveler (NOSH)	WV	LC	R	2.93066476
Tringa ochropus (TROC)	VP	LC	R	0.14295926
White stork (WHST)	VP	LC	R	0.64331665
Fulica atra (FUAT)	VP	LC	R	1.28663331
Yellow-legged gull (YEGU)	NM	LC	MC	11.93709793
Phalacrocorax carbo (PHCA)	VP	LC	R	0.78627591
Podiceps cristatus (POCR)	VP	LC	R	0.92923517
Ardea cinerea (ARCI)	WV	LC	MC	1.0007148
Melanitta nigra (MENI)	VP	LC	UC	1.64403145
Gavia arctica (GAAR)	VP	LC	R	0.35739814
Anas crecca (ANCR)	VP	LC	R	7.21944246

WV[a]: Winter visitor, **VP[a]:** Passage visitor**, MB[a] :** Migrant breeder**.**

[b]**Bird life checklist version7 (2014): LC:** least concern.

[c]Species Omnipresent (O) (fi=100%); Mondatory Common (MC) (50%<fi<75%), Uncommon (UC) (25%<fi<50%), Rare (R) (5%<fi<25%).

Table 3. *Season-wise diversity, dominance and evenness index for birds at Oued Charef dam during 2018-2019*

Season / Diversity indices	**Winter**	**Spring**	**Summer**	**Autumn**
Species richness (S)	10	8	5	7
Total number of individuals (N)	2373	778	61	104
Shannon wiever diversity index (H2)	0.6	1.2	0.8	1.6
Simpson's dominance index (c)	0.15	0	0	0.07
Pielon's evenness index (e)	0.51	0.70	0.76	0.8

To determine most effective variables on the bird numbers, PCA was performed on 9 factors. (Fig. 1). The first ordination Axis (PC1, 60.52%) showed a positive correlation with all environment factors (Table 4). Defined by the appearance of species: *White Stork, Fulica atra, Yellow legged gull, Phalacro coraw, Podiceps cristatus, Aredea cinerea, Melanitta nigra, Anas crecca, Gavia arctica.*

In addition, the second component (PC2, 22.57 %) is not correlated with any environment factor.

Table 4. *PCA applied to the correlation matrix of the environment factors in the wetland*

Component matrix

	Composante	
	1	2
Little egret	-,977	,063
Mallard duck	-,969	,095
Northern pintail	-,978	,007
Eurasian wigeon	-1,000	,015
Northern shoveler	-,957	,122
Tringa ochropus	-1,000	,015
White stork	,983	-,158
Fulica atra	,981	,180
Yellow legged gull	,989	-,126
Phalacrocorax carbo	1,000	-,015
Podiceps cristatus	1,000	-,015
Ardea cinerea	,993	,112
Melanitta nigra	,983	-,158
Gavia arctica	1,000	-,015
Anas crecca	,946	,295
Ph	,963	,249
Temperature	1,000	-,015
Conductivity	,989	-,126
Salinity	,993	,112
Dissolved Oxygen	,942	,241
Chloride	,983	-,158
Nitrates	,983	-,158
Nitrites	,993	-,021
Phosphorus	,993	,112

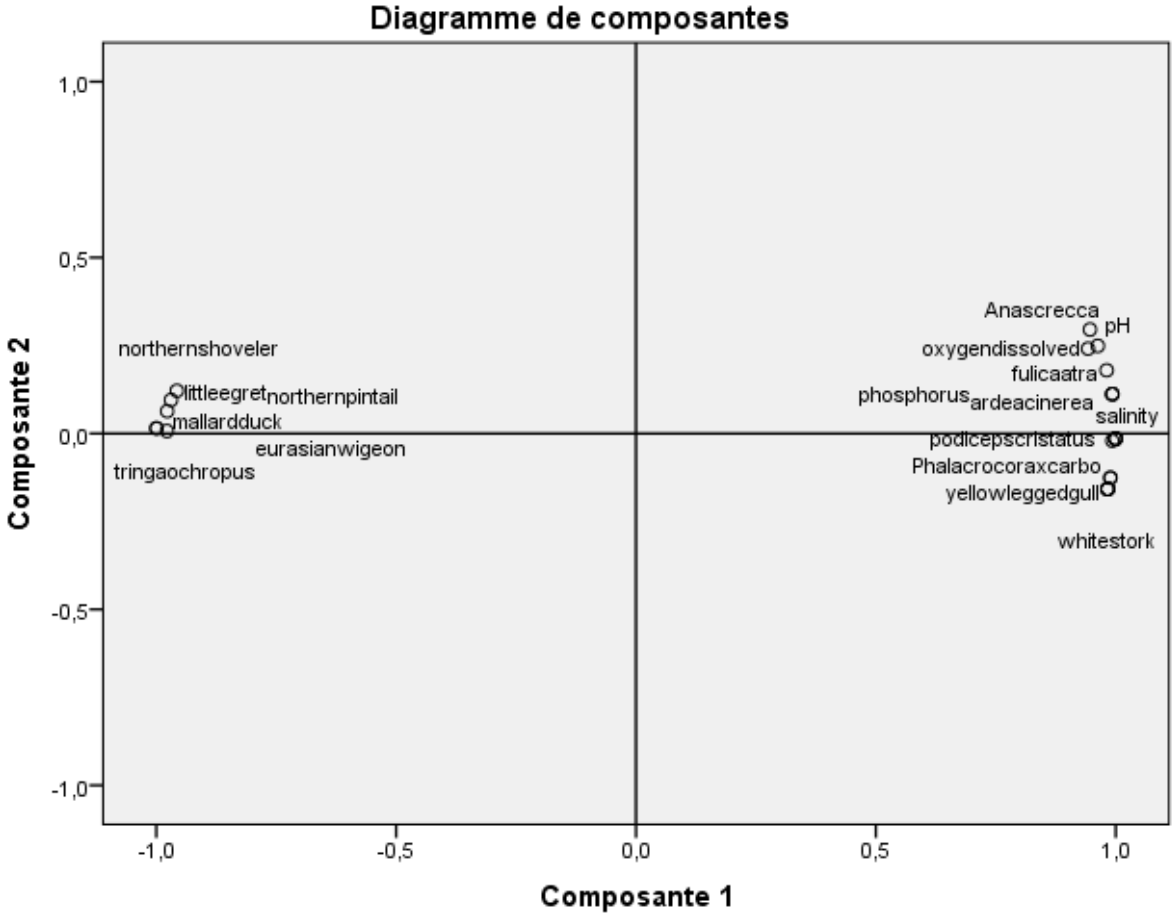

Fig. 1. *shows a plot of Water birds against their values for axes 1 and 2*

It was observed that Migrants began to congregate in numbers with a variety of species in autumn. Bird numbers reached a peak in winter and began to decline as birds left the dam in spring and summer. The range, distribution and abundance of birds are closely linked to climatic factors which shape the relation between wetlands and birds [17]. The factors include the availability of depth, quality of water, availability of food and shelter and the presence or absence of predators. Birds that use wetlands for breeding depend on the physical and biological attributes of the wetland. Any variation in any of these wetland features affects the distribution of birds [18].

In this study, a positive correlation between species richness and seasons may be related to climatic conditions, breeding, food availability and suitable foraging areas. Water birds tend to be highly mobile in winter, moving to other areas in response to factors such as cold weather and changes in water levels and in food resources [19].

The present investigation reveals that the increase in diversity index during autumn reflects an increase in the diversity of the community [20].

High dominance value during winter reflects diversified resources in the habitat available for components of the community. Low dominance value during autumn indicates increase by an average species resulting in the lowering of the number of coexisting species in the community [21].

High index of species evenness in the autumn may be attributed to increase in community diversity [20].

The seasonal distribution pattern showed two peaks, one in winter and the other in autumn. A number of reasons including north-south migration, breeding, food availability and vegetation changes could be attributed to this pattern [22].

The presence study showed that *White Stork, Fulica atra, Yellow legged gull, Phalacro coraw, Podiceps cristatus, Aredea cinerea, Melanitta nigra, Anas crecca, Gavia arctica.* are relate to all environment factors which favor their presence. The levels of dissolved oxygen are related to the function of water temperature [23].

The oxygen deficit during summer is a characteristic feature of a productive wetland [24].

The oxygen concentration regulates the invertebrate distribution, which has an effect on the water bird population and distribution since these birds largely feed on a wide range of the invertebrate community and small fishes [25].

A positive correlation between hydrogen ion concentration and bird numbers may be, at least in part, a response to higher macroinvertebrates and thereby attracting more birds. A significant relationship between waders' diversity and pH of the wetland habitats was established by [26].

Absolute positive correlation between conductivity and water bird may be, at least in part, a response to the favorable saline conditions. Murphy *et al*. (1984) [27]; have reported that Both high duck density and species richness were associated with high concentration of nutrients such as phosphate. Absolute positive correlation between chloride and water bird could not be justified in the present study and hence needs further evaluation.

CONCLUSION

In conclusion, In the present study, the abundance of water birds in Oued Charef dam may be influenced by environmental factors. It is also evident that the water temperature influences food production. The present investigation reveals that the impact of physic-chemical parameters changes between season highly affect the feeding, breeding and the population so that the avian community is failed to attain a better position to grow and establish for the continuation of the race.

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