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Seasonal changes of the bird community in the Vembanad-Kole Ramsar site, India

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Abstract

Bird species richness, abundance, density and seasonality were assessed in different seasons in the Vembanad-Kole Ramsar site, India. Observations were made from November 1998 through October 2001. The species richness and abundance of birds was highest in the dry season of 2000 (120) and lowest in the wet-I season of 1999 (46). Diversity Index (H') was highest in the dry season of 2000 (3.19), followed by the dry season of 2001 (2.89). The species richness was highest in the migratory season of the third year (2000-2001) (127) followed by second year (1999-2000) (119). The highest abundance was in the migratory season of the third year (2000-2001) (1,88,006) and lowest in the migratory season of the first year (1998-1999) (19,350). Significant negative correlations were found between the rainfall, water depth and the bird community parameters. The highest number of birds was recorded during the replanting season and sowing period of paddy. Significant negative correlation was also obtained between the paddy height and the abundance of birds ($r = -0.7898$; $P<0.01$; $n = 8$). During the migratory season, the Vembanad-Kole wetlands supported more waders than the other wetlands of Kerala in terms of species richness and abundance of birds. The area served many avian species for a wide variety of purposes such as nesting, roosting and wintering ground. The present study showed that the Vembanad-Kole wetlands are one of the important regions in Kerala for winter visitors.

Keywords: bird community, diversity, Kerala, India, Ramsar site, seasonal changes, Vembanad - Kole

INTRODUCTION

Population studies have been traditionally used to monitor large scale, long term changes in avian population and to assess both habitat quality and the responses of birds to both management practices and natural and human caused environmental changes (Wiens, 1989). Species composition, abundance and behaviour of birds are known to vary seasonally (Morrison *et al*., 1986). Some species are permanent residents in an area and others occupy an area only during winter or summer months.

Many studies have been conducted on seasonal changes on whole bird community or individual species in the tropical forest of India (Vijayan, 1975; Khan, 1978; Zacharias, 1979; Price, 1979; Yahya, 1980; Toor and Sandhu, 1980, Vijayan 1984; Vijayan, 1989; Daniels, 1989; Thiyagesan, 1991; Sundaramoorthy, 1991; Johnsingh and Joshua, 1994; Jayson and Mathew, 2000), but such studies on seasonal changes on wetland birds of India are meagre. Hence, the present paper fulfills this lacuna to some extent and describes the seasonal variations of wetland bird community in the Vembanad-Kole Ramsar site in terms of species richness, abundance, diversity and density. This study was a part of major ecological study carried out from November 1998 to October 2001 on wetland birds in the Vembanad Kole Ramsar site of Kerala, India.

Study area

Location and topography

The study area is located in Thrissur and Malappuram District of Kerala State, Southern India and lies between 10° 20' and 10° 40' N latitudes and 75° 58' and between 76° 11' E longitudes (Fig. 1). This wetlands with an extent of 13,632 ha and extend from the northern banks of *Chalakudy* River in the South to the southern banks of *Bharathapuzha* River in the North. Eastern side of Kole wetlands is Thrissur town and western side extends up to Arabian Sea. These wetlands are low lying tracts located 0.5 to 1 m below MSL and remain submerged for about six months in a year.

Climate and season

The climate of the area is moderate and there are three different distinct seasons. The dry season (December to April), wet season-I (May to August) during the period of southwest monsoon and wet season-II (September to November) during northeast monsoon. About 60 per cent of the rainfall is obtained during the southwest

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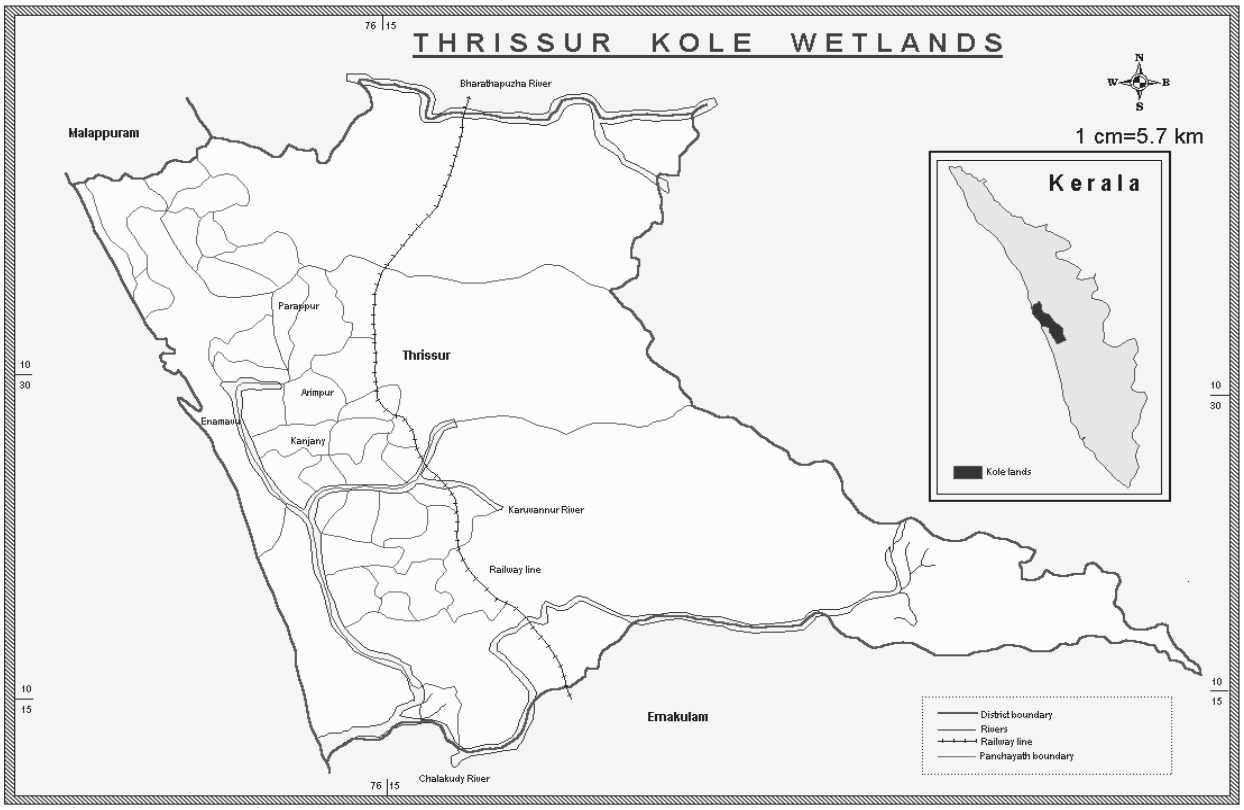

Figure 1. Location of Kole wetlands of Thrissur, India

monsoon, 30 per cent during the northeast monsoon and the remaining 10 per cent in summer months. The average annual rainfall is 3,200 mm and there is a variation in the temporal distribution of rainfall. The maximum rainfall is received during the month of June followed by July and the temperature varied from 28°C to 31.5°C in a year.

MATERIALS AND METHODS

The study was conducted from November 1998 to October 2001 and bird population was estimated using the total count method (Hoves and Bakewell, 1989). In this method, representative blocks were identified and birds in the blocks were counted using a telescope (15x - 45x). These blocks had natural boundaries in the form of bunds. The time of observation was from 0700 h to 1000 h. On an average, 20 days were spent in the field in a month and census was avoided during heavy rains. Birds were identified based on physical features with the help of field guides and reference books (Ali and Ripley, 1983; Grimmett *et al.*, 1998).

Seasonal pattern

The study area has three distinct seasons *viz*. dry season (December to April); wet-I, the period of southwest monsoon (May to August) and wet-II, the period of northeast monsoon (September to November). Based on the arrival of migratory birds, the months are divided into migratory season (September to March) and non-migratory season (April to August). Occurrence of birds in each month obtained through the daily census data was used for the seasonality analysis.

Species richness and abundance

Species richness and abundance of birds in each season in the study area were calculated from the census data.

Diversity index

Shannon-Weiner (H') index was calculated using the computer program SPDIVERS.BAS developed by Ludwig and Reynolds (1988).

Evenness measures

A number of indices have been used to quantify the evenness of diversity. Two evenness measures *viz*. Shannon Evenness and Sheldon Evenness were calculated using the computer program SPDIVERS.BAS developed by Ludwig and Reynolds (1988).

Correlation coefficient was used to find out the correlation between the bird species richness, abundance and diversity with environmental factors like rainfall and water depth. Paddy growth was measured using centimeter scale in different stages and correlated with the abundance of birds.

RESULTS

Species richness and abundance of birds

Species richness and abundance of birds varied in different seasons. Species richness and abundance was highest during the dry season of 2000 and was lowest in the wet-I season of 1999 (Fig. 2). The wet-I season always recorded lowest species richness and abundance of birds in all the years.

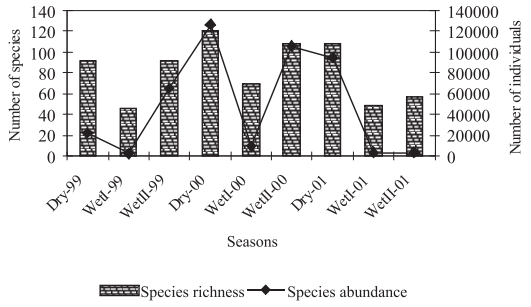

Figure 2. Species richness and abundance of birds in different seasons of the present study period

Diversity Index

Diversity Index (H′) was highest in the dry season of 2000 (3.19) followed by the dry season of 2001 (2.89) (Fig. 3). Lowest diversity index (H′) was observed in wet-II season (2.45).

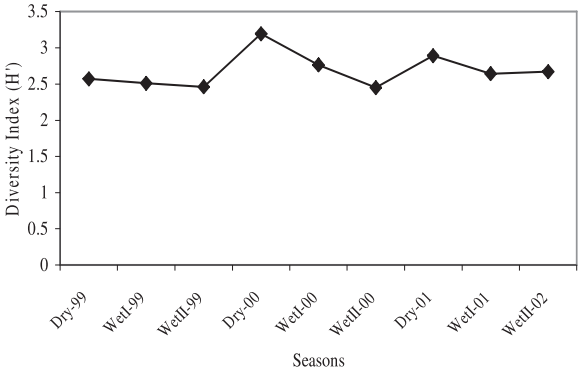

Figure 3. Diversity Index (H′) of birds in different seasons of the present study period

Migratory and non-migratory seasons

Species richness was highest in the migratory season of the third year (2000-2001) followed by second year (1999-2000). Highest abundance was in the migratory season of the third year (2000-2001) and lowest in the first year (1998-1999) (Figs. 4 and 5). Species richness and abundance was high during the migratory seasons compared to the non-migratory seasons.

Highest diversity index (H′) was recorded in the migratory season of the second year (1999-2000) and lowest in the non-migratory season of the second year (1999-2000) (Fig. 6). Not much variation was found in the diversity index (H′) between the migratory and non-migratory seasons.

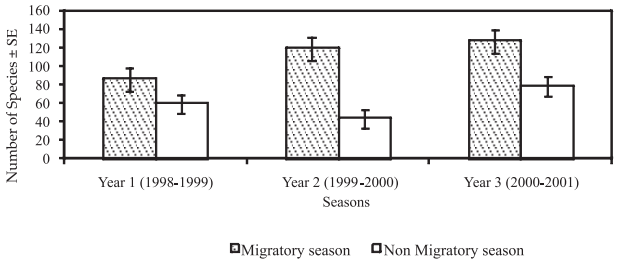

Figure 4. Species richness in migratory and non-migratory seasons (1998-2001)

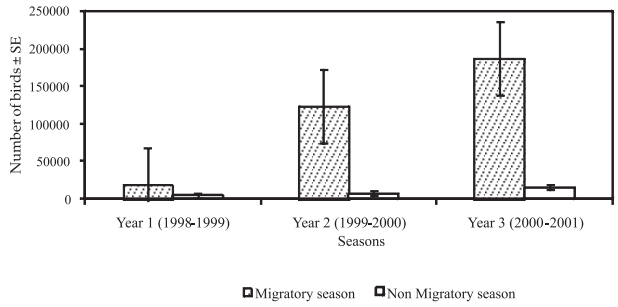

Figure 5. Abundance of birds in the migratory and non-migratory seasons (1998-2001)

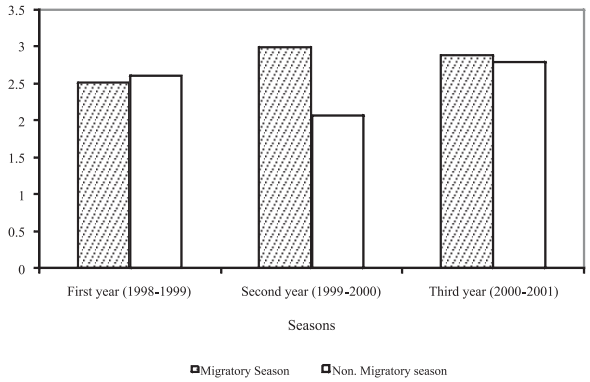

Figure 6. Diversity index (H′) during migratory and non-migratory season

Evenness Indices

Evenness Indices during the three migratory seasons were also calculated. Highest Evenness index was obtained during the migratory season of the second year (1999-2000) (E1 = 0.62; E2 = 0.16) followed by the third year (2000-2001) (E1 = 0.59; E2 = 0.14) and the first year (1998-1999) (E1 = 0.57; E2 = 0.14). Overall Evenness indices during the migratory season were 0.60 and 0.13 for E1 and E2 respectively.

Factors governing the changes in the bird population

Rainfall

A negative relationship was observed between the species richness, abundance and diversity index of birds with total monthly rainfall, *i.e.*, when the rainfall increased, the species richness and total number of birds decreased. A significant negative correlation was observed between the species richness and rainfall ($r = -0.65$, $P<0.05$, $n = 12$). Similarly, there was a significant negative correlation between the rainfall and abundance of birds ($r = -0.50$, $P<0.05$, $n = 12$) and density of birds ($r = -0.49$, $P<0.10$, $n = 12$) (Fig. 7).

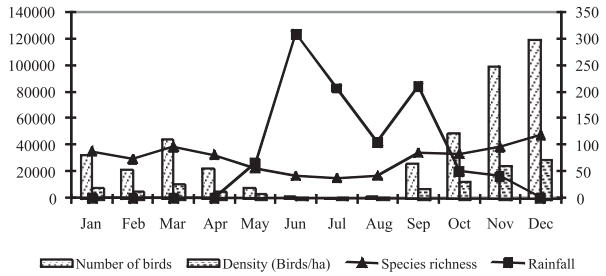

Figure 7. Relationship between species richness, abundance and density of birds and rainfall in the Kole wetlands

Water depth

Water depth in the Kole wetlands varied from 8 cm in the month of February to 130 cm in July. Species richness decreased as the water depth increased in the wetlands. A significant negative correlation was also observed between water depth and bird population parameters, Richness: $r = -0.85$, $P<0.01$, $n = 12$; Abundance: $r = -0.60$, $P<0.02$, $n = 12$; Density: $r = -0.59$, $P<0.05$, $n = 12$ (Fig. 8).

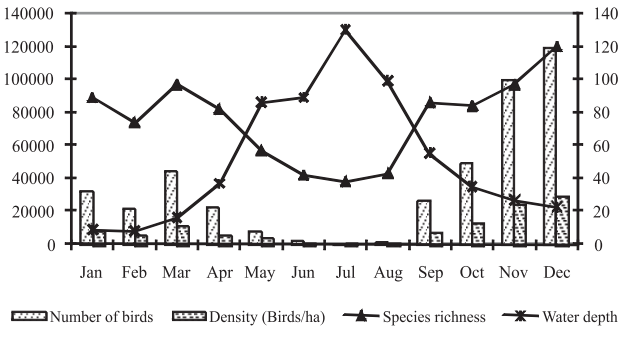

Figure 8. Relationship between species richness, abundance and density of birds and depth in the Kole wetlands

Population variation of birds in relation to paddy growth

The abundance of birds varied in relation to the height of paddy. Highest number of birds was recorded during the replanting season and sowing period (0 to 11 cm) and there was a decline in the bird population, when the paddy reached a height of 21 to 30 cm. Sudden influx in the bird population was recorded, when paddy reached a height of 31 to 40 cm height during the flowering season (Fig. 9). Flowering season attracted many nectarivores species. Weaverbirds and Munias were congregated in huge numbers during the harvesting period of paddy. A significant negative correlation was found between the paddy height and the abundance of birds ($r = -0.7898$; $P<0.01$; $n = 8$).

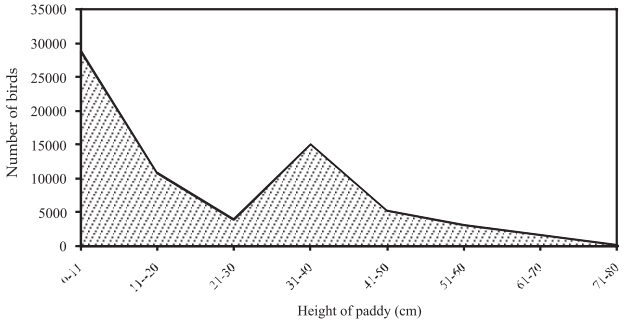

Figure 9. Relationship between abundance of birds and height of paddy in the Kole wetlands

DISCUSSION

Seasonal fluctuation in the abundance of a species is considered as an adaptive phenomenon evolved through ages to derive maximum advantage from the ambient environmental conditions (Koen, 1992). Depending on the season of the year, the species composition of birds might vary. Availability of microhabitats and various food resources are the determining factors that control the seasonal changes of bird species composition. In the present study, it was found that species richness and abundance of birds were highest during the migratory season. Increase in the size of bird population in the second and third year might be due to the early exposure of the preferred microhabitat of shallow waters and mudflats during that period. The peak population of birds was during the migratory season and a decrease was recorded during the non-migratory season, which is comparable with earlier studies (Saikia and Bhattacharjee, 1990; Nagarajan and Thiyagesan, 1996; Acharya, 2000).

During the monsoon months, there was reduction in the species richness and abundance of birds at Kole wetlands. Distribution and abundance of birds in the Kole wetlands are influenced simultaneously by habitat

preferences, seasonal and geographic variations in habitat availability and variations in the climatic conditions. The monthly variations of richness, abundance, density and diversity of bird population were found to be correlated with the rainfall and the water depth, which showed that the rainfall and water depth were the major factors influencing the abundance of birds at Kole wetlands. When the water depth and the rainfall increased, numbers of birds were decreased. There was a strong response to water depth in the Kole wetlands with considerable decrease of population in the wet seasons. The number of birds during November, December and January were highest, when precipitation was less and extensive mud flats and shallow waters were available in the Kole wetlands. It is clear that the environmental factors are determining the wetland bird community primarily by their direct or indirect impact on the availability and abundance of birds prey. The role of abundance of food on wetland bird densities have been well established (Sjoberg, 1989; Parker *et al*., 1992; Nagarajan and Thiyagesan, 1996) which agrees with the present study.

According to Kushlan (1986), wading birds may use diverse strategies to cope up with the seasonal functions of water depth. Hafner and Britton (1983) reported that the food availability between different habitats played a sensitive role in the distribution and seasonal movement. The distribution of wetland birds at Kole wetlands might thus be due to the local depletion of food resources mediated by increased interference of other birds, which is comparable with the reports of Goss-Custard (1977) and Zwarts (1978). The water depth was another important factor, which could be used to predict the wetland bird population of Kole wetlands.

The Kole wetlands served many avian species for a wide variety of purposes such as nesting and roosting besides acting as a wintering ground. Maintenance of habitat diversity is essential for avian diversity, which requires various natural water regimes and plant communities. The present study showed that the Kole wetlands are one of the important regions in Kerala for winter visitors. During the migratory season, the Kole wetlands supported more waders than other sites in Kerala.

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