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Biodiversity Measures of Avian Fauna in the Human Inhabited areas of Thattekkad Bird Sanctuary, Ernakulam District, Kerala, India

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Abstract—*Thattekkad Bird Sanctuary is the first bird sanctuary in Kerala and is a haven for nature lovers and Bird watchers with a wide variety of flora and fauna. World famous ornithologist Dr. Salim Ali recognized the species richness of this sanctuary and declared it as the richest one he had ever seen. A total of 18000 birds belonging to 14 orders and 37 families were reported in the present study, carried out in the human inhabited areas of the sanctuary. Birds are one of the most populous life forms on the planet, and its diversity leads to a richness of life and beauty. Apart from this, birds have always fascinated mankind with their intrinsically beautiful plumage, melodious songs and artistic behavior. Ecosystem evaluation is one of the most important concepts in ecology. It can be obtained in different ways in which one of them is biological indices. Many biological indices have been introduced to estimate the evenness, richness and dominance of various biological communities in ecosystems. Biological indicators are utilized in monitoring programs which can provide to determine anthropogenic effects on the respective ecosystems The present study deals with the measures of diversity of avian fauna observed in the study area. Line transect method was adopted and six plots of three hectares each were selected for the present stud, y each with different cultivated crops in human inhabited areas of Thattekkad Bird sanctuary. Diversity indices like Simpson, Shannon, Berger parker and Margalaf's richness, Equitability, Menhinick indices and Ginicoeffeicient was calculated for three years (2015-2018) and found that Plot IV is found conspicuous with high simpson index, Gini co-efficient and average population size while Plot I showed highest values for Margalaff richness index as well as Menhinick index, which are species richness measures indicating the plot's richness in species composition. Plot I represented the maximum value for Shannon index conferring its diversely rich habitat for maintaining homeostasis which suggest that many factors like the availability of food, water, climatic conditions and surrounding vegetation is favorable for avian fauna . These diversity index values help us to calculate and understand the ecological significance of different habitats in stabilizing diversity. The index with the most gradient is the best and the most sensitive index for that concept of ecological estimations.*

1. INTRODUCTION

Birds are the fascinating creatures of the nature, with gifted aerial lifestyle adaptations. Indian sub-continent occupies about 13 percent of worlds bird population which owes to the presence of varied habitats, from the hot deserts of Rajasthan to the tropical rain forests of the Western Ghats and Northeast India (Grimmett and Inskipp,2003).Plenty of research was carried out worldwide on different aspects of avian fauna like breeding, ecology, behaviour, nesting, mating etc. Avifaunal diversity is one of the most important biotic components for any type of ecosystem (Dhindsa & Saini, 1994). Avian fauna acts as an important bio-indicator (Centerbury *et al*. 2000) that assesses different habitats qualitatively as well as quantitatively. Ecosystem evaluation is one of the most important concepts in ecology. It can be obtained in different ways in which one of them is biological indices. Many biological indices have been introduced to estimate the evenness, richness and dominance of various biological communities in ecosystems. Biological indicators are utilized in monitoring programs which can provide to determine anthropogenic effects on the respective ecosystems The present study measures of diversity of avian fauna observed in the study area.

Thattekkad Bird Sanctuary (TBS) falls between 10˚7' and 11˚ N latitude and 760 40' and 760 45'E longitude. The altitude ranged from 40m to 523m. And TBS is located at Kothamangalam Taluk of Ernakulam District, Kerala state, India and The Sanctuary is having well defined boundaries. Sanctuary covers an area of 25.16 Sq. Km., out of which 9Sq.Km come under human inhabited area which lies almost at the foothills of the Western slopes of the Western Ghats.. This world famous sanctuary owes much of its fame to the internationally renowned Ornithologist, Dr. Salim Ali.

2. STUDY AREA

The study area selected for the present study is the human inhabited land area within the Thattekkad bird sanctuary, cultivated with diverse kinds of crops, spread around 9 kms. Six plots of three hectares each were selected for the present study each with different cultivated crops.

3. METHODOLOGY

Direct observation and line-transect methods were involved and observations were made once in a week in the morning hours (8am -10am) for three years (March 2015-April 2018) in the selected six plots on either side of the transect. The type of diversity used here is α- diversity which is the diversity of species within a community or habitat. The diversity index was calculated by using the Shannon – Wiener diversity index (1949).

Diversity index = H = – ∑ Pi In Pi where Pi = S / N where,S = number of individuals of one species N = total number of all individuals in the sample In = logarithm to base e

Simpson's Diversity Indices (D = 1 –Σ(ni/N)2), where ni is the abundance of the i-th species in an area and N the total number of said species living in the same area (Gotelli & Graves, 1996; Heip*et al.,* 1998; Oksanen2015).

Margalef's index was used as a simple measure of species richness (Margalef, 1958). Margalef's index = (S – 1) / In N where S = total number of species N = total number of individuals in the sample In = natural logarithm

4. RESULTS AND DISCUSSIONS

A total of 18,000 birds of 100 species belonging 14 orders and 37 families were observed in the study area altogether in 6 plots and following diversity measures were calculated:-

4.1. Average population size

Average population size of each plot was calculated for three consecutive years which showed that population was maximum for plot IV in 2015-2016 period, followed by same plot in 2017-2018, and least value was observed by plot I (2015-2016). Gradual declining population size was represented by two plots- III and V, whereas increasing by I and II, but plot VI shows a stabilized population in all three years (Fig.1).

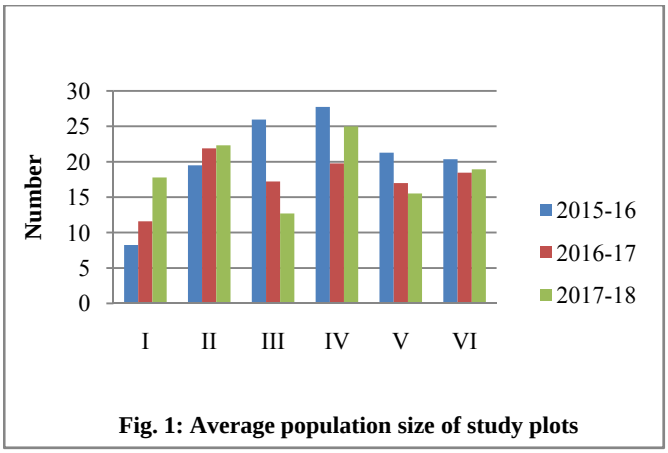

Fig. 1: Average population size of study plots

4.2. Simpson index (H)

Simpson index was calculated using the referred formula for all plots in three years and shown that plot IV had maximum values for two years(2015-16 and 2017-18) while plot III represented highest value for the period 2016-17(fig.2). As the Simpson's index (D) increases, the diversity decreases. The value ranges from 0 to 1. With this index, 0 represents infinite diversity and 1, denotes the least diversity. Hence, plot IV is less in diversity while plot VI is highly diverged one.

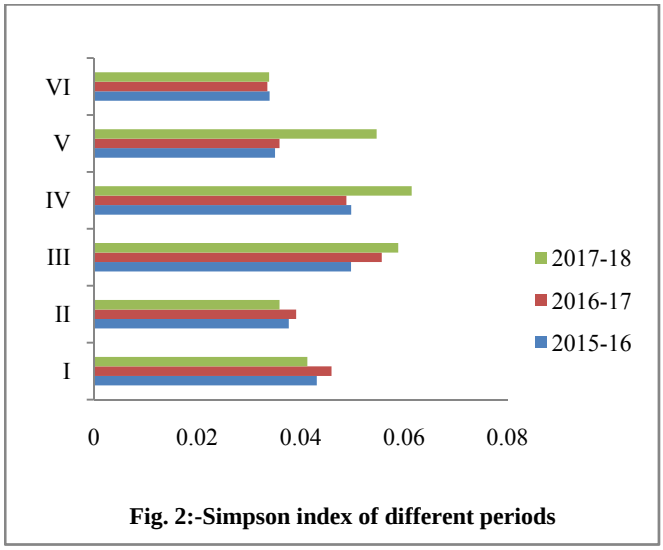

Fig. 2:-Simpson index of different periods

4.3. Menhinick, Berger-Parker and Equitability indices and Gini coefficients

Menhinick richness index is simply the species richness and was found maximum in plot I and least in plot IV, indicates more number of species in plot I and less in plot IV. Berger Parker dominance index was high for plot IV which means that the community was dominated by most dominant species while least measure for plot II and VI ,shows domination by lesser numbered ones..

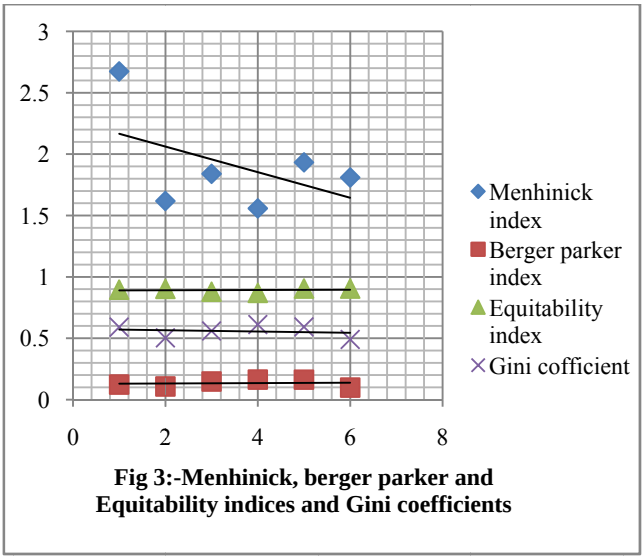

Fig 3:-Menhinick, berger parker and Equitability indices and Gini coefficients

Equitability or Evenness indices of all plots showed more or less a constant value with very little variance (0.80-0.90) indicating the even distribution of species. Evenness is a measure of the relative abundance of the different species making up the richness of an area Gini coefficient was highest for plot IV whereas least for plot VI, indicate a uniform distribution of resources in the habitat

4.4. Shannon diversity index

Species diversity decreases in a system controlled by strong physico-chemical limiting factors while the diversity of species increases in biologically controlled communities and is directly proportional to the stability of the system. The diversity in the community can be determined by Shannon index of general diversity. The higher the value the greater the diversity. A high value of Shannon index was shown by plot VI in three years of study while the least was shown by plot III, indicate a high diversity of fauna in former area while less in the latter one(fig4). A gradual decline in the value can be seen followed by a slow increase in measure from plot III to VI.

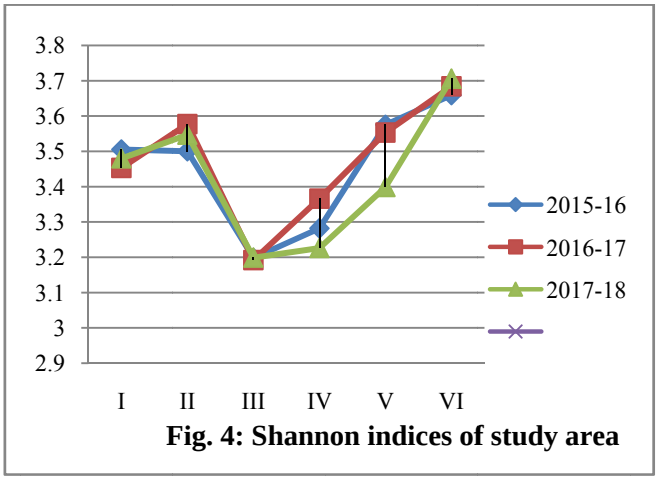

Fig. 4: Shannon indices of study area

4.5. Margalaff Richness index

The number of species per sample is a measure of richness. The more species present in a sample, the 'richer' the sample. Species richness as a measure on its own takes no account of the number of individuals of each species present. It gives as much weight to those species which have very few individuals as to those species which have many individuals. Species richness was measured using this index and was shown by maximum value for plot I and minimum for plot III during 2015-16 and 2016-17 periods, while highest for plot V and lowest for plot III in the period of 2017-2018.This indicate the species richness in plot I was maximum(fig:- 5) .

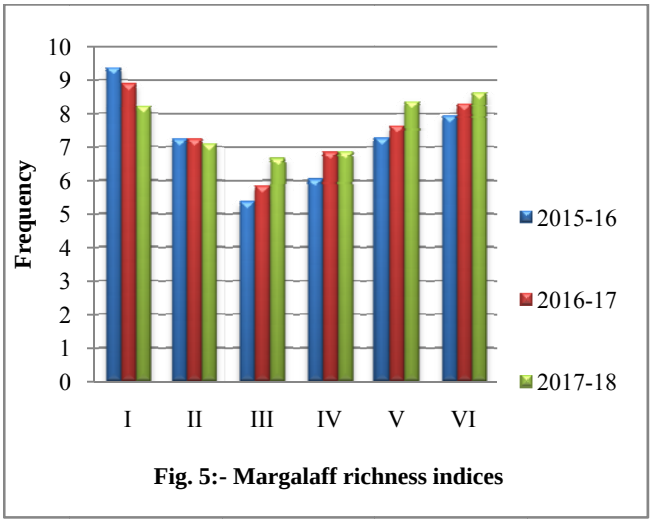

Fig. 5:- Margalaff richness indices

Beisel *et al*. believe that evenness indices must be interpreted with both richness and diversity indices. By this way, data interpretation can perhaps facilitate. Boyle *et al.* used sixteen indices to assess the status of aquatic communities in water quality studies and it was evaluated by using computer simulation techniques to determine specific index responses.

5. CONCLUSIONS

Different Measures of biodiversity found varying in the study area. Plot IV is found conspicuous with high Simpson index, Gini co-efficient and average population size while Plot I showed highest values for Margalaff richness index as well as Menhinick index, which are species richness measures indicating the plot's richness in species composition. Plot I represented the maximum value for Shannon index conferring its diversely rich habitat for maintaining homeostasis which suggest that many factors like the availability of food, water, climatic conditions and surrounding vegetation is favourable for avian fauna . These diversity index values help us to calculate and understand the ecological significance of different habitats in stabilizing diversity. The index with the most gradient is the best and the most sensitive index for that concept of ecological estimations. The structural diversification of trees within green spaces, is a significant

aspect, in supporting increased level of species abundance of avifauna. Thus it can be concluded that bird community structures can be good indicators for different woody ecosystems within a landscape with mosaics. The conservation value of a habitat can be well reflected by the distribution of bird species. The human-influenced habitats, can hold high bird diversity, thus indicates the ecological significance of such habitats.

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