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Diversity and Threats of Avifauna in Cheleleka Wetland, Central Rift Valley of Ethiopia

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ABSTRACT

This study was conducted in Cheleleka Wetland, Central Rift Valley of Ethiopia to assess Species diversity and threats of avifauna from August to February 2019. Data were analysed by using Simpson’s and Shannon-Weiner Index in analysing biodiversity indices. One way ANOVA was applied for analysis of the effect of season on the composition and abundance of species. Questionnaire surveys, key informant interviews and focus group discussion were also used to determine the threats of avifauna in the study area. The result indicated that 49 avian species record under 21 families and 10 orders during both the wet and dry seasons. The Shannon-Weiner diversity index shown that highest bird species diversity (H′=3.42) was recorded during wet season. Over grazing, agricultural expansion, settlement and sand extraction were the major avifaunal threats in the wetland. The result suggests that the need to conserve the avifauna through the conservation of their habitats by creating awareness to the local people and it will enable to decrease biodiversity threats.

Keywords:
Species richness
Cheleleka wetland
Bird
Threats

1. Introduction

Avian species play a significant role in enriching the biological diversity of wetlands. Wetlands habitats are considered one of the most fruitful environments in the glob [14,22]. They are homes for wide range of biodiversity including the assemblages of birds, reptiles, amphibians, mammals, fish and invertebrate species [2,25]. These habitats are also vital stores of plant genetic material [8,9]. This is an indication for the recognition by Ramsar International in 1971 as a haven for waterfowl habitats [12]. In line for to their immense biodiversity and ecological features, wetlands are also destinations for recreational and ecotourism opportunities [10,23]. Where wetlands habitats are developed as ecotourism sites, they provide enormous benefits for ecotourism activities [27].

The (IUCN) “Red List” document shown that amount of extinction are getting worse among species restricted to lesser islands to inland level [7]. This damage is mostly in line for their gradually intolerance to the lowest ecosystem disruption which is related to pollution [19], habitat type and bird distribution [9], wetland patch size [17], farming system and town expansion within the wetland ecosystem [20] and habitat destruction [26].

These anthropogenic factors at the landscape scale, has structured the diversity and the abundance of bird species due to their highly specific habitat requirements [13]. Sympathetic overall bird reactions to disturbances also require the assessment of the different disturbance consequences on a seasonal basis, because of the impacts of environ-
mental factors are many and differ along seasonal tendencies.

The country harbors 864 avian species of which 19 are endemics, 35 are globally threatened and 1 introduced species and a further 13 are shared only with Eritrea [29]. Although these findings were recorded from parts of Ethiopia, the phenomenon suggests that some birds may be under threat or at risk of extinction, giving current undocumented, but observed ecological disturbances on the wetlands. Environmental variations and land use activities within Cheleleka wetland like urbanization, change of shrub by woodland and bush land in to cultivated land and change of Lake Cheleleka in to a swamp are found to be the major changes [28]. And this can possibly disturb bird species diversity and habitat preference.

Systematic studies on bird ecosystem, richness and abundance is inadequate in Cheleleka wetland. There is a vital need for collecting appropriate information on the diversity of the water bird communities to fill gaps on the overall bird list from this habitat types to the country list. The preparation of a list of species is essential to the study of avifauna of an area, because a list indicates species diversity in a common sense [4,5]. Thus, the absence of a scientific exploration makes it impossible to determine the current state of bird diversity and habitat preference on the study area. The result of this study will help provide biodiversity managers with first-hand information on the types of anthropogenic disturbances and how these disturbances could possibly change bird abundance in the future and the selection of proper management method for improving the sustainability of bird abundance.

2. Description of the Study Area

Cheleleka wetland comprises parts of Oromya Regional State, and Southern Nations and Nationalities Peoples’ Regional State (Figure 1). Cheleleka Wetland is located in the upper side of Lake Hawassa and at the exit of the Tikur Wuha River. The geographical co-ordinates of Cheleleka wetland lies on 07° 00’ 13” - 07°6’ 37”N and 38°30’ 51”-38° 34’ 44”E. It is located around 265 km far from Addis Ababa the capital city of Ethiopia with altitudes ranging from 1670-2000m a.s.l. in a total area of 56.6 km². The major vegetation varieties found in the studied wetland are Typha (cattail), which is emergent and herbaceous, and Nymphaea odorata (water lily), which is of the floating-leaved type. Mean annual temperature is around 19 °C. The rainfall is much higher (around 1250 mm annually) in Cheleleka wetland and the surrounding highlands.

3. Materials and Methods

Ornithological Data were collected from 6:30 a.m. to 10:00 a.m. in the morning and from 3:00 p.m. to 6:00 p.m. in the afternoon while bird activity was highest and on days with worthy weather conditions [11]. Avian population was assessed using total count method [21]. In this method, representative wetlands were identified and birds in the areas were counted. Weekly visits to the site were made for six months during both wet and dry seasons and an average of 2 weeks was accounted for a month around total of 80 recording hours. During counting of birds the start and end geographical coordinates of each blocks were saved in Garmin 72 GPS unit to ensure same blocks were repeated during the dry season. Date including starting and finishing time, bird species, number and survey site were recorded. Bird identification was carried out on their morphological features and calls [34] and using field guides [34,37], and observations were assisted by Nikon (8x40mm) binoculars. On each sampling transect line and in each counting session, a species heard without being seen was recorded once to escape overestimation of species abundance due to repeated vocal by the similar individual [37]. Finally, birds’ checklist was prepared on the basis of their scientific names, common names and IUCN status as per [7] and [34].

Secondary and primary data collection methods like Key informants, focus group discussion, and interview were used to identify threats of bird species. Personal observation also used to find out information related to threats on bird species within the wetland habitat. The questions contain a group with closed style items requiring the respondents to rank their percentage of agreement with a particular item such as “yes” or “no”; “increasing”, “decreasing” and unchanged (where 1=disagree; 2= neutral; and 3=agree) depend on a particular question.
as used by [35]. Detailed interviews were conducted using structured and semi-structured questions. In doing so the participants for the detailed interview were selected purposefully based on their tasks they have knowledge, and relevance to subjects understudy.

Three FGD were accompanied. The contributors were selected purposively based on their duties they had knowledgeable, and the importance to the problems under study. The first two FGD was held with experts (4 from agriculture, 2 tourism experts, 3 natural resources management expert, 3 plant sciences, 2 animal science, and 4 wildlife experts). The third FGD was carried out with local communities, (2 from religious leaders, 4 from diverse types of community members and 4 village administrators).

Determined, methodical and careful observation and recording of information based on the threats of birds was carrying out by using surveillance checklists. Camera was used to take the pictures of bird species and anthropogenic practices in and around the wetland.

4. Data analysis

Statistical Product Services and Solutions (SPSS) Version 20 software was used to do the statistical analysis. Diversity of species was also calculated by using Simpson’s Index (Simpson, 1949) and Shannon-Weiner Index (Shannon and Weiner, 1949) for both wet and dry seasons.

\[
H' = - \sum P_i \ln P_i \quad D = 1 - \sum P_i^2
\]

Where,
- \( H' \) = Shannon-Weiner index
- \( S \) = the number of species observed
- \( P_i \) = the proportion of the total sample
- \( \ln \) = natural logarithm
- \( D \) = Simpson’s Index

The collected data was presented by using descriptive statistics methods. The result from numerical data was undertaken or described through tables, bars, and pie charts. In addition, the results of surveys were combined and compared with that of detailed interviews, field observation, focus group discussion and document analysis.

5. Results

5.1 Species Richness

A total of 3500 individual birds belonging to 49 species, 21 families and 10 orders were recorded from the study area. Among the 10 orders Ciconiiformes dominates with 14 species followed by Passeriformes and Anseriformes (9) species each. The least species was recorded in the order Accipitriformes, Charadriiformes, Columbiformes and Piciformes one species each (Table 1). Out of the species recorded in the study area, Wattled Ibis (Bostrychia carunculata) was endemic to both Ethiopia and Eritrea (Table 1).

The species composition of birds during the wet and dry seasons was not significantly different (ANOVA \( p = 0.23 \)) but there was a significant difference in the abundance of bird species (\( t = 1.13, P < 0.05 \))

Table 1. Systematic list of bird species at Cheleleka wetland (August 2018 to February 2019)

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Biological Name</th>
<th>Family/ Sub family</th>
<th>Order</th>
<th>MS</th>
<th>2018 IUCN Red List category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abdim’s Stork</td>
<td>Ciconia abdimii</td>
<td>Ciconinæ  Ciconi-formes</td>
<td>AM</td>
<td>R</td>
<td>LC</td>
</tr>
<tr>
<td>African pygmy Goose</td>
<td>Nettapus auritus</td>
<td>Anatinæ  Anseri-formes</td>
<td>NM</td>
<td>LC</td>
<td></td>
</tr>
<tr>
<td>Black Crane</td>
<td>Amaurornis flaviostris</td>
<td>Rallinæ  Grui-formes</td>
<td>R</td>
<td>LC</td>
<td></td>
</tr>
<tr>
<td>Black Crow</td>
<td>Corvus capensis</td>
<td>Corvidæ  Passeri-formes</td>
<td>R</td>
<td>LC</td>
<td></td>
</tr>
<tr>
<td>Black Heron</td>
<td>Egrettæ ardeiacia</td>
<td>Ardeinæ  Pelecani-formes</td>
<td>NM</td>
<td>LC</td>
<td></td>
</tr>
<tr>
<td>Black-crowned Night Heron</td>
<td>Nycticorax nycticorax</td>
<td>Ardeinæ  Ciconi-formes</td>
<td>R</td>
<td>LC</td>
<td></td>
</tr>
<tr>
<td>Black-headed Heron</td>
<td>Ardea melanophræ ala</td>
<td>Ardeinæ  Ciconi-formes</td>
<td>R</td>
<td>LC</td>
<td></td>
</tr>
<tr>
<td>Black-tailed Godwit</td>
<td>Limosa limosa</td>
<td>Scolopaci-formes  Charadriiformes</td>
<td>NM</td>
<td>NT</td>
<td></td>
</tr>
<tr>
<td>Blue-headed Coucal</td>
<td>entropus erythroceaus</td>
<td>Cuculidæ  Cuculiformes</td>
<td>R</td>
<td>LC</td>
<td></td>
</tr>
<tr>
<td>Comb (Kob-billed) Duck</td>
<td>Sarkidiomis melanoat</td>
<td>Anatinæ  Anseriformes</td>
<td>R</td>
<td>NR</td>
<td></td>
</tr>
<tr>
<td>Common Bulbul</td>
<td>Pycnonotus barbatus</td>
<td>Pycnonotidæ  Passeri-formes</td>
<td>R</td>
<td>LC</td>
<td></td>
</tr>
<tr>
<td>Egyptian Goose</td>
<td>Alopochen aegyptiacus</td>
<td>Anatinæ  Anseriformes</td>
<td>R</td>
<td>LC</td>
<td></td>
</tr>
<tr>
<td>Glossy Ibis</td>
<td>Plegadis falcinællus</td>
<td>Threskior-bithinæ  Ciconiiformes</td>
<td>NM</td>
<td>LC</td>
<td></td>
</tr>
<tr>
<td>Goliath Heron</td>
<td>Ardea goliath</td>
<td>Ardeinæ  Ciconi-formes</td>
<td>R</td>
<td>LC</td>
<td></td>
</tr>
<tr>
<td>Great Egret</td>
<td>Egrettæ alba</td>
<td>Ardeidæ  Pelecaniformes</td>
<td>R</td>
<td>NR</td>
<td></td>
</tr>
<tr>
<td>Great Reed Warbler</td>
<td>Acrocephalu sarundi-nacus</td>
<td>Sylviidæ  Passeri-formes</td>
<td>NM</td>
<td>LC</td>
<td></td>
</tr>
<tr>
<td>Grey Heron</td>
<td>Ardea cinerea</td>
<td>Ardeidæ  Pelecaniformes</td>
<td>NM</td>
<td>LC</td>
<td></td>
</tr>
<tr>
<td>Gull-billed Tern</td>
<td>Gelochelidon nilotica</td>
<td>Laridæ  Charadriiformes</td>
<td>NM</td>
<td>LC</td>
<td></td>
</tr>
<tr>
<td>Hadada ibis</td>
<td>Bostrychia hagedash</td>
<td>Threskior-bithinæ  Ciconiiformes</td>
<td>R</td>
<td>LC</td>
<td></td>
</tr>
<tr>
<td>Hammerkop</td>
<td>Scopus umbretta</td>
<td>Scopidæ  Ciconiiformes</td>
<td>R</td>
<td>LC</td>
<td></td>
</tr>
</tbody>
</table>
### 5.2 Species Diversity, Evenness and Dominance

The Shannon-Weiner diversity index shown that highest bird species diversity ($H'=3.42$) was recorded during wet
season. During dry season the least diversity of avian species was recorded. The highest even distribution of species was recorded during wet season (E=0.89). During dry season highest dominance index was recorded (0.04) (Table 2).

Table 2. Avian species abundance, diversity and evenness during wet and dry seasons

<table>
<thead>
<tr>
<th>Study site</th>
<th>Season</th>
<th>species richness</th>
<th>Abundance (no. of individuals)</th>
<th>D</th>
<th>H’</th>
<th>H’/H’max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cheleleka wetland</td>
<td>Wet</td>
<td>49</td>
<td>1900</td>
<td>0.02</td>
<td>3.42</td>
<td>0.89</td>
</tr>
<tr>
<td></td>
<td>Dry</td>
<td>41</td>
<td>1500</td>
<td>0.04</td>
<td>3.41</td>
<td>0.82</td>
</tr>
<tr>
<td></td>
<td>Both</td>
<td>38</td>
<td>835</td>
<td>0.02</td>
<td>3.38</td>
<td>0.83</td>
</tr>
</tbody>
</table>

Notes: D=Simpson’s Dominance Index; H’=Shannon-Wiener Index; H’/H’max= Evenness; H’max= ln(S)

5.3 Threats to the Avifauna in Cheleleka Wetland

According to community residents, farmers and local communities who have lived in and around the wetland, the main threats of bird species are grazing, urbanization, agricultural expansion, habitat fragmentation, accessibility and resource extraction (Figure 4).

The highest respondents approved that overgrazing the wetland (86%), agricultural expansion (85.6%), human settlement (75.8%), sand extraction(45%),4%) and habitat fragmentation were major threats. Whereas, out of the total respondents, 39% and 22% respondents were disagreed to the presence of wetland shrinking and killing and hunting of bird species, respectively.

Figure 4. Responses of respondents regarding on threats of bird species in Cheleleka wetland

The investigation shown that all of the nominated interviewed the surrounding district community and offices respondents have feeling the highest threat towards bird diversity were due to the highest in grazing (20.29%), wetland degradation and fragmentation(15.71%) and expansion of agriculture (14.29%). Settlement, sand extraction, district administration problems, pollution and invasive species also highly contributed to threats of bird species (Table 3).

Table 3. Threats of avifuna in Cheleleka wetland

<table>
<thead>
<tr>
<th>Threats</th>
<th>Frequency</th>
<th>Percent (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grazing</td>
<td>16</td>
<td>20.29</td>
</tr>
<tr>
<td>Wetland degradation and fragmentation</td>
<td>11</td>
<td>15.71</td>
</tr>
<tr>
<td>Expansion of Agriculture</td>
<td>10</td>
<td>14.29</td>
</tr>
<tr>
<td>Sand extraction</td>
<td>8</td>
<td>11.43</td>
</tr>
<tr>
<td>Settlement</td>
<td>9</td>
<td>12.86</td>
</tr>
<tr>
<td>Administration problem</td>
<td>4</td>
<td>5.71</td>
</tr>
<tr>
<td>Pollution</td>
<td>3</td>
<td>5.43</td>
</tr>
<tr>
<td>Urbanization</td>
<td>6</td>
<td>8.57</td>
</tr>
<tr>
<td>Invasive species</td>
<td>2</td>
<td>4.72</td>
</tr>
<tr>
<td>Total</td>
<td>68</td>
<td>100%</td>
</tr>
</tbody>
</table>

Based on direct field observations, there were many human induced threats of birds directly or indirectly (Figure 5). Settlement, agriculture expansion, direct human disturbance through sand extraction, overgrazing by livestock, and habitat fragmentation were the maximum critical threats directly to the Cheleleka wetland that in turn will effect on biodiversity protection in the habitat. Various development activities, such as roads, agriculture and settlements have also made an edge. The destruction events are conveyed from (Figure 5) which has been changed into agricultural fields and new human settlements.

Figure 5. Major threats of bird species in Cheleleka wetland (Photo: Amare Gibru, 2018)

6. Discussion

6.1 Species Diversity

The significant seasonal variation of species diversity in
Cheleleka wetland might be due to the seasonal availability of food for different bird species and nesting sites in the area. Other studies have also shown that seasonal variations in rainfall and food resources have led to seasonal variations in the diversity of birds [6]. The diversity of bird species is influenced by the structure of the vegetation that forms a major component of their habitats.

The lowest abundance and richness of species was shown during the dry season in Cheleleka wetland. This may be due to the presence of human disturbance and livestock grazing in the wetland. There was also sand extraction as observed during field visit. Over grazing is associated with the decreased physical density of vegetation; and this forced to the decline and loss of a diversity of bird species in the wetland [36]. This has an effect on the number of birds that depend on such habitats. The impacts of habitat loss and grazing on cover, nesting grounds and food availability to birds reasons for a dangerous situation for the survival of avian fauna [18, 24].

6.2 Threats of Avian Species

Various biodiversity habitats in Ethiopia are exposed to habitat loss and degradation [13]. In case of growing human population, agricultural expansion in to the wetland area increments and the presence of additional lands adjacent to the wetland habitat area used for farmland; this makes pressure on bird species inhabitants. Agricultural practices nearby wild life habitats, rural and urban expansion activities have led to the decline and modification of habitats, causing in the losses of biodiversity. The outcomes of this investigation were addressing some of the effects of threats of the wetland habitat which directly impacts to bird species. High demand for natural resources uses consequences to land use changes hence loss to genetic diversity, species decrease and ecosystem changes such as accidental population changes, disease outliers, habitat fragmentation and consequential to biodiversity losses [31].

As per population growths, there is an aggregate use for space and resource consumption and impacts on wild life ecology [38]. In similar situation, the Cheleleka wetland bird species were decreased and the wetland habitat is threatened in different cases. During the local communities’ interview, there were also a many threats that were identified by local communities in Cheleleka wetland.

According to this study, the major threats of the bird species on the study area were habitat disturbances by over grazing, agricultural expansion around the wetland, settlement and sand extraction. The finding of the present study is in agreement with [33]. Anthropological actions impact ecosystem structure and function, specifically the spatial and temporal distribution of wildlife’s [32]. This is particularly true for the Cheleleka wetland, in which the wetland becomes increasingly narrow, and become points of contacts. These threats of bird species increased from livestock grazing, settlement and expansion of agriculture. These and other activities resulted in disruption, reduction in diversity of species in line to devastation of habitat and high competition on foraging in the area. According to [30] report, the main problem facing biodiversity areas today is the development in human settlement of adjacent lands and the illegal harvesting of natural resources within the areas. In Cheleleka wetland habitat also there is the expansion of settlements in and the surrounding areas which might be a threat to the wetland and bird populations. Habitat fragmentation and overexploitation are effect on biodiversity sustainability [16] this is in agreement with the present study. [31] Reported that habitat loss is one of the major causes of wildlife habitat loss. Improper disposal of garbage and also Effluent discharge from Hawassa Textile Factory to Cheleleka wetland were observed in the present study area which causes pollution in the habitat. These factors are considered to be threats to the avifauna in the Cheleleka wetland, thus strong conservation measures are needed.

7. Conclusion and Recommendations

The study area comprised resident, endemic, migratory and globally threatened bird species. The presence a high number of these species suggests that Cheleleka wetland is key conservation habitat of birds. The seasonal variation in avian species and number of individuals in the study area was related to the differences in resource availability of the wetland. During wet season, the highest species richness and abundance of species were recorded in the study area. Generally the study area harbour diverse bird species. However, interferences with the wetland were identified. Overgrazing, human settlement, agricultural expansion, sand extraction and habitat fragmentation were the major threats of avian species. Therefore, conservation measures by involving the local community are needed to protect the biological diversity of the wetland habitat.

8. Conflict of Interests

The author(s) has not declared any conflict of interests.

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