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

Amare Gibru* Zelalem Temesgen

Ethiopian Biodiversity Institute, 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.

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 globe [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 [3], 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 [15]. 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-

*Corresponding Author:

Amare Gibru,

Ethiopian Biodiversity Institute, Ethiopia;

Email: agibru64@gmail.com

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.

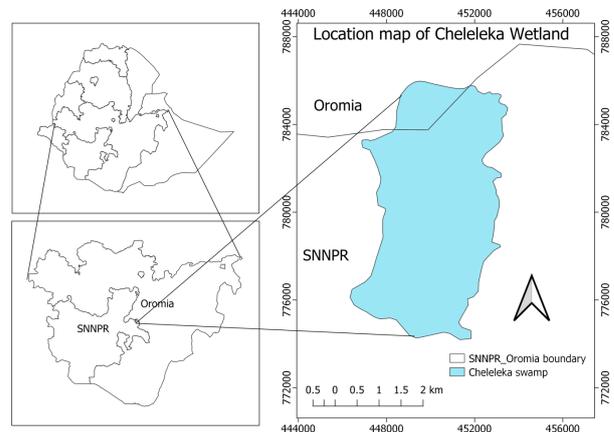


Figure 1. Location map of the study area

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 purposively based on their tasks they have, knowledge, and relevance to subjects under study.

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.

$$H' = -\sum_{i=1}^S P_i \ln P_i \quad D = 1 - \sum_{i=1}^S P_i^2$$

Where,

H’ = Shanon-Weiner index

S = the number of species observed

Pi =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 un-taken 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)

Common Name	Biological Name	Family/sub family	Order	MS	2018 IUCN Red List category
Abdim’s Stork	<i>Ciconia abdimii</i> Polyboroides typus	Ciconiinae Accipitridae	Ciconiformes	AM R	LC LC
African pygmy Goose	<i>Nettapus auritus</i>	Anatinae	Anseriformes	NM	LC
Black Crane	<i>Amauromis flavirostris</i>	Rallinae	Gruiiformes	R	LC
Black Crow	<i>Corvus capensis</i>	Corvidae	Passeriformes	R	LC
Black Heron	<i>Egretta ardesiaca</i>	Ardeidae	Pelecaniformes	NM	LC
Black-crowned Night Heron	<i>Nycticorax nycticorax</i>	Ardeinae	Ciconiformes	R	LC
Black-headed Heron	<i>Ardea melanocephala</i>	Ardeinae	Ciconiformes	R	LC
Black-tailed Godwit	<i>Limosa limosa</i>	Scolopacinae	Charadriiformes	NM	NT
Blue-headed Coucal	<i>entropus cupreicaudus</i>	Cuculidae	Cuculiformes	R	LC
Comb (Knob-billed) Duck	<i>Sarkidiomis melanotos</i>	Anatinae	Anseriformes	R	NR
Common Bulbul	<i>Pycnonotus barbatus</i>	Pycnonotidae	Passeriformes	R	LC
Egyptian Goose	<i>Alopochen aegyptiacus</i>	Anatinae	Anseriformes	R	LC
Glossy Ibis	<i>Plegadis falcinellus</i>	Threskiornithinae	Ciconiformes	NM	LC
Goliath Heron	<i>Ardea goliath</i>	Ardeinae	Ciconiformes	R	LC
Great Egret	<i>Egretta alba</i>	Ardeidae	Pelecaniformes	R	NR
Great Reed Warbler	<i>Acrocephalus sarundinaceus</i>	Sylviidae	Passeriformes	NM	LC
Grey Heron	<i>Ardea cinerea</i>	Ardeidae	Pelecaniformes	NM	LC
Gull-billed Tern	<i>Gelochelidon nilotica</i>	Laridae	Charadriiformes	NM	LC
Hadada ibis	<i>Bostrychia hagedash</i>	Threskiornithinae	Ciconiformes	R	LC
Hammer kop	<i>Scopus umbretta</i>	Scopidae	Ciconiformes	R	LC

Hooded Vulture	Necrosyrtes monachus	Accipitridae	Accipitiformes	R	LC
Hottentot Teal	Spatula hottentota	Anatidae	Anseriformes	NM	LC
Intermediate Egret	Egretta intermedia	Ardeinae	Ciconiiformes	R	LC
Lesser Swamp Warbler	Acrocephalus gracilirostris	Sylviidae	Passeriformes	R	LC
Little Egret	Egretta garzetta	Ardeinae	Ciconiiformes	R	LC
Little Ringed Plover	Charadrius dubius	Charadriidae	Charadriiformes	NM	LC
Little Weaver	Ploceus luteolus	Ploceinae	Passeriformes	R	LC
Marsh Warbler	Acrocephalus alustris	Sylviidae	Passeriformes	NM	LC
Northern Carmine Bee-eater	Merops nubicus	Meropidae	Coraciiformes	R	LC
Northern Pintail	Anas acuta	Anatidae	Anseriformes	NM	LC
Northern Shoveler	Anas clypeata	Anatinae	Anseriformes	NM	LC
Pied Avocet	Recurvirostra avosetta	Recurvirostridae	Charadriiformes	NM	LC
Pied Crow	Corvus albus	Corvidae	Passeriformes	R	LC
Purple Heron	Ardea Purpurea	Ardeidae	Ciconiiformes	R	LC
Red-eyed Dove	Streptopelia semitorquata	Columbinae	Columbiformes	R	LC
Ruff	Philomachus pugnax	Calidritinae	Charadriiformes	NM	LC
Sacred Ibis	Threskiomis aethiopicus	Threskiorbithinae	Ciconiiformes	R	LC
Silver-cheeked Hornbill	Bycanistes brevis	Bucerotinae	Coraciiformes	R	LC
Slender-billed Starling	Onychognathus tenuirostris	Sturnidae	Passeriformes	R	LC
Southern Pochard	Netta erythrophthalma	Anatinae	Anseriformes	NM	LC
Spur-winged Goose	Plectropterus gambensis	Anatinae	Anseriformes	R	LC
Squacco heron	Ardeola ralloides	Ardeinae	Ciconiiformes	NM	LC
Village Weaver	Ploceus cucullatus	Ploceinae	Passeriformes	R	LC
Wattled Ibis	Bostrychia Carunculata	Threskiorbithinae ^{NE}	Ciconiiformes	R	LC
White Stork	Ciconia ciconia	Ciconiinae	Ciconiiformes	NM	LC
Whitebacked Duck	Thalassomis leuconotus	Anatinae	Anseriformes	R	LC
Yellow-billed Egret	Egretta intermedia	Ardeidae	Pelecaniformes	R	LC
Yellow-billed stork	Mycteria ibis	Mycteriinae	Ciconiiformes	R	LC

Description:

(1) Movement: MS=migratory status, PM=Palaearctic Migrant, AM= Intra-African Migrant, R=resident

(2) Endemism: NE=near endemic^{NE}

(3) IUCN Conservation Status: NT=Near Threatened, LC=Least Concern, CR =Critically Endangered, NR= Not Recognized

(4) Family names end with ...dae. And subfamily ...nae.

The analysis of data on migratory status revealed that out of 49 species, 17 Palaearctic Migrants (34.69%) and 1 Intra-African Migrants (2.04 %) were recorded during the study period. The remaining (31) bird species (63.26%) were residents (Figure 2).

As per IUCN status (2018), 46 species were least concern, and one species Black-tailed Godwit (Limosa limosa) was near threatened. Two non-recognized species were also recorded during the study period (Figure 3).

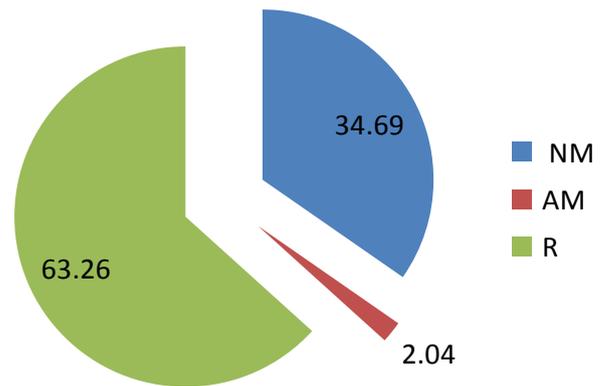


Figure 2. Percentage migratory status of bird species

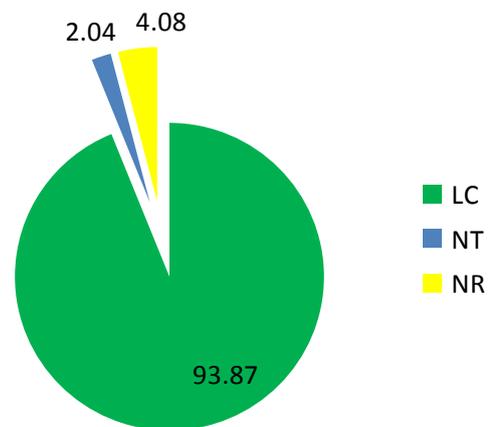


Figure 3. Percentage IUCN status of bird species

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

Study site	Season	species richness	Abundance (no. of individuals)	D	H'	H'/H'-max
Cheleleka wetland	Wet	49	1900	0.02	3.42	0.89
	Dry	41	1500	0.04	3.41	0.82
	Both	38	835	0.02	3.38	0.83

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.

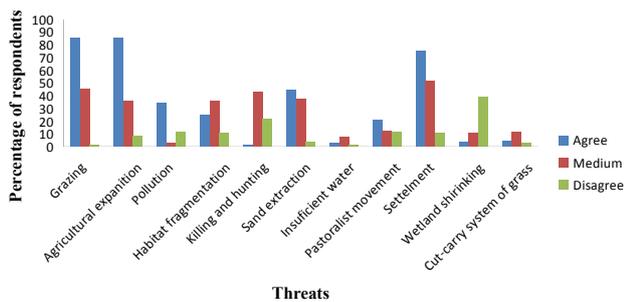


Figure 4. Responses of respondents regarding on threats of bird species in Cheleleka wetland

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 avifauna in Cheleleka wetland

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

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^[1].

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.

References

- [1] Abebe, F.B., Bekele, S.E. Challenges to national park conservation and management in Ethiopia. *Journal of Agricultural Science*, 2018, 10(5): 52.
- [2] Babu A. Assessment of Challenges and Opportunities of Wetlands Management in Bule Hora Woreda,

- Borena Zone, Southern Ethiopia. Science Technology and Arts Research Journal, 2015, 4(2): 99- 111.
- [3] Benson, T.J., Brown, J.D., Bednarz, J.C. Identifying predators clarifies predictors of nest success in a temperate passerine. *Journal of Animal Ecology*, 2010, 79(1): 225-234.
- [4] Bibby, C. Why count birds. Expedition Field Techniques: Bird Surveys. Expedition Advisory Centre. Royal Geographical Society. Kensington, London, 1998: 5-11.
- [5] Bibby, C.J. Burgess, N. D., Hill, D. A., Mustoe, S. Birds' Census Techniques. 2nd edition. Academic Press. London, 2000: 302.
- [6] Bibi, F., Z. Ali. Measurement of diversity indices of avian communities at Taunsa Barrage Wildlife Sanctuary, Pakistan. *The Journal of Animal & Plant Sciences*, 2013, 23(2): 469-474.
- [7] BirdLife International. Country profile: Ethiopia, 2017. Available from: <http://www.birdlife.org/datazone/country/ethiopia> Checked: 2018-02-17
- [8] Blumenfeld S, Lu C, Christophersen, D.Coates. Water, wetlands and forests. a review of ecological, economic and policy linkages. In Secretariat of the Convention on Biological Diversity and Secretariat of the Ramsar Convention on Wetlands, Montreal and Gland. CBD Technical Series, 2009, 47.
- [9] Brawn, J. D., S.K. Robinson, F.R. Thompson. *Journal of Annual Review of Ecological Systems*, 2001, 32: 251-276.
- [10] Brooks RP, TL. Serfass, M.Triska LM Rebelo. Ramsar Protected Wetlands of International Importance as Habitats for Otters. In Proceedings of XIth International Otter Colloquium, IUCN Otter Spec. Group Bulletin B, 2011, 28: 47-63.
- [11] Centerbury, G.E., T.E., Martin, L.J Petit, D.F. Bradford. Bird communities and habitats are ecological indicators of forest condition in regional monitoring. *Conservation Biology*, 2000, 14: 1-14.
- [12] Davis, T. J. (Ed.). *The Ramsar Convention Manual: A Guide to the Convention on Wetlands of International Importance especially as Waterfowl Habitat*. 6th edition. Ramsar Convention Bureau, Gland, Switzerland, 1994: 207.
- [13] Debella, H.J. "Command and Control": 75 Years of Quasi Wildlife Policy Analysis of Ethiopia. *Journal of International Wildlife Law & Policy*, 2019, 22(1): 33-54.
- [14] Dubeau P, King DJ, Unbushe DG, Rebelo LM. Mapping the Dabus Wetlands, Ethiopia, Using Random Forest Classification of Landsat, PALSAR and Topographic Data. *Remote Sensing*, 2017, 9(1056): 1-23.
- [15] Faaborg, J., Holmes, R.T., Anders, A.D., Bildstein, K.L., Dugger, K.M., Gauthreaux Jr, S.A., Heglund, P., Hobson, K.A., Jahn, A.E., Johnson, D.H., Latta, S.C. Recent advances in understanding migration systems of New World land birds. *Ecological monographs*, 2010, 80(1): 3-48.
- [16] Fisher, M.C., Henk, D.A., Briggs, C.J., Brownstein, J.S., Madoff, L.C., McCraw, S.L., Gurr, S.J. Emerging fungal threats to animal, plant and ecosystem health. *Nature*, 2012, 484(7393): 186.
- [17] Gbogbo, F. The importance of unmanaged coastal wetlands to waterbirds at coastal Ghana. *African Journal of Ecology*, 2007, 45(4): 599-606.
- [18] Girma Mengesha, Yosef Mamo, Afework Bekele, K.S.C.E.A. Effects of Land-use on Birds Diversity in and around Lake Zeway, Ethiopia. *Journal of Science & Developemnt*, 2014, 2: 5-22.
- [19] Gordon, C., K. Yankson., C.V. Biney., J.W. Tumbolto., D.S. Amlalo, D. Kpelle. Report of the Working Group on Wetland Typology. Report to Ghana Coastal Wetlands Management Project, Accra: Ghana Wildlife Department, 1998: 54.
- [20] Heino, J., Melo, A.S., Siqueira, T., Soininen, J., Valanko, S., Bini, L.M. Metacommunity organisation, spatial extent and dispersal in aquatic systems: patterns, processes and prospects. *Freshwater Biology*, 2015, 60(5): 845-869.
- [21] Hoves JG, Bakewell D. *Shore Bird Studies Manual*. AWB Publications, 1989, 55: 362.
- [22] Israel, P. M., Timar P.M. Wetland ecosystems in Ethiopia and their implications in ecotourism and biodiversity conservation. *Journal of Ecology and The Natural Environment*, 2018, 10(6): 80-96.
- [23] Jafari N. Ecological integrity of wetland, their functions and sustainable use. *Journal of Ecology and the Natural Environment*, 2009, 1(3): 045-054.
- [24] Jansen H., H. Hendsidijk, Dagnachew Legesse, Tenaalem Ayenew, P. Hellegrs, H. Spliesthoh. Land and water resources assessments in Ethiopian central rift valley: ecosystem for water, food and economic development in the Ethiopian central rift valley. *Alterra: Wageningen*, 2007: 1-85.
- [25] Johnson S. Texas aquatic science: Teacher guide to aquatic science and ecosystems curriculum. A joint project of Texas parks and wildlife department, Texas state university and University of Corpus Christi, 2013.
- [26] Kangah-Kesse, L., D. Attuquayefio., E.H. Owusu, F. Gbogbo. *West African Journal of Applied Ecology*, 2007, 11: 41-50.
- [27] Lamsal P, Pant KP, Kumar L, Atreya K. Sustainable livelihoods through conservation of wetland resource-

- es: a case of economic benefits from Ghodaghodi Lake, western Nepal. *Ecology and Society*, 2015, 20(1): 1-11.
- [28] Lemlem, Abrha. Assessing the Impact Of Land Use And Land Cover Change On Groundwater Recharge Using Rs And Gis; A Case Of Awassa Catchment, Southern Ethiopia (Doctoral Dissertation, Addis Ababa University; Ethiopia. Unpublished), 2007.
- [29] Lepage. D. Avibase-Bird check lists of the World-Ethiopia, 2017.
<https://avibase.bsc-eoc.org/checklist.jsp?region=ET&list=clements> (Accessed on 12/09/2017)
- [30] Luck, G.W. A review of the relationships between human population density and biodiversity. *Biological Reviews*, 2007, 82(4): 607-645.
- [31] Mekonen, S., Chinasho, A., Berhanu, K., Tesfaye, S. Threats and conservation challenges of wildlife in Harenna Forest, Harenna Buluk District, South East Ethiopia. *International Journal of Biodiversity and Conservation*, 2017, 9(7): 246-255.
- [32] Ogutu JO, Piepho HP, Reid RS, Rainy ME, Kruska RL, Worden JS, Nyabenge M, Hobbs NT. Large herbivore responses to water and settlements in savannas. *Ecol. Monogr*, 2010, 80: 241-266.
- [33] Redfern JV, Grant CC, Biggs HC, Getz WM. Surface water constraints on herbivores foraging in the Kruger National Park. *S. Afr. J. Ecol.*, 2003, 84: 2092-2107.
- [34] Redman, N., Stevenson, T., Fanshawe, J. *Birds of the Horn of Africa: Ethiopia, Eritrea, Djibouti, Somalia, and Socotra*. Princeton University Press, Princeton and Oxford, 2009: 496.
- [35] Sefi M., Alefu C., Kassegn B., Sewnet T. Threats and conservation challenges of wildlife in Harenna Forest, Harenna Buluk District, South East Ethiopia. *International Journal of Biodiversity and Conservation*, 2017, 9(7): 246-255.
- [36] Scott, M.L., S.K. Skagen, M.F Merigliano. Relating geomorphic change and grazing to avian communities in riparian forests. *Conservation Biology*, 2003, 17(1): 284-296.
- [37] Stevenson, T. Fanshawe, J. *Field Guide to the Birds of East Africa: Kenya, Tanzania, Uganda, Rwanda and Burundi*. T and A D Poyser Ltd. London, 2002: 602.
- [38] Yihune M, Bekele B, Tefera Z. Human-Gelada Baboon Conflict in and around the Simien Mountains National Park, Ethiopia. *Afr. J. Ecol.*, 2008, 19: 1-7.