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DIVERSITY, ABUNDANCE AND THREATS OF AVIAN SPECIES IN KOGA DAM AND ITS SURROUNDINGS, NORTH-WESTERN ETHIOPIA

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ABSTRACT: A survey of birds was conducted in Koga Dam Reservoir of the Amhara Region, Northwestern Ethiopia from October 2010 to March 2011. The objective of the study was to assess the diversity of birds and anthropogenic activities in the Dam and its environs. Data collection methods included transect method, interviews, and direct observations. Three habitats were identified for the study, i.e., wetland, farmland and scrubland. Diversity indices including Shannon diversity index were used for data analysis. The results showed that a total of 103 bird species belonging to 75 genera, 24 families and 11 orders were found. Charadriiformes appeared to be the most dominant order represented by 8 families and 25 species, followed by Passeriformes with 5 families and 15 species. The least was Phoenicopteriformes, Coraciiformes and Strigiformes, with1 family and 3 species each. Bird diversity was high in the scrubland (H′=3.96) and low in the farmland (H′=3.20) during the wet season. The highest species richness during both seasons was recorded in wetland (65) followed by farmland(55). The least species number was recorded in the scrubland (53). The newly constructed dam has changed the species composition and feeding habits of birds. After the construction of the dam, new bird species arrived and the number of natives increased. According to farmers, after the construction of the dam, seed feeder birds, unlike carnivores, shifted their feeding habits from the wetland to crops and became pests. Anthropogenic threats such as clearing of natural vegetation, sedimention, over-grazing, recesssion farming and over exploitation of other resources all contribute to the decline of the bird species. Thus, appropriate measures must be taken to re-stabilize the bird habitat.

Key words/phrases: Bird species, Change of habitat, Diversity, Reservoir.

INTRODUCTION

Ethiopia is a country of great geographic diversity with wide altitudinal and physiographic variation. The altitude ranges from 116 meters below sea level in the Danakil Depression to the highest peak of 4,653 meters above sea level on Mount Ras Dashen. Ethiopia is rich in biodiversity and 7 thousand km^2 of its 1.1 million km^2 area is covered by water (Yilma Delelegn and Geheb, 2003). Ecosystems range from dry lowlands to humid forests, wetlands to cool highland plateaus resulting in variable climate, topography and vegetation and unique biota with high level of endemism (EWNHS, 1996). Ethiopia has established about 73 Important Bird Areas (IBAs), 30 of which comprise wetlands, while the rest represent other ecosystems (Shimelis Aynalem and Afework Bekele, 2008).

Birds are considered as useful biological indicators because they ecologically adapt to all kinds of habitats (Sivaperuman and Jayson, 2006). Wetlands are important habitats of fauna (Ramseur Convention Bureau, 2000; Beury *et al*., 2008). However, the importance of wetlands depends on different factors (wetland size, diversity of vegetation, water quality, food resources and topography) (Mitsch and Gosselink, 2000). In wetlands, birds breed, nest and teach young, drink water, feed, rest, shelter and interact (Bibby *et al*., 1998). Wetlands provide food for birds such as plants, vertebrates, and invertebrates (Ramseur Convention Bureau, 2000).

Birds are the most conspicuous, with specialized traits evolved to exploit the resources of habitats in rivers and wetlands (Ormerod and Tyler, 1993; Buckton and Ormerod, 2002). The effect of environmental change on the distribution, abundance and range of river birds is often reduced (Ormerod *et al*., 1986; Ormerod and Tyler 1993; Colombari and Cordiner, 1999; Ormerod *et al*., 2000).

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Dams are vital for the society because they serve as source of water and hydropower (WCD, 2000; Lehner *et al*., 2011). However, damming also impacts their y ecosystems, fresh water ecosystems and terrestrial species (Ligon *et al*., 1995; Liermann *et al*., 2012). The Koga dam has dramatically altered or eliminated the previous wetland ecology and habitat, and the result was complete damage of the habitat of the wetland-dependent bird species (Kingsford and Johnson, 1998; Kingsford, 2000; Leslie, 2001; Kingsford *et al*., 2004; Brandis *et al*., 2011).

Loss and alteration of habitats leads to degradation of breeding sites (Davidson and Rothwell, 1993; Scott and Poole, 1989). The response of birds to loss of habitat is a central issue of contemporary conservation biology (Mikusiński and Angelstam, 2004). Alteration of Koga River and the establishment of new man-made habitat along the river have been accompanied by changes in vegetation composition and structures, which affect the life of birds. We hypothesized that the construction of Koga Dam leads to the extinction of wetland birds, encourage water birds and force wetland birds to feed on crops because of loss of food resources of their original wetland habitat and it invites newcomers who prefer water in the dam. This study provides comprehensive baseline information of the birds in this area for the future as well as to create awareness for conservation.

MATERIALS AND METHOD

The Study Area

This study was carried out in and around Koga Dam reservoir (Figure 1) which is situated in Mecha district, northwestern Ethiopia. Koga Dam is bordered by five kebeles, i.e., Abyotfana, Kurt Bahir, Enashenfalen, Enamert and Kudmi. Koga catchment is found in the North Western Ethiopian highlands, situated between longitudes of 37°02' and 37°18'E and latitudes of 11°9.7' and 11°30'N. It covers an area of about 2000 hectares and the catchment is 250 km². Koga River is one of the rivers in the catchment, which is a tributary of the Blue Nile river. The source of the river is Wezem, 3200 m altitude, and it runs 64 km before reaching and filling the reservoir.

The dam was constructed to irrigate 7 thousand ha of the district. Meteorological data were obtained from the nearest station located in Merawi town. The mean annual rainfall is 2000 mm. The rainy season extends from May to October and the dry season from November to April. Most of the rainfall is received in July and August. The mean minimum temperature is 12.3 °C and mean maximum is 26.7 °C. Figure 2 shows some of the land use systems commonly practiced in the area.

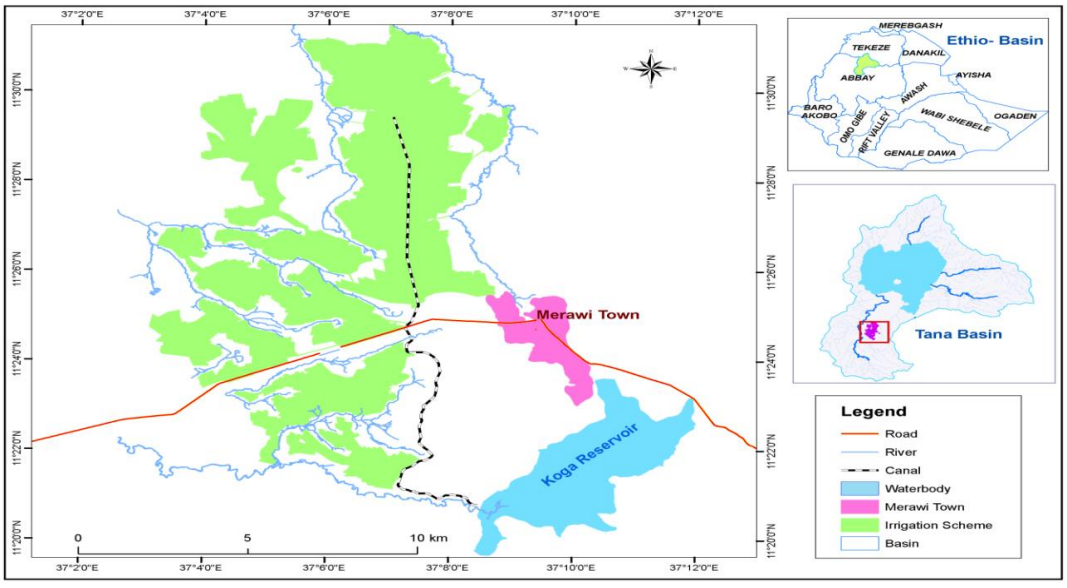

Figure 1. Map of the study area (source: Mecha woreda Koga Project Office, unpublished)

Methodology

First the area was divided into blocks and then data were collected using three methods: transect walk, point transect and observation. Data were recorded from August 2010 to March 2011 during the wet and dry seasons (Amare Lemma, 2005). Birds were physically observed using naked eyes, digital camera, and binoculars (7 × 35) and they were identified using standard African bird guidebooks (Mack Worth-praed and Grant, 1955; Harrison and Smith, 1993; Perlo,1995; Sinclair and Ryan, 2003).Data were collected by observation in line ransects walk and point transects. Toassess avifauna species and abundance, line transect sampling method was used for large and relatively uniform areas of wetlands (Bibby *et al.,* 1992). A total of 18 transects were placed at existing paths (Bibby *et al*., 2000). The length of each transect varied and ranged from 400-500 m depending on the situation in the area. Transects were separated from each other by 300 m.

a)

b)

c)

Figure 2. Some representative landuse systems in the dam area. The pictures show the most important threats of the dam, most of which are never regulated; a) severity of sedimentation in the area; b) steadily encroaching recession agriculture and c) ubiquitous livestock grazing in the dam area.

Birds were also studied using point count method, whereby 6 point counting sites were selected. The bird count was done at each point for 5-15 minutes. Distance of each point is 300 m at minimum. All bird species were recorded within 25 meters radius. Data collection was carried out

twice daily early in the morning from 6:00 AM to 10:00 AM and late afternoon from 4:00 PM to 6:30 PM when birds were active (Tsigereda Dessalegn, 2011). Birds recorded were categorized to species, genera, family and order levels with the aid of field guidebook of West African Birds (Bibby *et al*., 2000).

Interview of local community members about birds before and after the dam

Three of the five *kebeles* that border the dam area, i.e., Elino got, Shafrie got and Kudmi (Shatie got) were selected for the interview by using purposive sampling method. Respondents were selected using simple random sampling from the three kebeles. According to kebele administration office, during the study period, 300 households resided permanently in that area and from these 10%, i.e., 30 respondents were included in the study.

RESULTS

Diversity

In the present study, a total of 103 bird species belonging to 75 genera, 24 families and 11 orders were identified (Table 1).Each bird species was assigned to an Order, Family, common name, scientific name. and status. Charadriiformes appeared to be the most dominant order represented by 8 families and 25 species, followed by Passeriformes with 5 families and 15 species. The least was Phoenicopteriformes, Coraciiformes and Strigiformes, with1 family and 3 species each (Table 1). During the study, 19 Northern or Pala arctic migrant, 2 intra-Africa local migrants' one residents or partial migrants and the rest 81 species were resident (Table 1).

Data analysis

Descriptive statistics such as percent was used to analyze the data using SPSS software (Version 21).The species diversity of each habitat in the two seasons was analyzed using Shannon diversity Index (H′) (Shannon and Wiener, 1949) using the formula $H' = -\Sigma (pi \ln pi)$. Species evenness was evaluated using Shannon-Wiener evenness Index ($E = H'/H$ Max). The Richness Index (RI) of each species was calculated using the formula ($RI = S-1/\ln I$).

Based on the IUCN Red List criteria, birds of the study were grouped as follows: Hooded vulture and white headed vulture were critically endangered, Lappet faced vulture was endangered, Black crown crane, watt led crane and Abyssinian ground horn bill, Woolly necked storkand Black crowned- crane were vulnerable, Rouget's rail was near threatened and the rest ninety five species were least concerned (Table 1).

Distribution across habitats and seasons

During the present study, bird species varied in distribution with respect to habitat types. Among the observed bird species, 68 species were recorded from wetland, 37 from scrubland, and 23 from farmland site (Table 2). Seasonal distribution appeared to be similar (wet and dry seasons).

Table 1. Bird order, family and status of birds.

Common name	Scientific name	Life Style (status	Status
Order: Charadriiformes, **Family:** Charadriidae			
Black bellied plover	*Pluvialissquatarola*	Migrant	LC
Crowned lapwing	*Vanelluscoronatus*	Resident	LC
Spur winged lapwing	*Vanellusspinosus*	Resident	LC
Black headed lapwing,	*Vanellustectus*	Resident	LC
Wattled lapwing	*Vanellussenegallu*	Resident	LC
Order: Charadriiformes, **Family:** Phalacrocoracidae			
White necked cormorant	*Phalacrocoraxlucidus*	Resident	LC
Long tailed cormorant	*Microcarbo africanus*	Resident	LC
Order: Charadriiformes, **Family**: Jacanidae			
Lesser jacana	*Microparracapensis*	Resident	LC
African jacana	*Actophilornis africanus*	Resident	LC

Order: Charadriiformes, **Family***:* Pluvianidae			
Egyptian plover	*Pluvianusaegyptius*	Resident	LC
Order: Charadriiformes, **Family**: Recurvirostridae			
Black-winged stilt,	*Himantopushimantopus*	Resident	LC
Order: Charadriiformes, **Family***:* Scolopacidae			
Common sandpiper	*Actitishypoleucos*	Migrants	Lc
Lesser yellowlegs	*Tringaflavipes*	Palearctic migrants	LC
Marsh sandpiper	*Tringastagnatilis*	Palearctic migrants	LC
Great snipe	*Gallinago media*	Resident	Near Threatened
Long-toed stint	*Calidrissubminuta*	Palearctic migrants	LC
Little stint	*Calidrisminuta*	Palearctic migrants	LC
Order: Charadriiformes, **Family**: Burhinidae			
Water thick	*Burhinusvermiculatus*	Resident	LC
Spotted thick	*Burhinuscapensis*	Resident	LC
Senegal thick	*Burhinus senegalensis*	Resident	Lc
Order: Charadriiformes, **Family**: Laridae			
Black-headed gull	*Chroicocephalusridibundus*	Northern or Palaerctic Migrant	LC
Lesser black-backed gull	*Larusfuscus*	Northern or Palaerctic migrant	LC
Great black-backed gull	*Larus marinus*	Northern Or Palaearctic migrant	LC
Great black-backed gull	*Larus marinus*	Northern Or palaearctic migrant	LC
Great black-backed gull	*Larus marinus*	Northern Or Palaearctic migrant	LC
Order: Ciconiiformes, **Family**: Ciconiidae			
White stork	*Ciconia ciconia*	Intra African migrant	LC
Marabou stork	*Leptoptiloscrumenifer*	Resident	LC
Woolly necked stork	*Ciconiaepiscopes*	Intra African migrant	Vulnerable
Order: Pelecaniformes, **Family**: Ardeidae			
Back headedheron	*Aredamelanocephala*	Resident	LC
Grey heron	*Ardeacinerea*	Northern or Palaearctic migrant	LC
Yellow billed egret	*Ardea intermedia*	Local resident	LC
Cattle egret	*Bubulcus ibis*	Resident	Lc
Greategret	*Ardea alba*	Resident	Lc
African fish eagle	*Haliaeetus vocifer*	Resident	LC
African harrier-hawk,	*Polyboroidestypus*	Northern or Palaearctic migrant	LC
Black kite	*Milvus migrans*	Northern or Palaearctic migrant	LC
Long-crested eagle	*Lophaetus occipitalis*	Resident	LC
Order: Pelecaniformes, **Family**: Scopide			
Hamerkop	*Scopus umbrett*	Resident	LC
Order: Pelecaniformes, **Family**: Threskiornithidae			
Hadada ibis	*Bostrychiahagedash*	Resident	LC
African sacred ibis	*Threskiornisaethiopicus*	Resident	LC
White-faced whistling-duck	*Dendrocygnaviduata*	Resident	LC
White-backed duck	*Thalassornisleuconotus*	Resident	LC
Blue-winged goose	*Cyanochencyanopterus*	Resident	LC
Knob-billed duck	*Sarkidiornismelanotos*	Resident	LC
Egyptian goose	*Alopochenaegyptiaca*	Resident	LC
Spur-winged goose	*Plectropterusgambensis*	Resident	LC
Red-billed duck	*Anas erythrorhyncha*	Resident	LC
Yellow-billed duck	*Anas undulata*	Resident	Lc

Tufted duck	*Aythyafuligula*	Resident	LC
Ferruginous duck	*Aythyanyroca*	Resident	LC
Hottentot teal duck	*Spatula hottentota*	Resident	LC
Order: Phoenicopteriformes, **Family**: Phoenicopteridae			
Greater flamingo	*Phoenicopterus roseus*	Resident	LC
Little grebe	*Tachybaptusruficollis*	Resident	LC
Eared grebe,	*Podicepsnigricollis*	Resident	LC
Order: Accipitriformes, **Family**: Accipitridae			
Westernosprey	*Pandion haliaetus*	Nortern or Palaercicmigrant	LC
Hooded vulture	*Necrosyrtesmonachus*	Resident	Criticallyendangered
Lappet-faced vulture or Nubian vulture	*Torgostracheliotos*	Resident	Endangered
White-headed vulture	*Trigonoceps occipitalis*	Resident	Criticallyendangered
African fish eagle	*Haliaeetus vocifer*	Resident	LC
African harrier-hawk,	*Polyboroidestypus*	Northern or Palaearctic migrant	LC
Black kite	*Milvus migrans*	Northern or Palaearctic migrant	LC
Long-crested eagle	*Lophaetus occipitalis*		LC
Order: Strigiformes, **Family**: Strigidae			
Spotted eagle-owl	*Bubo africanus*	Resident	Lc
Northern white-faced owl	*Ptilopsisleucotis*	Local resident	LC
Little owl	*Athene noctua*	Resident	Lc
Order: Columbiformes, **Family**: Columbidae			
Speckled pigeon	*Columba guine*	Resident	Lc
White-collared pigeon	*Columba albitorques*	Resident	Lc
Red-eyed dove	*Streptopeliasemitorquata*	Resident	Lc
Ring-necked dove	*Streptopelia capicola*	Resident	Lc
Laughing dove	*Spilopeliasenegalensi*	Resident	Lc
Dusky turtle-dove	*Streptopelialugens*	Resident	Lc
Vinaceous dove	*Streptopeliavinacea*	Resident	Lc
Lemon dove	*Columba larvata*	Resident	
Order: Passeriformes, **Family**: Sturnidae			
Greater blue-eared starling	*Lamprotornischalybaeus*	Resident and partial migrant	LC
Splendid Starling	*Lamprotornissplendidus*	Resident	LC
Red billed oxpecker	*Buphagus Erythrorynchus*	Resident	LC
Yellow-billed oxpecker	*Buphagus africanus*	Resident	LC
Order: Passeriformes, **Family**: Corvidae			
thick-billed raven	*Corvuscrassirostris*	Resident	LC
Pied crow	*Corvusalbus*	Resident	LC
Cape crow or black crow	*Corvuscapensis*		LC
Order: Passeriformes, **Family**: Estrildidae			
Red cheeked cordon bleu	*Uraegintusbengalus*	Resident	LC
African fire finch	*Lagonosticarubicata*	Resident	LC
Order: Passeriformes, **Family**: Muscicapidadae			
Abyssinian salty fly catcher	*Melaenoomischocolatinus*	Resident	LC
Order: Passeriformes, **Family**: Motacillidae			
Eruopean pied fly catcher	*Ficedulahypoleuca*	Resident	LC
Eruopean pied fly catcher	*Ficedulahypoleuca*	Resident	LC
Pied wagtail	*Motacilla alba*	Norther(palaearcic)migrant	LC
Yellow wagtail	*Motacilla flava*	Northern or palaearctic migrant	LC
African pipit	*Anthuscinnamomeus*	Resident	Lc

Order: Coraciiformes, **Family**: Meropidae			
Carmine bee eater	*Meropsnubicus*	Resident and partial intra-africa migrant	LC
Little bee eater	*merops*	Resident	LC
Blue headed be eater	*Meropsmulleri*	Local resident	LC
Order: Bucerotiformes, **Family**: Bucerotidae			
Silvery cheeked horn bill	*Ceratogymna brevis*	Resident	Lc
Abyssinian ground horn bill	*Bucorvusabyssnicus*	Resident	Vulnerable
Red billed horn bill	*Tockuserythrorhynchus*	Resident	Lc
Nubian wood pecker	*Campeltheranubica*	Local resident	LC
Gray wood pecker	*Dendrooicosgortae*	Local resident	LC
Order: Gruiformes, **Family**: Rallidae			
Rouget's rail	*Rougetiusrougetii*	Resident	Near Threatened
African rail	*Ralluscaerulescens*	Resident	Lc
Red-knobbed coot	*Fulicacristata*	Resident	Lc
African crake	*Crex egregia*	Resident	Lc
Black crowned- crane	*Balearica pavonina*	Resident	Vulnerable
Watt led crane	*Bugeranuscarunculatus*	Resident	Vulnerable
Demoiselle crane	*Anthropoidesvirgo*		LC

CE=critically endangered, E=endangered, VU=vulnerable, NT= near threatened, LC=least concern

Table 2. Abundance of birds in different seasons and habitats at Koga Irrigation Dam, northwestern Ethiopia (2010-2011)

Common name	Scientific name	Wet land	Farm land	Scrub Land	Dry season	Wet season
Black bellied plover	*Pluvialissquatarola*	x	---	---	x	x
Crowned lapwing	*Vanelluscoronatus*	xxx	---	---	xxx	xxx
Spur winged lapwing	*Vanellusspinosus*	xxx	---	---	xxx	xx
Black headed lapwing	*Vanellustectus*	x	---	---	x	xx
Wattled lapwing	*Vanellussenegallu*	x	---	---	xx	x
White necked cormorant	*Phalacrocoraxlucidus*	x	---	---	x	x
Long tailed cormorant	*Microcarbo africanus*	xxx	---	---	xxx	xxx
Lesser jacana	*Microparracapensis*	x	---	---	x	X
African jacana	*Actophilornis africanus*	xx	---	---	xx	Xx
Egyptian plover	*Pluvianusaegyptius*	xx	---	---	xx	Xx
Black-winged stilt	*Himantopushimantopus*	x	---	---	x	X
Common sandpiper	*Actitishypoleucos*	xxx	---	---	xx x	xx x
Lesser yellowlegs	*Tringaflavipes*	x	---	---	x	X
Marsh sandpiper	*Tringastagnatilis*	xx	---	---	xx	Xx
Great snipe	*Gallinago media*	x	---	---	x	X
Long-toed stint	*Calidrissubminuta*	xxx	---	---	xxx	Xxx
Little stint	*Calidrisminuta*	x	---	---	x	X
Water thick	*Burhinusvermiculatus*	x	---	---	x	X
Spotted thick	*Burhinuscapensis*	xx	---	---	xx	Xx
Senegal thick	*Burhinus senegalensis*	xxx	---	---	xx x	xx
Black-headed gull	*Chroicocephalusridibundus*	xxx	---	---	xxx	Xxx
Lesser black-backed gull	*Larusfuscus*	xx	---	---	xx	Xx
Great black-backed gull	*Larus marinus*	x	---	---	x	X
White stork	*Ciconia ciconia*	x	---	---	x	X
Marabou stork	*Leptoptiloscrumenifer*	x	---	---	x	X
Woolly necked stork	*Ciconia*	x	---	---	x	x
Back headed	*Episcopes Aredamelanocephala*	xxx	---	---		

Heron						
Grey heron	*Ardeacinerea*	xxx	---	---	xxx	xxx
Yellow billed egret	*Ardea intermedia*	x	---	---	x	x
Cattle egret	*Bubulcus ibis*	xxx	---	---	xxx	xxx
Great egret	*Ardea alba*	x	---	---	x	x
Hamerkop	*Scopus umbretta*	xxx	---	---	xxx	xxx
African fish eagle	*Haliaeetus vocifer*	xx	---	---	xx	xx
African harrier-hawk,	*Polyboroidestypus*	---	---			
Black kite	*Milvus migrans*	---	X	X	x	x
Long-crested eagle	*Lophaetus occipitalis*	--	--	Xxx	xxx	xxx
Hadada ibis	*Bostrychiahagedash*	xxx	Xx	X	xxx	xxx
African sacred ibis	*Threskiornisaethiopicus*	xx	Xx	---	---	xx
White-faced whistling-duck	*Dendrocygnaviduata*	x	---	---	x	x
White-backed duck	*Thalassornisleuconotus*	x	---	---	x	x
Blue-winged goose	*Cyanochencyanopterus*	x	---	---	x	x
Knob-billed duck	*Sarkidiornismelanotos*	x	---	---	x	x
Egyptian goose	*Alopochenaegyptiaca*	xxx	xxx		xxx	xxx
Spur-winged goose	*Plectropterusgambensis*	xxx	---	---	xxx	xxx
Red-billed duck	*Anas erythrorhyncha*	xx	---	---	xx	xx
Yellow-billed duck	*Anas undulate*	xx	---	---	xx	xx
Tufted duck	*Aythyafuligula*	x	---	---	x	x
Ferruginous duck	*Aythyanyroca*	x	---	---	x	x
Hottentot teal duck	*Spatula hottentota*	x	---	---	x	x
Greater flamingo	*Phoenicopterus roseus*	xx	---	---	xx	xx
Little grebe	*Tachybaptusruficollis*	xx	---	---	xx	xx
Eared grebe,	*Podicepsnigricollis*	x	---	---	x	x
Hooded vulture	*Necrosyrtesmonachus*	--	X	Xx	x	xx
Lappet-faced vulture or Nubian vulture	*Torgostracheliotos*	--	X	X	x	x
White-headed vulture	*Trigonoceps occipitalis*	---	X	X	x	x
African fish eagle	*Haliaeetus vocifer*	---	---	X		x
African harrier-hawk,	*Polyboroidestypus*	---	---	X	x	x
Black kite	*Milvus migrans*	---	---	X	x	x
Long-crested eagle	*Lophaetus occipitalis*	---	X	Xx	xx	x
Spotted eagle-owl	*Bubo africanus*	---	---	X	x	x
Northern white-faced owl	*Ptilopsisleucotis*	---	---	X	x	x
Little owl	*Athene noctua*	---	---	X	x	x
Speckled pigeon	*Columba guine*	xx	xxx	Xx	xxx	xxx
White-collared pigeon	*Columba albitorques*	x	Xx	X	xx	xx
Red-eyed dove	*Streptopeliasemitorquata*	--	X	x x	x	x
Ring-necked dove	*Streptopelia capicola*	x	xxx	X	x	x
Laughing dove	*Spilopeliasenegalensi*	--	X		x	x
Dusky turtle-dove	*Streptopelialugens*	--	Xx	X	x	xx
Vinaceous dove	*Streptopeliavinacea*	--	X	--	x	x
Lemon dove	*Columba larvata*	x	Xx	X	xx	x
Thick-billed raven	*Corvuscrassirostris*	--	X	Xx	xx	xx
Pied crow	*Corvusalbus*	xx	--	X	x	xx
Cape crow or black crow	*Corvuscapensis*	--	--	X	x	x
Greater blue-eared starling	*Lamprotornischalybaeus*	x	--	--	x	x
Splendid starling	*Lamprotornissplendidus*	x	--	--	x	x
Red billed Oxpecker	*Buphagus Erythrorynchus*	xxx	Xx	Xxx	xxx	xxx
Yellow-billed oxpecker	*Buphagus africanus*	xx	--	Xx	xxx	xxx
Red cheeked cordon bleu	*Uraegintusbengalus*	--	--	X	x	x
African fire finch	*Lagonosticarubicata*	xx	xxx	Xx	xxx	xxx
Abyssinian salty fly	*Melaenoomischocolatinus*	--	X	X	x	--

catcher						
European pied fly catcher	*Ficedulahypoleuca*	--	--	X	x	x
Pied wagtail	*Motacilla alba*	x	--	--	x	x
Yellow wagtail	*Motacilla flava*	x	--	--	x	x
African pipit	*Anthuscinnamomeus*	x	--	--	--	x
Carmine bee eater	*Meropsnubicus*	--	--	Xx	xx	xx
Little bee eater	*Merops*	--	--	X	x	x
Blue headed be eater	*Meropsmulleri*	--	--	X	xx	xx
Silvery cheeked horn bill	*Ceratogymna brevis*	--	--	X	x	x
Abyssinian ground horn bill	*Bucorvusabyssnicus*	--	X	X		xx
Red billed horn bill	*Tockuserythrorhynchus*	--	--	X	xx	xx
Nubian wood pecker	*Campeltheranubica*	--	--	X	x	x
Gray wood pecker	*Dendrooicosgortae*	--	--	X	x	x
Rouget's rail	*Rougetiusrougetii*	x	--	--	x	x
African rail	*Ralluscaerulescens*	x	--	--	x	x
Red-knobbed coot	*Fulicacristata*	xx	--	--	xx	xx
African crake	*Crex egregia*	x	--	--	x	--
Black crowned- crane	*Balearica pavonina*	xxx	--	--	xxx	xxx
Wattled crane	*Bugeranuscarunculatus*	xx	Xx	X	xx	xx
Demoiselle crane	*Anthropoidesvirgo*	--	X	--	x	x

Diversity Index

Diversity indices varied with respect to season and habitat (Tables 2), which ranged from H′=1.95 during the wet season to H′=3.56 during the dry season. Looking at the data regardless of season, the scrubland had the highest (H′=3.96), and the wetland and farmland habitats equal diversity (H′=3.25) (Table 2).

Species Richness

The species richness was generally high. One hundred bird species were found during the wet season as well as the dry season (Table 1), and from 23 at farmland to 68 species in the wetland habitat. The wetland habitat had the highest bird species richness during both seasons (Table 3).

Table 3. Species diversity of birds during wet season

Season	Habitat	Species richness	Abundance	H′	H_{max}	H′/H_{max}	D′=1- ЄP$_i^2$	1/ D′
Wet	Wetland	62	1801.5	2.55	4.13	0.62	0	
	Farmland	39	1261	1. 96	3.66	0.53	0	
	Scrubland	44	435	3.13	3.78	0.83	0.063	15.75
Dry	Wetland	62	2256.5	2.69	4.25	0.63	0.81	
	Farmland	55	649.5	3.51	4.01	0.87	0.96	
	Scrubland	56	754.5	3.56	4.03	0.88	0.96	
Both	Wetland	65	4058	3.32	4.17	0.80	0.99	1.11
	Farmland	55	1911	3.20	4.01	0.80	0.94	0.06
	Scrubland	53	1189.5	3.96	3.97	0.99	0.98	1.02

Variation in the number of species was observed among the three habitats and between seasons in the same habitat. The highest species richness during the dry season was recorded in wetland (62) scrubland (56) and farmland (55). The least species number were recorded in scrubland (44) and farmland (39) during the wet season. The highest species richness during both seasons was recorded in wetland (65) followed by farmland(55). The lowest number of species were recorded in the scrubland (53).

Abundance of birds

The abundance of birds varied with season (wet and dry) because of diffrences in avaliability of food, habitat condition, habitat size and breeding habits of the different species. Also, bird populations varied among habitats. More birds were found in the wetland, i.e., 4058, followed by farmland(1911) and the scrubland (1189).

Witness of the local farming community

Selected community members were requested to compare and contrast the condition of birds before and after the construction of the dam. They all believed that the dam changed the farming system of the area and they produced more food now than before the dam.

All interviewed individuals believed that many birds existed before the Dam; yet, their number increased dramatically after the dam. Majority (73.3%) of the respondents also suggested that new birds, unknown to them before the construction of the dam, arrived following the construction of the Dam. Over 95% of them claimed that birds used to feed primarily on the wetland before Dam and rarely on crop fields. All respondents agreed that after the construction of the dam, the food source of the birds was completely submerged under water, which attracted more birds to arrive. Over 80% of the respondents believed that birds shifted their feeding habits from the wetland area to field crops, from seeds to leaves and seedlings of field crops. Some 80% of respondents reported that bird species like common Egyptian goose, common crane and Damsel crane remained pests. About half the respondents kept birds away from crops by bird scaring or denying birds access to crops; over 30% of farmers used pesticides and about 17% of them requested government action against the harmful effects of these crop feeding birds.

DISCUSSION

In the present study, a total of 103 bird species belonging to 75 genera, 24 families and 11 orders were found. The variation in species composition and abundance of birds among different habitats is a function of the quality of the habitat and the preference of the species. Many birds used to forage in the wetland before the dam, but their number increased significantly after the dam because of the increase in the volume of the reservoir. Ecologically healthy lakes attract more birds (Rajpar and Zakaria, 2013). Water birds often prefer wetlands with great diversity of plant species, vegetation types and permanent water to complete their life cycle, i.e., to feed, nest, molt, breed, and protect from predators. After the Dam, waterfowls occupied farmlands during the wet season because the area was rich in resources (seeds, seedlings, leaves and patches of water) (Henderson *et al*., 2000). Land use changes alter the environment of lakes, negatively affecting water-bird community structures (Hill-Lukkarinen *et al*., 2011).

Feeding habits of birds varied with respect to season (dry and wet). Season affects food and birds themselves, which in turn affects breeding success and finally survival of the bird species (Girma Mengesha and Afework Bekele, 2008). Bird diversity was higher in the wet season than in the dry season. During the wet season, many small ponds were created where birds foraged, nested and bred. The irrigation scheme should be managed wisely to prevent any potential environmental damage. Altered river flow disturbs the Dam ecosystem and accumulates sediment in the reservoir (Krüger *et al*., 1996; Nigussie Haregeweyn *et al*., 2005). Koga River enters the reservoir with runoff loaded with debris from anthropogenic activities in the catchment, i.e., natural vegetation cover cleared, sediments, over-grazed, recession agriculture, over-exploited natural resources. Environmental protection and agricultural productivity should be balanced to keep the dam ecosystem healthy.

CONCLUSION

This study gave information about what happened to birds and their environment after the construction of Koga Dam. In the present study, the change in the ecosystem of birds, and of the number of birds and their habits, as a result of the construction of the dam is confirmed. Changes in bird diversity and abundance were a function of environmental change. The destruction of the wetland habitat due to the construction of the dam forced some native birds to infest crop fields, which they did not do before. Bird abundance and foraging habit varied with respect to season. The construction of the dam has changed the farming system of the area in such a way that it helped farmers to produce more crops multiples of times a year. Despite feeding habit changes of birds from the wetland habitat to food crops, famers now generate more income because of the introduction of irrigation agriculture after the dam. A delicate balance is yet to be in place between the benefits (increasing productivity) and drawbacks (environmental damage). Local people must be

trained how to live with birds, how to manage birds with techniques other than lethal ones. Recording year-round data is suggested to model the reproductive biology of these birds; the buffer zone and the watershed of the Dam must be rehabilitated and the ecology of the habitat around the edge of the reservoir must be protected and well managed.

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