Sudan university of science and Technology

College of animal production science and Technology

Department of fisheries and wildlife science

Seasonal Abundane and diversity of birds in Jabal Awlia,Sudan

Thesis Submitted in partial Fulfillment of the Requirement of the

B.Sc. Degree in Fisheries and wildlife Science (Honor)

By:

Nasser Mounir Mahmood

Supervisor:

Dr: Nawal Nugud Mirghani

October (2017)

الاستهلال

بسم الله الرحمن الرحيم

الحمد لله رب العالمين والصلاه والسلام علي سيدنا محمد الصادق الوعد الامين

قال تعالى:

(ألم يروا إلى الطير مسخرات في جوالسماء ما يمسكهن الا الله إن في ذلك لايات لقوم يؤمنون)

صدق الله العظيم

(سورة النحل الاية:79)

Dedication

I dedicated to my father for his constructive advice throughout my live and great mother _my teacher and friend to stood beside me and helped me

Thank you…..

Acknowledgement

To greatest thanks firest to allah Almighty the most merciful who gave me the health strength and patience to conduct this study .

I would like to express my appreciation to my supervisor: Dr.Nawal Nugud Mirghani who has cheerfully answered my queries and provided me with materials and assisted me in a myriad ways with the writing and helpfully commented on earlier drafts of this project. also I am also very grateful to my friends ' family for their good humour and support throughout the production of this study.

Abstract

This dissertation describes bird fauna in Jabal Awlia area (forest, khazzan), with emphasis on wetland . The study was conducted under natural condition at Jabal awlia area, Sudan .

There were no studies in this area , so the studies of the area become basic necessity .

The objective of this study are to document avifauna of Jabal Awlia – ldentify avifauna document their seasonal movement, as far as bossible, quantify such changes during the wet and dry season .

The investigation was carried out between (March to September 2017) .

The study area was patrolled on food from 7.am to 5.pm(direct observation) ,identification of birds were made using (Williams and Sinclair and Ryan 2010).

Point count was carried on foot, field binoculars Pentax of magnification (10×50) at approximately (4-8m) were used for observation bird .

The result was tabulated in months , There were 20 species eight wet season and five in dry season and the other species ,were recorded in both dry and wet season .

The numbers of bird which were recorded 1348 in wet season and the number of birds in dry season were 909.

مستخلص البحث

بحث التخرج هذا يصف الطيور في جبل أولياء منطقه الخزان والغابة مع التركيز على الارض الرطبة .

اجريت الدراسه تحت ظروف طبيعية في منطقة جبل أولياء لا توجد دراسة في نفس المجال مما يجعل الدراسة الحالية ضرورية واساسية .

تهدف الدراسه الى تحديد وتسجيل أنواع الطيور وتحركاتها الموسمية في منطقه جبل أولياء الي اقصي حد ممكن كما تهدف الي دراسة التغيرات خلال موسمي الأمطار والجفاف .

أجرى في (مارس- سبتمبر 2017) وتم مسح منطقه الدراسة سيرا علي الاقدام ابتداءا من السابعه صباحا حتي الخامسة عصرا , في المشاهده المباشره تم التعرف علي انواع الطيور باستخدام دليل الطيور لشرق ووسط افريقيا إسنكلر و ريان 2010م) استخدمت طريقه العد عند نقطه معينة , (وليام1991 سيرا علي الاقدام واستخدم المنظار الميداني (10*50) (4-8م) لمراقبة الطيور . لمعرفه وفره ووضع كل الانواع تم جدولتها في شهور من مايو – سبتمبر, ووجد ان هنالك 20 نوع من الطيور 8 انواع في موسم الامطار و5 أنواع في موسم الجفاف وتم جمع الطيور في الموسم الممطر كان عددها 1348 وفي الموسم الجاف وكان عددها 909 .

Table of contents

CHAPTER ONE

Introduction & Literature Review

1.Wetlands Definition:

According to Ramsar convention (1971); wetlands are define as areas of marsh, or water , whether natural or artificial, permanent or temporary, with water that is static or flowing fresh, brackish or salt, including areas of marine water, the depth of which at low tide does not exceed six meters. Wet lands include marshes, swamps, vales, ponds.

Wetlands are one of the most productive ecosystems and play crucial role in hydrological cycle. World wide, wetlands directly and indirectly support millions of people in providing services such as storm and flood control, food, fibre –and raw materials, scenic beauty, educational and recreational benefits .

They are two type of wetland; natural wetlands and man made wetlands like dams on the Nile for example Sennar dam and Jabal Awlia dam, Kashm el Girba dam and Roseires dam.

Jabal Awlia dam was built in 1937 to augment the storage of water for summer irrigation in Egypt. It is a yearly storage dam with aregime similar to that of Sinnar. It worth mentioning that it is only dam in the Sudan with afish passage way and a navigation lock. Monkov (1968) made a survey 1500km of the white Nile and emphasized the impact of Jabal awlia dam on the ecology of the river. It is of interest to mention that whereas that the maximum biomass of zooplankton was close to the dam.

Water lands constitute one of the most important faunal components of wetlands (Pescador and Perris,2007). However, these water birds are seldom distributed uniformly in the wetlands because some of them only occur for part of their annual cycles, breeding or wintering ,More over, lakes and ponds can be important areas of concentration during the annual migration of certain species of birds . The abundance of these birds is associated with local environmental conditions as well as the the specific demands of each species (Pescadorand Peris, 2007). Thus, waterbird abundance on a local scale depends upon habitat characteristics, and avabilability and distribution; food density and the availability of suitable breeding sites(pescador and peris 2007). This dissertation is intended to give information on seasonal abundance and diversity in bird in Jabal Awlia dam (wetland).

1.2. Birds Migration:

Migration are particularly well developed in the cold and temperate regions of the northern hemisphere, where strongly marked seasonal climatic changes force most birds to seek refuge during the winter in more hospitable regions. The migrants which travel the greatest distances are those that breed in that part of the world. The temperate and cold regions of the southern hemisphere also witness regular migrations but with marked differences. These migrations are shorter (Dorst, 1962).

Dodman and Diagana (2006) consider intra-Africa migration as 'the movement of birds within Africa according to continental weather patterns, especially rainfall. Nomadism is displayed by animals that move irregularly. Nomads are wanderers, though their movements away from and to particular areas may be predictable, usually relating to climatic conditions. Afew species such as

Abdims Stork (*Ciconia abdimii*) come to the Sudan from central Africa to breed during the rainy summer months.

Seasonal movements of migratory birds in Africa are well documented (Hamed,). They have, for example, been described in Morocco by (Nisbet,et al 1982), in Nigeria by(EL good, et al 1966), at lake Chad by (Fry et al, 1970), et.al in Kenya by Pearson and Back Hurst (1976). Tramer, (1969) has proposed that changes in diversity may be mediated by changes in one or the other component and that these changes reflect alternative environmental conditions.The causes of such changes are often difficult to determine because patterns of variation in abundance and distribution differ among species (Hogstad 1993, Holmes & Sherry 2001).

Seasonal changes in the bird fauna there and it seemed likely that they occurred as consequence of the migratory habits of different species (Hamed, 1981). Factors responsible for changes in bird population densities and local distribution include climatic and /or resource variation on a local regional or contiuental scale (Blake et al, 1994), inter-spcific competition (Holmes et al.1986), density fluctuations of predators and changes in the type, amount and spatial configuration of available habitat(Holmes and Sherry.2001)

Change in species composition occur because resident and migrant species contribute in varying proportion in different periods of the year (Avery & Van, Ribber, 1989). Some resident African birds also migrate from one part of the continent to another. The large number of African birds have regular seasonal movements within the continent always coinciding with the rainy season (Hamed and Evans, 1982).

1.2.1. Birds adaptation to migration:

Flight affords the utmost in mobility and has made possible the evolution of avian migration as means of exploiting distant food resource and avoiding the physiological stress associated with cold weather. Variation in the patterns of migration are nearly as numerous as the birds that migrate. While some species move only a few kilometers up and down mountain slopes.

Others will travel hundreds or even thousands of kilometers, often traversing vast bodies of water or tracts of inhospitable terrain (Alerstam,T.1990 and Alerstam,T, 1991).

One of the most adaptation of birds, feather the trademark of class Aves.Provide the insulation necessary to maintain a high "engine" body temperature ranging from 107to 113degrees(F) a cross species. Additionally the long feathers of the wings act as airfoils which help generate the lift necessary for flight. Astremlined body shape and a light weight skeleton composed of hollow bones minimize air resistance .Efficient circulatory and respiratory systems .

1.2.2. Migratory mania:

In addition to these general avian characteristics birds exhibit a suite of specialized traits. Migratory generally have longer, more pointed wings than non –migrants species, a feature which further minimizes air resistance. Also , the pectoral muscles of migrants tend to be larger and composed of fibers which are more richy supplied with nutrient – and oxygen caring blood vessels energy producing mitochondria, making the pectoral muscles of migrants especially efficient or energy production and use (Bairlein, F. 1992).

1. 3. Bird in Sudan:

Sudan is a large country with different habitats including rivers, plains, valleys, plateaux and Mountains, all are of importance to birds. And also Sudan is considered one of the richest African countries in wild life. Sudan geographically is located on the main routes used by migratory birds from three contineuls (Europe, Asia, and Africa). Sudan is a place for migratory bird in providing food, water and resting sites after a long and arduous journey (Hamed, 1994).

There have been relatively few publications on the birds of Sudan. The only field guide to cover the whole country was published in 1955(Cave & Macdonald 1955), and since then the only major publication was a distribution atlas of Sudan's birds (Nikolaus 1987). Which recorded more than 972 species. Including more than 200 migratory species coming from Europe and Asia which are palearctic migrants which come to spread the cold months of winter in Sudan . The large numbers of African birds have seasonal movement within the continent always coinciding with the rainy season. Many of the local Sudanese birds undertake local seasonal movements (Nicklaus,1987).

Sudanese birds have been classified into three groups: resident birds, locally migrating birds, and Palearctic migratory birds.

Khartoum is considered a transitional zone between the extreme desert to the north and the dry wood savannah to the south. Therefore,representatives of birds of both Desert and savannah species are found there

Khartoum is Located on the great migration route of most of the summer bird visitors from Europe and the rest of the palearctic region. It is also considered as an important centre of some African migrant birds which spend their

summer, especially the rainy season in the northern part of their range returning south during October after the breeding season.

The names and classification of bird species sometimes change as new informating on about their biology becomes available. In addition, most birds have different common names in different parts of the world, and different authorities use different classifications .Birds are among the most extensively studied of all animals group. The scientific study of birds is called ornithology. Birds range in size from the tiny sunbirds to the huge Ostrich.

The birds are very familiar component of the environment and can be noticed and identified because they are colorful active during the day . They roamed the air, and also linked to human life in many the events.They have lovely and sound music.

Some birds roost in groups for at least part of the year, although the habit of roosting communally has been described for many species of birds such as the House Sparrow *passer domesticus arboreus* and Laughing Dove *streptopelia senegalensis.* The habit of aggregating in this way is not completely understood. Lack (1968) suggested that protection from predators is the primary reason but an alternative suggestion by Ward (1965) is that communal roosting functions primarily as ″information centers″ where information on the location of food is made available to fellow roosters. Evidance for this interesting hypothesis is however limited (Ward and Zahavi, 1979as quoted by Lado1994) .

1.4.Objective of the study ：

-The aim of the study focus mainly on the identification of the bird species

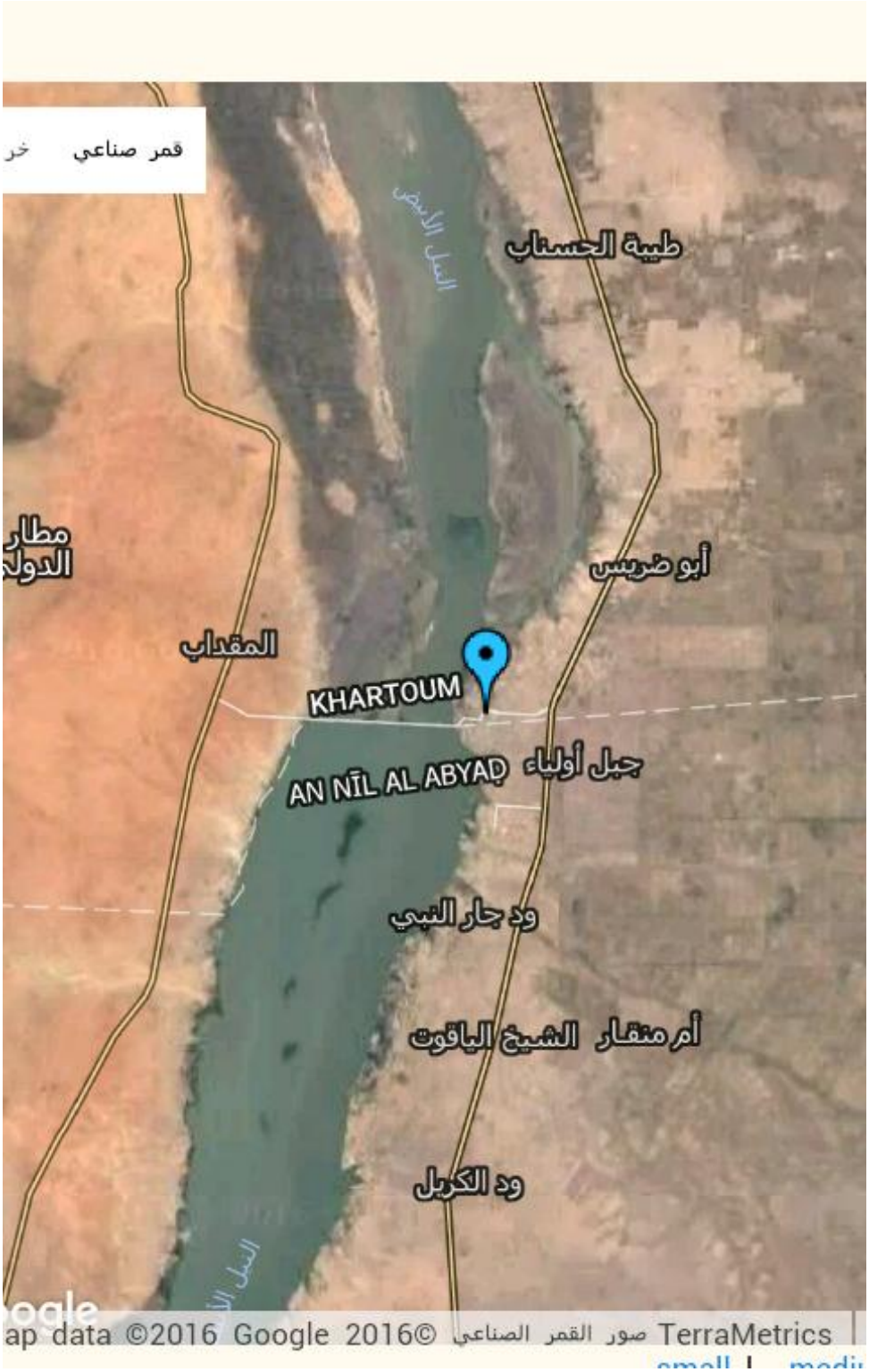
-Seasonal changes and the quantification of these change (relative abundance)in Jabal Awlia

CHAPTER TWO

MATERIALS AND METHOD

2. 1.Study Area:

The study area is consist of two parts, the first part; Forest area the tree species covers the forest is Sunnt *(Acacia nilotica*) which extended to the west,and north these area is covers with water in wet summer (June – September) (Plate1). The second part is Al Khazzan area(which covers with storage water). The study area is very important wetland ecosystem it provides a refuge to wildlife including birds fishes and floral species. It is also important as rangeland for livestock and it's woodland is important habitat for breeding birds especially Little Egret and Cattle egret .The geographical coordinates are 15° 14′ 28″ North 32° 29′ 59″ east. It About 50km south of khartaum, The Khazzan was built in 1937 to augment the storage of water for summer irrigation. There are another species of tree covers the study area in few numbers for example, Kiter *(Acacia mellifera*) and Meskeat *(Prosopis glandulosa* **),** and Talih ahmar (Acacia seyal) , it is noteworthy , because it has several roles to play in the site. Acacia is nitrogen support and good habitat for birds ;they are like to nest at the branches of it



www.maplandia.com

2.2. Climate: (Rainfall & Temperature)

The climate of Khartoum is tropical desert .There are three seasons per year cool winter,dry summer and a rainy season (wet summer). Highest temperatures(45°C or more**)** are recorded in summer months (March –June) while lowest temperature (22°C or less) are recorded during winter months (November –February). The rain fall is about 150mm per annum. The forest which is nearest to khazzan flooded during the rainy season (june –October). Later, during winter and early summer. The forest become totally dry

2.3 .Field Methods and Tools Used in Birds Survey:

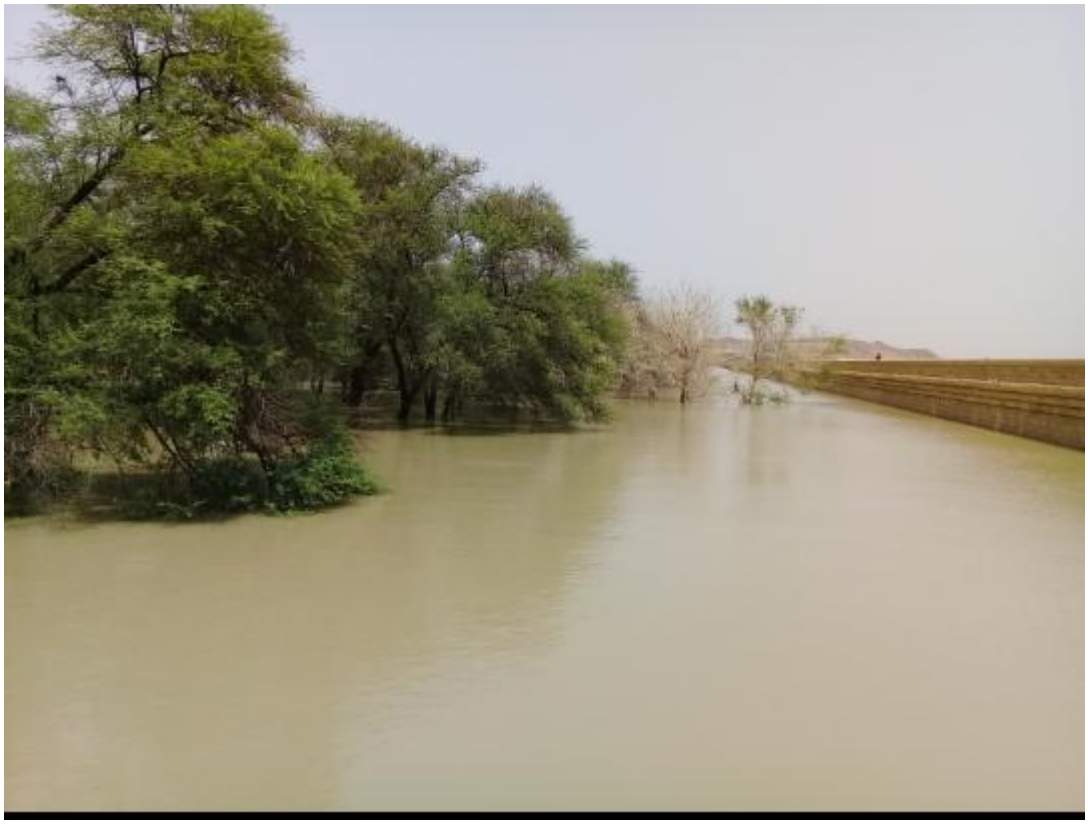
The study areas were reached and patrolled on foot by two trained researchers in order to observe and identify all species of birds as far as possible

2.3.1..Direct Observation:

Bird species were identified, quantified. Discussion with local people were carried to determine avifauna species and their numbers, feeding location. The survey period covered one years from March to September 2017.Observation started at 7am and ended at 5 pm and the species and the number were recorded from all fixed point for all sites using point count methods(Altman, 1974 and Girish &Pooja,2015). General observation were carried out two times every months at different sites. The count of birds was done at every 30 minute intervals, number of birds for each species sighted were recorded ,it perching on trees, wire of electericity, flying overhead and for a session of two hours.

2.3.2.Tools used:

field binocular Pentax of magnification (10×50) at approximately (4-8m) and two field guides (Williams 1991 and Sinclair and Ryan 2010) were used for identification and recording of birds species. Identification of birds sound was also used to supplement the direct field observation.



(Plate1) The study area (Forest) which was flooded in rainy season in (22\8\2017) by Author

CHAPTER Three

RESULT

3. Changes in the bird fauna

From the Table 1 it can be seen that there were annual variation in species and number of birds in the study area, and the total number of species were 20 species, recorded throughout the study period, the number of species showed considerable fluctuation in some species, while there some species registered small variation. There were some species occurred in the study which were not classified as water birds but they registered with them like, Laughing Dove *Streptopelea senegalensis,* Black Kite *Milvus migrants*, Namaqua dove *Oena capensis***,** Eurasian Roller *Coracias garrulous***,** White fronted sparrow lark *Eremopterix nigriceps***,** Eurassian Swallow *Hirundo rustica* **,** Ethiopian Swallow *Hirundo aethiopica***,** House Sparrow *Passer domesticus***,** Sudan golden Sparrow *Passer luteus* **.**

The onest of rains resulted in a considerable influx of birds eight species including Spur- wing plover which was seen in large numbers, Little egret, Great egreat ,Cattle egret , European roller ,Abdmis stork, White fronted sparrow lark and Sudan golden sparrow were recorded for wet season. In dry season there were only five species recorded; Spur- wing plover, great cormorant, long tailed cormorant, Open bill stork, Black stork. It can be seen that there were marked seasonal changes in bird inhabiting the study area. Some species were recorded breeding in study area especially the Little egret and Cattle egret,Great White egret which were nest sites extended through the forest area and they were nest in colony

Table 1:Estimates of the numbers of individuals birds species at Jabal Awlia during the study period (May -Septmber 2017)

Common name	Scientific name	Estimated numbers of birds in study area						
		March	April	May	June	July	Augsts	September
Long tailed cormorant	*Phalacrocorax africanus*	40	35	25	19	0	0	0
Great cormorant	*Phalacrocorax carbo*	20	12	`19	14	0	0	0
Grey Heron	*Ardea cinerea*	20	30	25	2	0	0	24
Cattle Egret	*Bubulcus ibis*	15	34	40	80	130	150	100
Little Egret	*Egretta garzetta*	13	33	50	200	150	57	0
Great White Egret	*Egretta alba*	15	21	15	40	29	12	0
African Open –bill Stork	*Anastomus lamelligerus*	0	20	18	0	0	0	0
Abdims Stork	*Ciconid abdimii*	0	0	70	42	33	5	0
Black stork	*Ciconia nigra*	9	10	0	0	0	0	0
Spur-winged plover	Vanellus spinosus	30	20	32	80	30	14	0
Whiskered tern	*Chlidonias hybrid*	2	6	0	0	0	0	4
Black Kite	*Milvus migrans*	9	12	3	4	2	10	24
Namaqua dove	*Oena capensis*	9	40	75	0	0	0	0
Laughing dove	*Streptopelia senegalensis*	7	13	20	0	0	0	0
Eurasian Roller	*Coracias garrulous*	0	0	0	0	2	7	0
White fronted sparrow lark	*Eremopterix nigriceps*	0	0	0	0	25	30	0
Eurassian Swallow	*Hirundo rustica*	0	4	0	0	0	0	4
Ethiopian Swallow	*Hirundo aethiopica*	2	0	0	2	0	0	6
House Sparrow	*Passer domesticus*	9	3	0	0	6	0	0
Sudan golden Sparrow	*Passer luteus*	0	0	0	5	6	0	0

The species were classified into families as follow according to Nikolause (1987)

Family Phalacrocoracidae:

Long-tailed cormorant *(Phalacrocorax africanus)* large number move the area in wet season usually feeds in shallow water.

Great cormorant (*Phalacrocorax carbo*), small numbers . not recorded in wet season.

Family Ardeidae (Herons, Egrets):

Grey Heron (Ardea cinerea), which were seen in flock near the water bank, one was nesting on Acacia nilotic in May

Cattle Egret (Bubulcus ibis) resident in few numbers in dry summer, and the large flocks of it which consist of hundered or more seen breeding in wet season in the study area. They were breeding in colonially, the nest of it was a flat form built of sticks

Little Egret (Ardea alba), which were seen in small numbers in dry summer but in wet summer the flock of it extended in the hall of the forest area. They nesting colonially on acacia nilotic in wet season

Great White Egret **(***Egretta* alba), which were seen in large number in wet

Season. There were breeding in the study areas

Family Ciconiidae:

African openbill stork (*Anastomus lamelligerus*), large flocks of it near the river bank

Black Stork (*Ciconia nigra*) in pairs or small flocks near the rivers bank

Family Ciconiidae (Stork)

Abdims Stork (Ciconia abdimii) very common summer visitor, which were seen in the bank of rivers or nesting in large trees

Family Charadriidae

Spur-winged lapwing (Vanellus spinosus) seen in large number in the bank of the river in wet season

Family Sternidae

Whiskered tern (Chlidonias hybrid) seen flight over the river of the dam in few numbers

Family Accipiteridea (Kites, Vultures, Eagles, Hawks, etc.)

Black Kite (Milvus migrans), Isaw it in all visit , but the large flock of it seen in September

Family Columbidae

Laughing dove (Streptopelia senegalensis), which were seen in small flocks, the maximum numbers in May, nesting in the study area

Namaqua dove (Oena capensis), seen in large flocks in May and nest in the study area

Family Coraciidae

European Roller Coracias garrulous), seen only in wet season in small numbers

Family Alaudidae

White-frownted Sparrow lark (Eremopterix nigriceps), seen in pairs in the bank of the lakes

Family Hirundinidae (Swallow)

Ethiopian Swallow (Hirundo aethiopica), flight over the river of dam

European Swallow (Hirundo rustica), flight over the river of dam

Family Passeridae

Sudan golden sparrow (Passer luteus), It was also seen around the banks of river in wet season

2-House sparrow(*Passer domesticus*), which were seen in small numbers

CHAPTER Four

Discussions

There were marked changes in the bird species in the study area between dry season **(**March-May**)** and wet season **(**June –September**)** in 2017. There is little doubt that these changes were associated with the climatic changes from the onest of rains (1348 individuals were recorded during the wet season and only 909 individuals were recorded during the dry season table1. It is probably that habitats, such as study area flourished during the rainy season and become attractive to birds. There was an increase in numbers of individual species due to migratory birds. They came to the area to breed. Presumably the area satisfies two basic requirements for these birds . First there was a highly diversity of flora presenting abundance of potential nesting sites and nesting materials . Second a lot of insect, fish, amphibian and worms . Also some of the migratory birds used the banks of the rivers and the forest as stop-over places to rest and feed.

There was a big influx of species into the study area in the wet season . Partically the number of Ardeidae (Cattle egret , little egret , great White egret), also the Family of Coraciidae which came to the area for breed . Sinclair (1978) has already stressed the importance of such factors for birds breeding in the Serengeti National park.

Not all species restricted breeding in wet season . But some of the birds nested in dry season **(e.g Namaqua dove and laughing dove).**

Greig-Smith (1980) provides evidence that birds inhabiting such habitats tend to have local migration. He reports that Savannah birds species in west Africa are wild ranging in their habitats and attributed this to the patchy distribution of food in such places

Hamed et al (1982) observed similar pattern at **Hantoub** Sudan, also Hamed (1998) found a similar pattern at **Dinder National park**.

Finally the forest habitat and river bank support most of needs of the local and migratory birds.

Conclusion:

The study gives important indicator for the water birds species

in **Jabal Awlia dam** reservoir, the number of species and the number of

individuals and the annual variation among them and showed that

there is a gap in some information and the need for monitoring for the

dry season and the rainy season, roosting sites, and nesting sites. The dam can be considered as an important site for some migratory birds.

References

- Alerstam, T. 1990.Birds Migration. Cambridge Univ. Press, N.y.vii/420pp.
- Alerstam, 1991. Bird flight and optimal migration. Trend Ecol. Evol.6:210-215
- Avery ML, Van Ripper III C (1989). Seasonal change in bird communities of the ch-parral and blue-oak wood land in Central California. Condor 91: 288-295.
- Avery ML, Van Ripper III C(1989); Seasonal changes in birds communities of the cha-parral and blue –oak wood land in Central Caifornia. Condor 91:288-295
- Bairlein,F.(1992). Birds during Southward, post –breeding migrations Ornithology Scand. 14:239-245
- Blake J.G, Hanowski J.M, Niemi G.J & Collins P.T.(1994) Annual variation in bird populations of mixed conifer-northern hardwood forestes. Condor96,381,99.
- Cave,C.F. and MacDonald, J.D. (1955). Birds of the Sudan. Oliver and Boyd Ltd.London&Ediburgh.pp444.
- Dodman, T and Diagana , CHD. (2006). Conservation dilemmas for intra-Afric migratory waterbirds . In:Boere GC, Galbraith CA and Stroud DA(eds)Waterbirds around the Worlds. TSO Scotland, Edinburgh, UK.
- Dorst,J.(1962). The Migrations of Birds. The Natural Museum of Natural History, Paris.

- Elgood, J. H. Sharland, R.E, and ward, P. 1966. palaerctic migrants in Nigeria . Ibis, 108, 183-216.
- Fry, C.H., Ash, J.S., & Ferguson-lees 1970. Spring weights of some palaearctic migrants at Lake Chad. Ibis, 112, 58-82.
- Greig-smaith, p.W.(1980). Ranging behavior of birds in savanna and riverine forest habitats in Ghana . Ibis, 122,209-226.
- Girish Chopra., &Rooja Rani, 2015.Species diversity and abundance of birds of Chilli Lake, Fatehabad, Haryana, . International Journal of Innovative Research and Development ISSN 2278-0211(online)
- Huyam Eltayeb, EihabIdris, Amal Adam, Tasabeeh Ezaldeen& Dawi Hamed . (2012)A forest in acityBiodiversity at Sunut forest, Khartoum, Sudan Egypt. Acad.J.Biolog.Sci.,4(1):199- 209(2012) .
- Hamed. D. M.1992. Seasonal changes in the bird fauna at Hantoub "Sudan Notes &Records Vol. LIXs. 176-189.
- Hamed, D.M (1994). Bird Funa in Dinder National Park. Sudan Notes and Records, Vol. II.
- Hamed, D.M & Evans, S.M.(1981). seasonal change in the bird luna at Hantub sudan notes and records, Vol. I.IXs: 176-189
- Hogstad O. (1993) Structure and dynamics of a passerine bird community in a spruce dominated boreal forst. A 12-year study. Ann. Zool. Fenn. 30, 4354.
- Holmes R.T. & Sherry T.W.(2001) Thirty-year bird population trends in an unfrag mented temperate decidnous forest. Importance of habitat change. Ank 118, 589609.
- Lack , D. (1968). Ecological Adaptation for Breeding in Birds. London

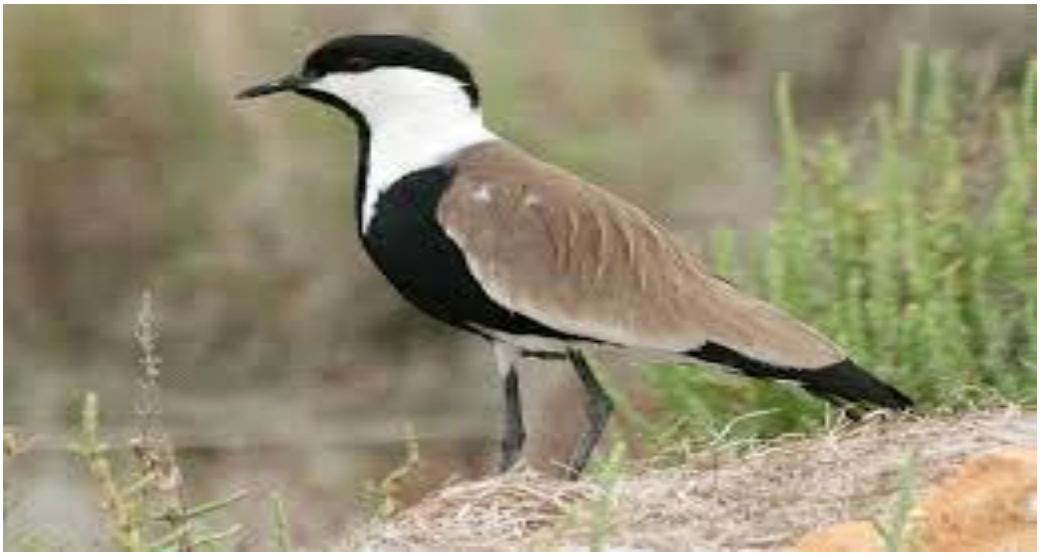
- Lado, B.D. (1994). Birds of Sunut forest in Khartoum. M.SC. Thesis . Zoology Department, Faculty of Science, University of Khartoum
- Monakov, A.V, (1968). The zooplankton and zoobenthos of White Nile and adjoining waters in the Repuplic of the Sudan. Hydrbiol.33:161-185.
- Mac Nally R. (1996). A winters tale: Among-year variation in bird community structure in a south eastern Australian forst. Aust. J. Ecol. 21, 28091.
- Nikolause, G. (1987) : Distribution atlas of Sudan birds with notes on Habitat and status, Bonner zoologische monographien, No,25,Bonn.
- Nisbet, I. C. T. , Evans , P. R. & Feeny P.P. (1961). Migration from Morocco into South west Spain in relation to weather. Ibis, 103, 349-371.
- Nikolaus, G. (1987). Distribution atlas of Sudans, birds with notes on habitat and status. Bonner zoologische monographien, Bonn.No25.322pp.
- O,Connor,R.J.(1984). The Growthand Development ofBirds . John Wiley and Sons . England
- Pescador , M. and Peris1. S.(2007). Seasonal and Water Mass Size Effects on the Abundance and Diversity of Waterbirds in a patagonian National park , Spain.
- Pearson, D.J. & Backhurst, G.C. (1976). The southward migration of palaeaerctic birds over Ngulia, Kenya. Ibis, 118,78-105.
- Ramsar , Iran, (1971). Appendix 7.Ramsar Wetland Defination, Classification and Criteria for Internationally Important Wetlands. Ramsar Definition of a wetland Under the Convention on Wetlands.www.Ramsar/convention .com.

- Sinclair, A. R. E. (1978) Factor affecting food supply and breeding season of resident birds and movements of palaeaerctic migrants in tropical African savanna. Ibis, 120, 480-497.

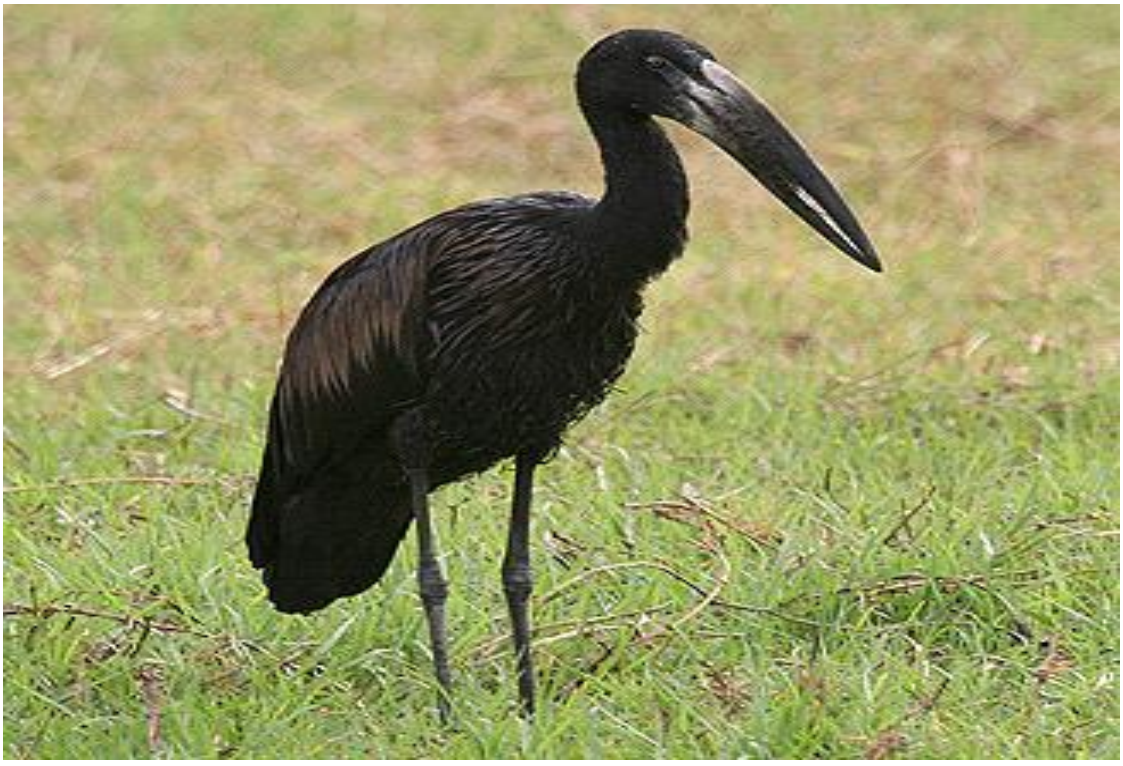
- Sinclair,I and Ryan, P. (2010). Birds of Africa south of Sahara. A comprehensive illustrated field guide . Struck Publishers. Cape Town, South Africa

- TRAMER, E. J. 1969. Bird species diversity components of Shannons formula. Ecology 50: 927-929

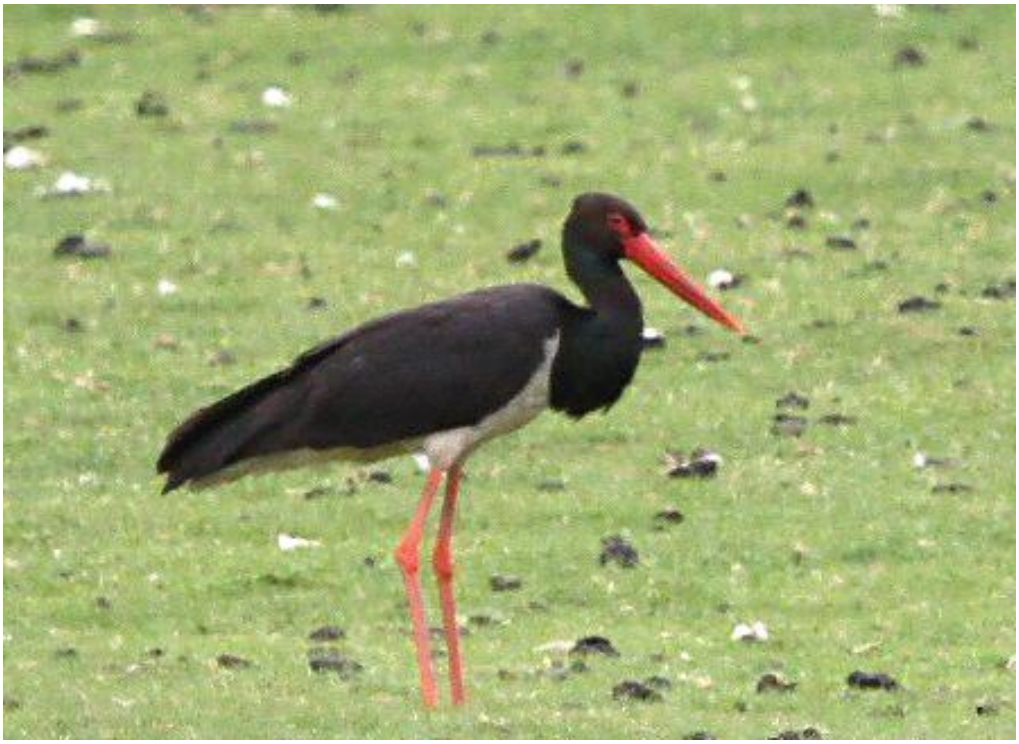
- Williams, J.G.(1991). Afield guide to the birds of East and central Africa. Collins, London



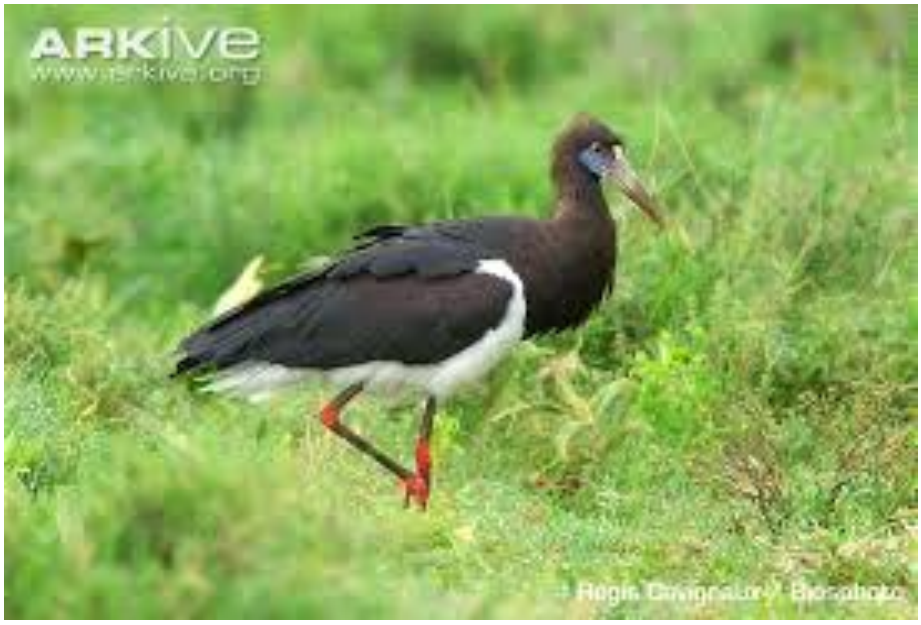
Spur-winged lapwing (Wikipedia,encyclopedia)



African openbill (Wikipedia,encyclopedia)

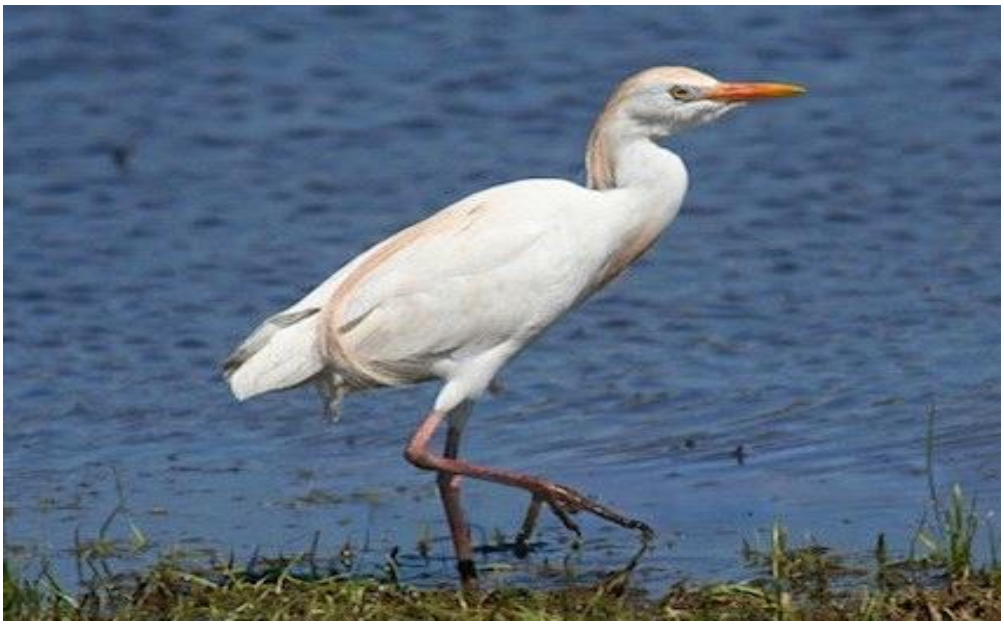


Black stork (Wikipedia,encyclopedia)

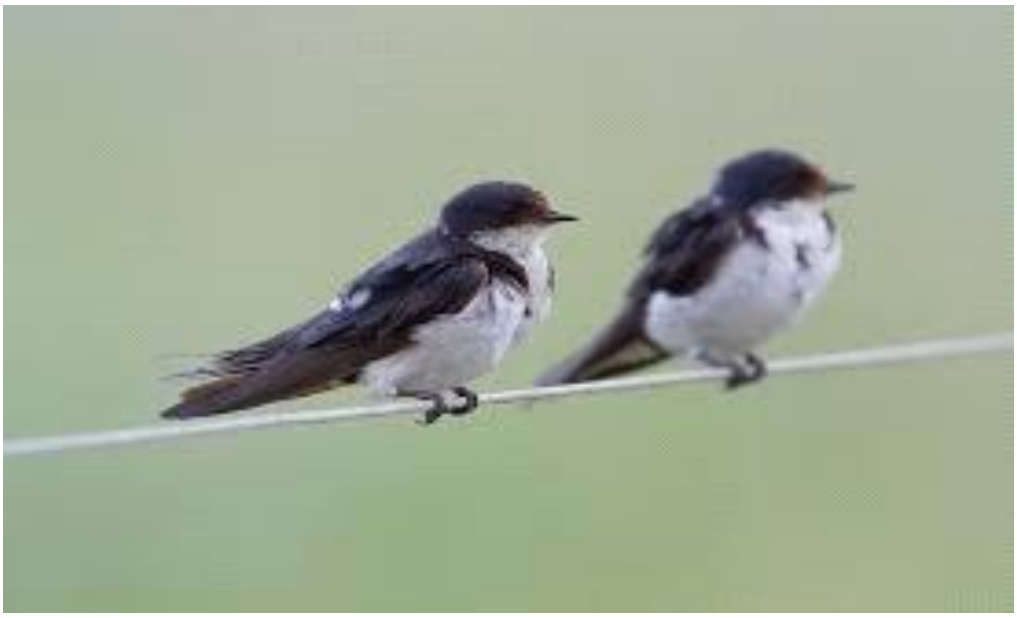


Abdims stork (Wikipedia,encyclopedia)

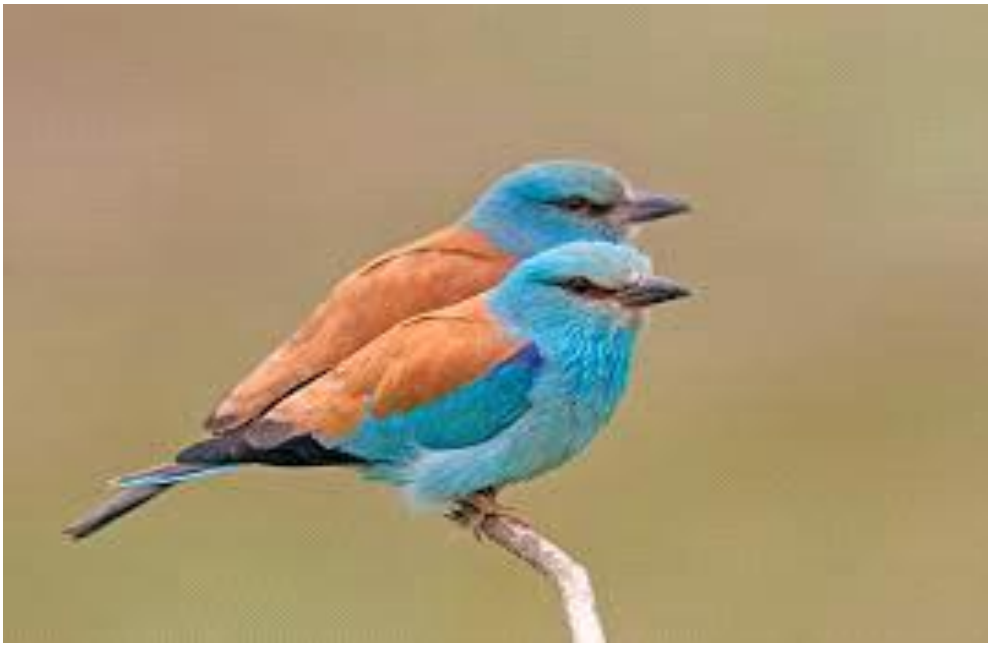
Black kite (Wikipedia,encyclopedia)



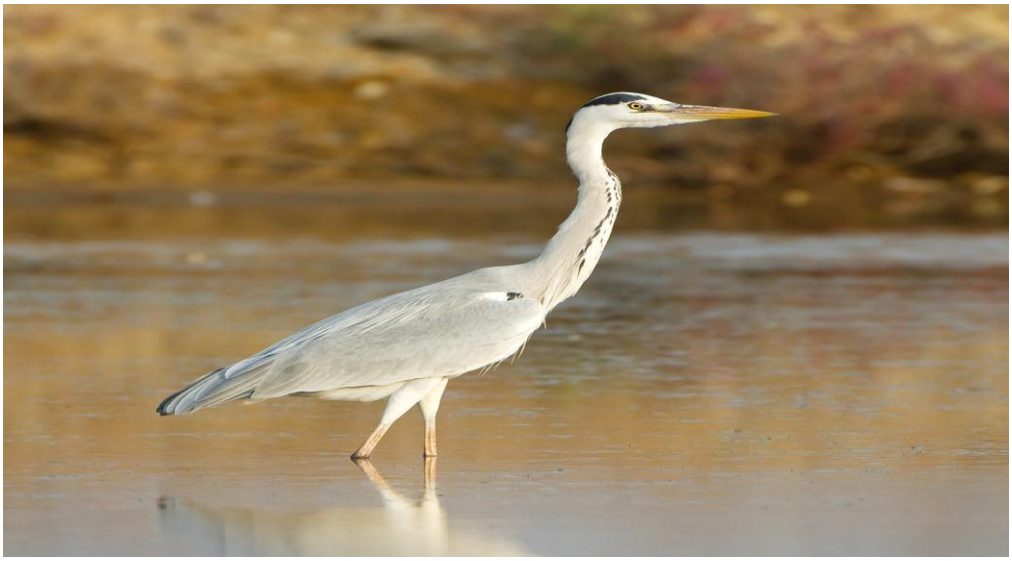
Cattle egret (Wikipedia,encyclopedia)



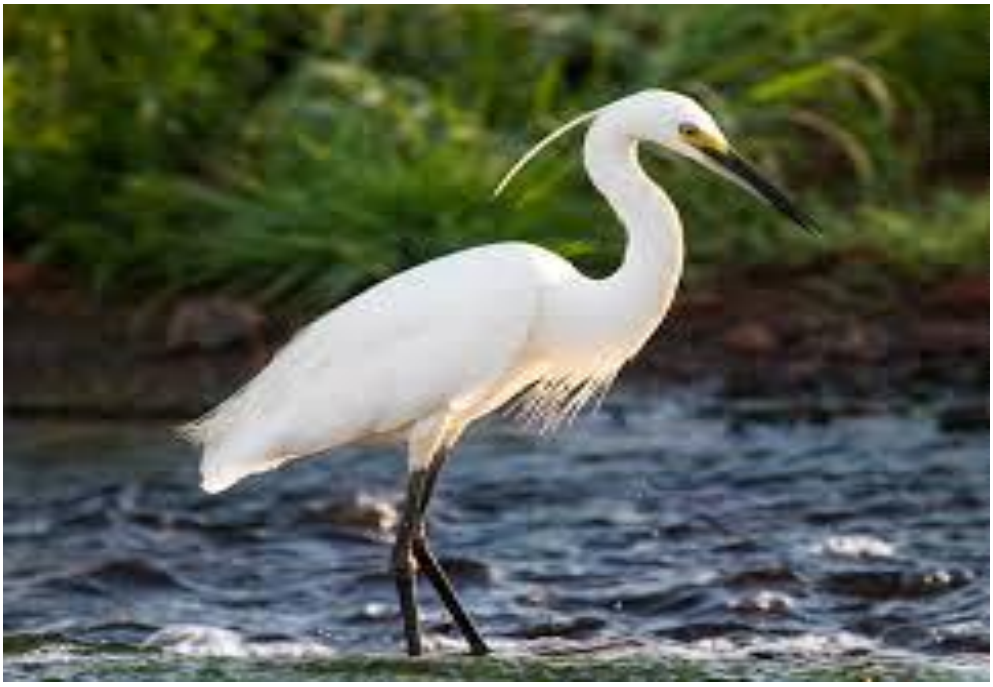
Ethiopian swallow (Wikipedia,encyclopedia)



European roller (Wikipedia,encyclopedia)

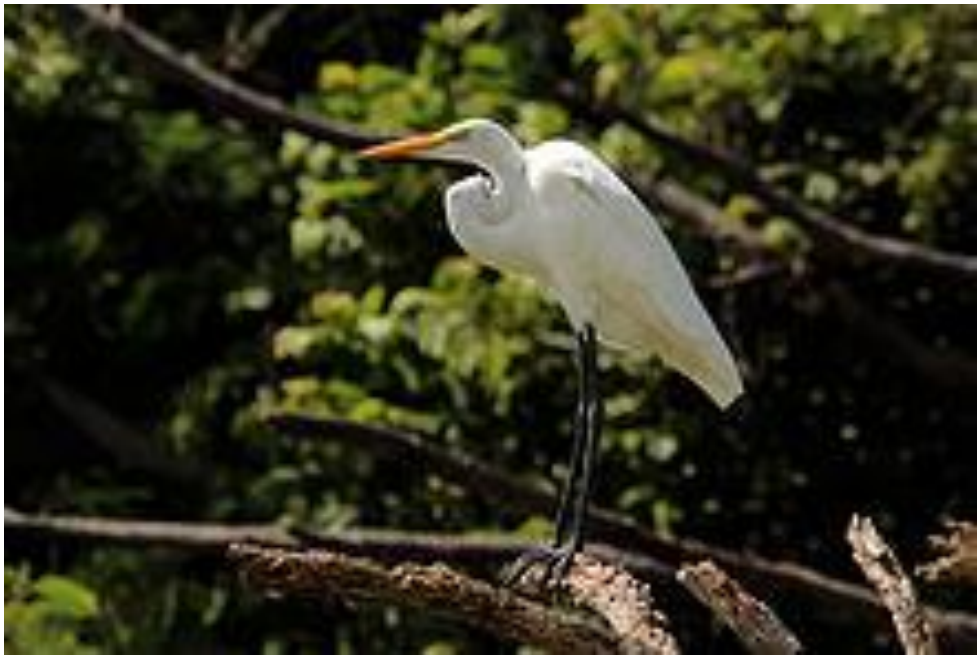


Greay heron (Wikipedia,encyclopedia)

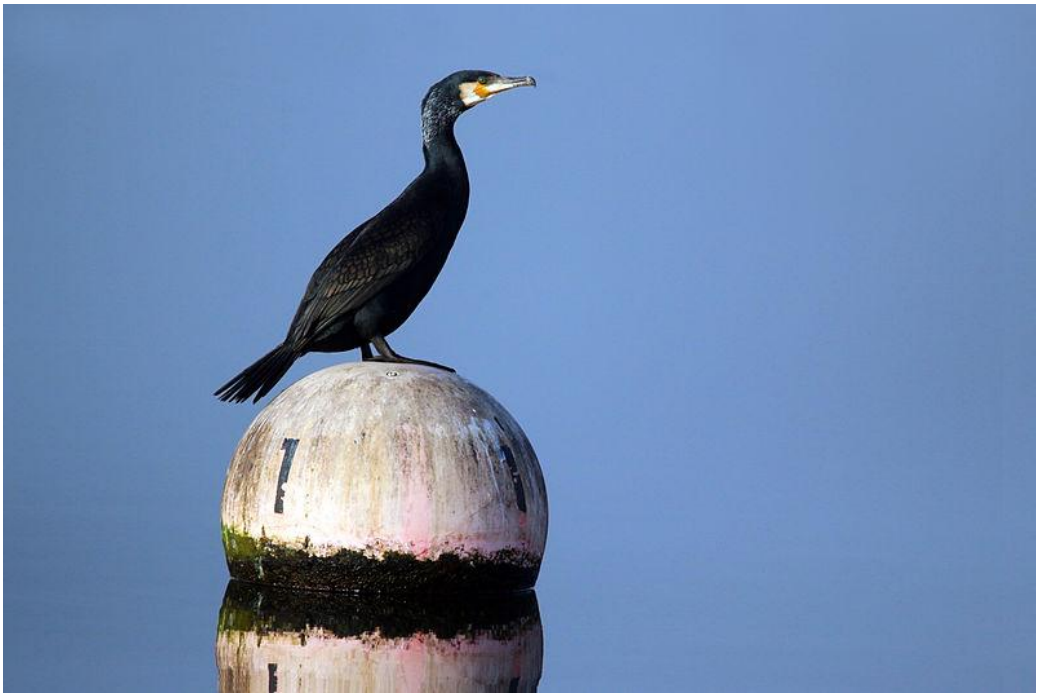


Little egret (wikipedia,encyclopedia)

Sudan golden sparrow (wikipedia,encyclopedia)

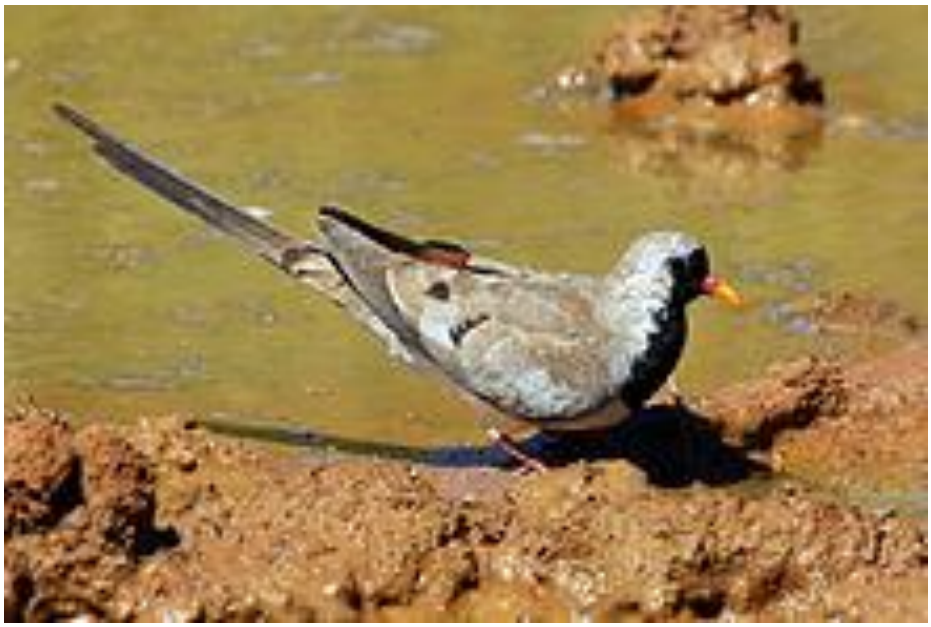


Great egret (Wikipedia,encyclopedia)

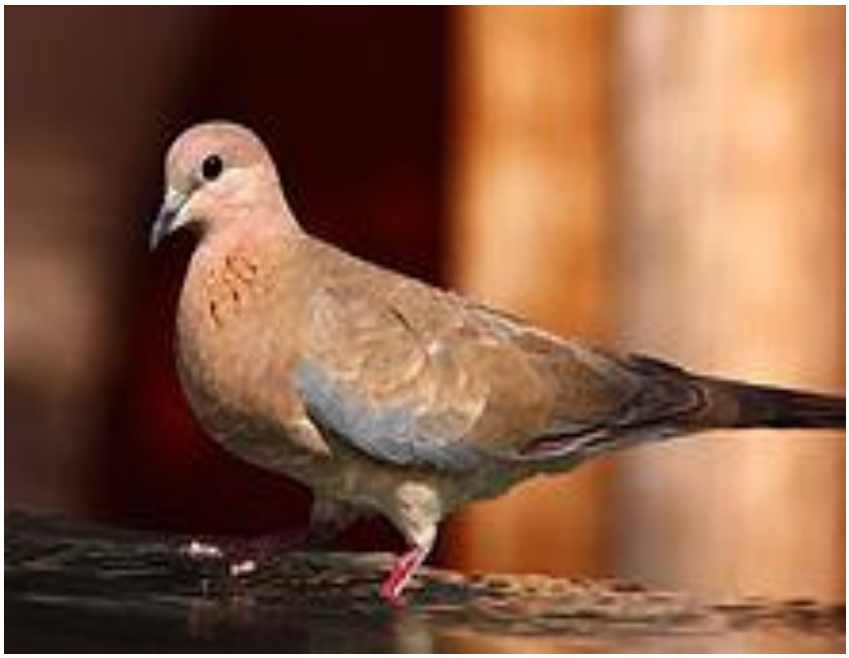


Great cormorant (Wikipedia,encyclopedia)

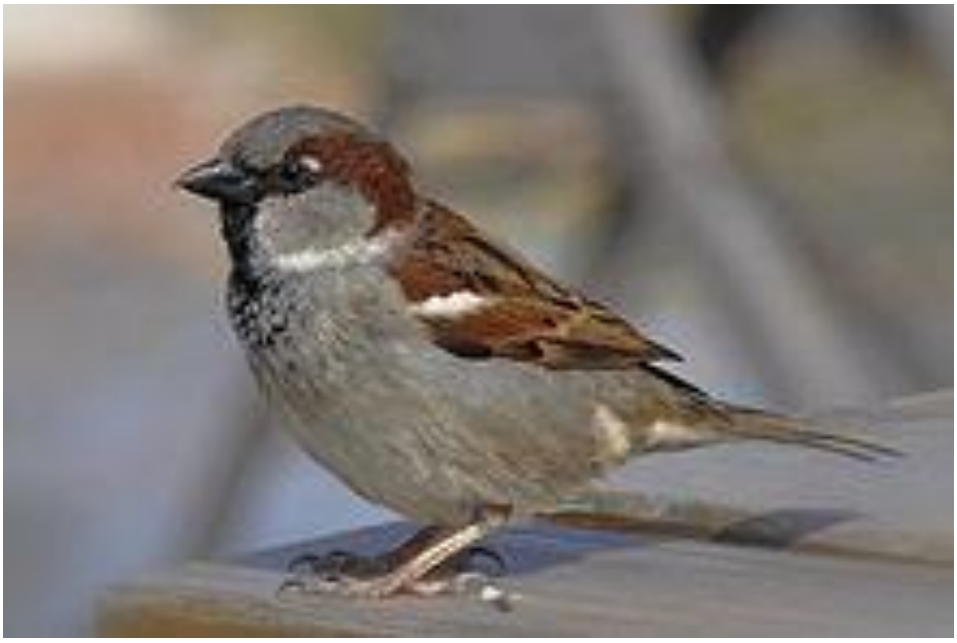
Whiskered tern (Wikipedia,encyclopedia)



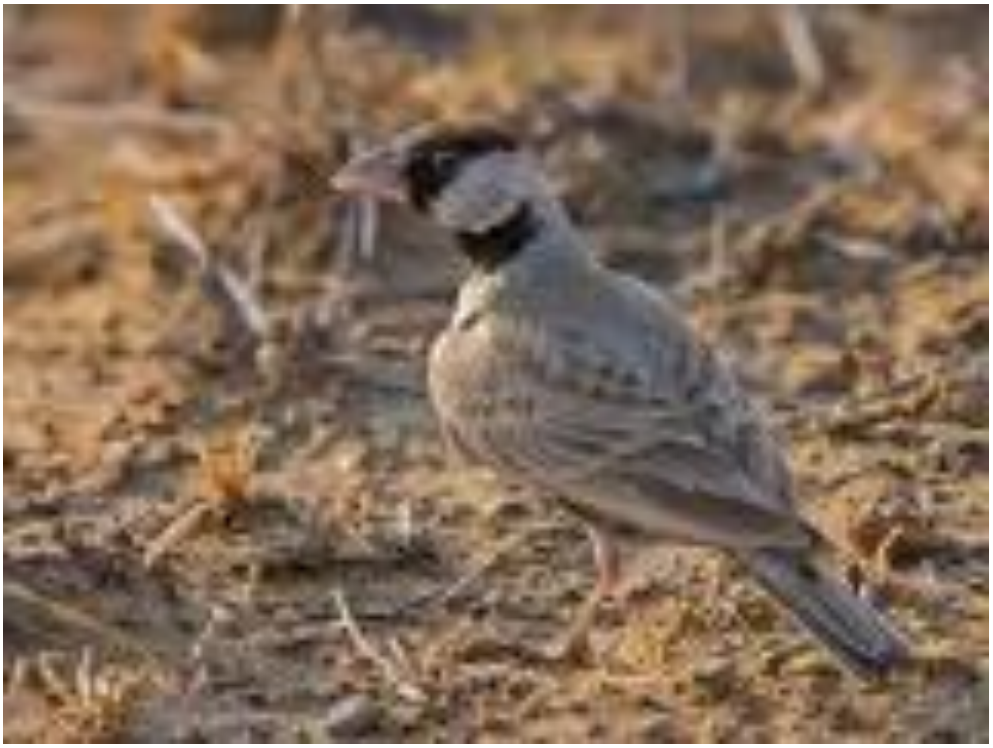
Namaqua dove (Wikipedia,encyclopedia)



Laughing dove (Wikipedia,encyclopedia)



House sparrow (Wikipedia,encyclopedia)



White fronted sparrow lark