ADDIS ABABA UNIVERSITY
SCHOOL OF GRADUATE STUDIES
COLLEGE OF NATURAL AND COMPUTATIONAL SCIENCES

FEEDING BEHAVIOUR AND ACTIVITY PATTERNS OF HAMERKOP (*Scopus umbretta*) IN LAKE HORA, BISHOFTU

BY
YONAS DAGNE

A thesis Submitted to the Department of Zoological Sciences in partial fulfilment of the requirements for the Degree of Masters of Science in Biology

ADVISOR DR. BEZAWORK AFEWORK

September 2019
Addis Ababa Ethiopia

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Chairman, College Academic Commission.

Acknowledgement

First of all, I would like to express my deepest gratitude to my beloved God. Next, I would like to acknowledge Ministry of Education for sponsoring me in this MSc Program and I would like to acknowledge and express my heartily thanks to my adviser Dr. Bezawork Afework to her continuous and generous assistance and in providing relevant input for the research and also I would like to thanks my examiner Dr. Tilaye Wube for his essential advises during my seminal preparation and for his valuable comments towards my thesis. Then I would like to thank those that helped in participating and supporting my studies to completion.

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Abstract

The feeding behavior and activity pattern of hamerkop (Scopus Umbretta) was studied on the Lake Hora Bishoftu. While study was carried out data were collected during dry and wet seasons (Jan- July 2019). Four days a month totally for 28 days data collected. Data collection throughout the day classified in to three phases. These are early morning (7:00-9:00am) a noon (12:00 -2:00 pm) and late afternoon (4:00-6:00pm). Scan sampling method was used to study feeding behavior and activity patterns of the species. During the dry season the species consumed fish scraps (57.4%). This makes fish scraps the highest consumed food item of the season. Hamerkop consumed amphibians (6.7%). This makes amphibians the least consumed item of the season. During the wet season the species consumed worms (33%). Which was the highest consumed item of the season. Also hamerkop consumed other food items like insects (2.5%). which was the least consumed food item of the season. During the dry season feeding (33.8%) was the most performed activity and bathing (0.86%) was the least performed activity. During the wet season feeding (23.3%) was the most performed activity and bathing (1.35) was the least performed activity.

CHAPTER ONE

1. Introduction

1.1 Background of the study

Hamerkop (*Scopus umbretta*) are wading birds that are widely distributed all over the Afro tropical region. They commonly occur in sub Saharan Africa, such as Ethiopia, Kenya, Tanzania and Uganda, as well as in Madagascar and Yemen. They are associated with water, but may also occur near temporary rivers and other water bodies (Brown *et al*., 1982; Maclean, 1993).

The hamerkop is also known as hammerkop, hammerkopf, hammerhead, hammerheadstork, umbrette, umber bird, tufted umber, or anvil head, it also locally called Bonju and its other Local name is Ayush in the study area.

The hamerkop is the only living member of its family, and one extinct species is known from the fossil record. *Scopus xenopus* was described by ornithologist Storrs Olson in 1984 from Pliocene deposits found in South Africa (Olson, 1984).

The hamerkop is a medium-sized waterbird, standing 56 cm high and weighing 470 g. Its plumage is a drab brown with purple iridescence on the back. The tail is faintly barred with darker brown. The sexes are alike and fledglings resembled adults (Elliot, 2017). The bill is long, 80 to 85 mm, and slightly hooked at the end. It resembles the bill of a shoebill, and is quite compressed and thin, particularly at the lower half of the mandible. The bill is brown in young birds, but becomes black by the time a bird fledges (Elliot, 2017)

The hamerkop occurs in Africa south of the Sahara, Madagascar, and coastal south-west Arabia. It requires shallow water in which to forage, and is found in all wetland habitats, including rivers, streams, seasonal pools, estuaries, reservoirs, marshes, mangroves, irrigated land such as rice paddies, savannahs, and forests. In Tanzania, it has also recently begun to feed on rocky shores (Elliot, 2017). In Arabia, it is found in rocky wadis with running water and trees. Most are sedentary within their territories, which are held by pairs, but some migrate into suitable habitat during the wet season only. The species is very tolerant of humans and readily feeds and breeds in villages and other human-created habitats (Elliot, 2017). Strangest aspect of hamerkop behaviour is the huge nest, sometimes more than 1.5 m across, and strong enough to support a man's weight. When possible, it is built in the form of a tree, often over water, but if necessary, it

is built on a bank, a cliff, a human-built wall or dam, or on the ground. A pair starts by making a platform of sticks held together with mud, then builds walls and a domed roof. A mud-plastered entrance 13–18 cm wide in the bottom leads through a tunnel up to 60 cm long to a nesting chamber big enough for the parents and young (Kahl, 1967).Nests have been recorded to take between 10 and 14 weeks to build, and one researcher estimated that they would require around 8000 sticks or bunches of grass to complete. Nesting material may still be added by the pair after the nest has been completed and eggs have been laid. Much of the nesting material added after completion is not sticks, but an odd collection of random items including bones, hide, and human waste (BirdLife International 2016)

The hamerkop is mostly active during the day, often resting at noon during the heat of the day. They can be somewhat crepuscular, being active around dusk, but are not nocturnal as has sometimes been reported (Elliot, 2017).

The hamerkop is mostly silent when alone, but is fairly vocal when in pairs or in groups. The only call it usually makes when alone is a flight-call, a shrill “nyip” or “kek”. In groups, vocalisations include a range of calls including cackles and nasal rattles (Elliot, 2017). One highly social call is the "yip-purr" call. This call is only made in a social context, when at least three birds, but up to 20 are gathered in a flock. Birds start by giving a number of "yip" calls, eventually giving way to purring notes. This call is made with the neck extended and sometimes accompanied by wing flapping, and becomes more vigorous when larger numbers of birds are present (Kahl ,1967).

Another common social behaviour is "false mounting", in which one bird stands on top of another and appears to mount it, but they do not copulate. This behaviour has been noted between both mated pairs and unmated birds, and even between members of the same sex and in reversed mountings, where females mount males. Because of this, the behaviour is thought to be social and not related to the pair bond (Hagemeyer, 2016). Dominant birds may signal to subordinates by opening their bills slightly and erecting their crests, but the species is not very aggressive in general towards others of its species. Birds in groups also engage in social allopreening when in groups. One bird presents its face of back of the head to the other to be preened (Kahl, 1967)

This species normally feeds alone or in pairs, but also feeds in large flocks sometimes .It is a generalist, although amphibians and fish form the larger part of its diet. The diet also includes shrimp, insects and rodents. The type of food they take seems to vary by location, with clawed frogs and tadpoles being important part of the diet in the East and Southern Africa and small fish being almost the only prey taken in Mali. Because it is willing to take a wide range of food items and also take very small prey, it is not resource -limited and only feeds for part of the day. (Elliot, 2017)

1.2 Statement of the problem

In spite of wide range of hamerkop distribution, there are few studies on nesting (Liversidge, 1963), observations on behavior (Kahl, 1967), copulation (Cheke, 1968), nest building (Wilson and Wilson, 1986), aspects of reproductive ecology (Wilson *et al* ., 1988) and nest site selection (Kopij,2005). In Ethiopia studies on different aspects of this species are lacking. In this study the researcher intended to investigate feeding behavior and activity patterns of hamerkop (*Scopus umbretta*) in Lake Hora, Bishoftu.

1.3 Objectives

1.3.1. General Objectives

- The general objective of this study was to understand the feeding behavior and activity patterns of hamerkop in Lake Hora Bishoftu.

1.3.2. Specific Objectives

The specific objectives of this study were:

- To assess the feeding behavior of hamerkop in Lake Hora Bishoftu.
- To identify activity patterns of hamerkop in Lake Hora Bishoftu.
- To examine potential threats of the species in the area

1.3.3. Significance of the study

The findings of this study are important to provide necessary information about feeding behavior and activity patterns of Hamerkop. In addition the findings of this will help to better understand the ecology and behavior of the species.

CHAPTER TWO

REVIEW OF RELATED LITRATURE

2.1. Taxonomy and systematics

The hamerkop was first described by the French zoologist Mathurin Jacques Brisson in 1760 in his landmark Ornithologia, published two years after the tenth edition of Carl Linnaeues' Systema Naturae (Jacques, 1760). Brisson's work was later incorporated by Linnaeus into the 12th edition of the Systema Naturae. Brisson's names for bird genera were widely adopted by the ornithological community despite the fact that he did not use Linnaeus' binomial system. The International Commission on Zoological Nomenclature ruled in 1911 that Brisson's genera were available under the International Code of Zoological Nomenclature, so Brisson is considered to be the genus authority for the hamerkop. The specific name umbretta was given to the hamerkop in 1789 by the German naturalist Johann Friedrich Gmelin (Friedrich, 1789). The generic name, Scopus, is derived from the Ancient Greek skia for shadow. The specific name umbretta is modified from the Latin for umber or dark brown (Jobling, 2017).

The hamerkop is sufficiently distinct to be placed in its own family, although the relationships of this species to other families have been a longstanding mystery (Elliot, 2017). The hamerkop is usually included in the Ciconiiformes, but might be closer to the Pelecaniformes. Recent studies have found that its closest relatives are the Pelicans and Shoebill (Ericson *et al., 2006).*

2.2. Description

The hamerkop is a medium-sized water bird, standing 56 cm high and weighing 470 g, although the subspecies *S. u. minor* is smaller. Its plumage is a drab brown with purple iridescence on the back; *S. u. minor* is darker. The tail is faintly barred with darker brown. The sexes are alike and fledglings resembled adults. The bill is long, 80 to 85 mm, and slightly hooked at the end. It resembles the bill of a shoebill, and is quite compressed and thin, particularly at the lower half of the mandible. The bill is brown in young birds, but becomes black by the time a bird fledges (Elliot, 2017). The neck and legs are proportionately shorter than those of similar looking Ciconiiformes. The bare parts of the legs are black and the legs are feathered only to the upper part of the tibia. The hamerkop has, for unknown reasons, partially webbed feet. The middle toe

is comb-like (pectinated) like a heron's. Its tail is short and its wings are big, wide, and round-tipped; it soars well, although it does so less than the shoebill or storks. When it does so, it stretches its neck forward like a stork or ibis, but when it flaps, it coils its neck back something like a heron (Shukla *et al*., 2004). Its gait when walking is jerky and rapid, with its head and neck moving back and forth with each step. It may hold its wings out when running for extra stability (Kahl, 1967).

Plate 1. Hamerkop on the branch (Wikipedia)

2.3. Distribution and habitat

The hamerkop occurs in Africa south of the Sahara, Madagascar, and coastal south-west Arabia. It requires shallow water in which to forage, and is found in all wetland habitats, including rivers, streams, seasonal pools, estuaries, reservoirs, marshes, mangroves, irrigated land such as rice paddies, Savannahs, and forests. In Tanzania, it has also recently begun to feed on rocky shores (Elliot, 2017). In Arabia, it is found in rocky Wadis with running water and trees (Richard and Simon, 2010). Most are sedentary within their territories, which are held by pairs, but some migrate into suitable habitat during the Wet Season only. The species is very tolerant of humans and readily feeds and breeds in villages and other human-created habitats (Elliot, 2017).

2.4. Social behavior and calls

The hamerkop is mostly silent when alone, but is fairly vocal when in pairs or in groups. The only call it usually makes when alone is a flight-call, a shrill “nyip” or “kek”. In groups, vocalizations include a range of calls including cackles and nasal rattles (Elliot, 2017). One highly social call is the "yip-purr" call. This call is only made in a social context, when at least three birds, but up to 20 are gathered in a flock. Birds start by giving a number of "yip" calls, eventually giving way to purring notes. This call is made with the neck extended and sometimes accompanied by wing flapping, and becomes more vigorous when larger numbers of birds are present (Kahl,1967).

Another common social behavior is "false mounting", in which one bird stands on top of another and appears to mount it, but they do not copulate. This behavior has been noted between both mated pairs and unmated birds, and even between members of the same sex and in reversed mountings, where females mount males. Because of this, the behavior is thought to be social and not related to the pair bond (Natasha, 2016). Dominant birds may signal to subordinates by opening their bills slightly and erecting their crests, but the species is not very aggressive in general towards others of its species. Birds in groups also engage in social allopreening when in groups. One bird presents its face or back of the head to the other to be preened (Richard and Simon, 2010).

2.5. Food and feeding

This species normally feeds alone or in pairs, but also feeds in large flocks sometimes. It is a generalist, although amphibians and fish form the larger part of its diet. The diet also includes shrimp, insects, and rodents. The type of food they take seems to vary by location, with clawed frogs and tadpoles being important parts of the diet in East and Southern Africa and small fish being almost the only prey taken in Mali. Because it is willing to take a wide range of food items and also take very small prey, it is not resource-limited and only feeds for part of the day (Elliot, 2017).

Plate 2. Hamerkop capturing amphibian(Wikipedia)

The usual method of hunting is to walk in shallow water looking for prey. Prey is located differently depending on circumstances; if the water is clear, it may hunt by sight, but if the water is very muddy, it probes its open bill into water or mud and shuts it. It may shuffle one foot at a time on the bottom or suddenly open its wings to flush prey out of hiding. Prey caught in mud is shaken before swallowing to clean it, or if available, taken to clearer water to do so. The species also feeds while in flight. A bird flies slowly low over the water with legs dangling and head looking down, then dipping feet down and hovering momentarily when prey is sighted. The prey is then snatched with the bill and swallowed in flight. This method of hunting can be very successful, with one birds catching prey on 27 of 33 attempts during one 45-minute session (Elliot, 2017).

Plate 3. Hamerkop searching for prey(Wikipedia)

It is also opportunistic, and feeds on swarming termites when they conduct their nuptial flights, snatching as many as 47 alates (flying termites) in five minutes (Dial and Vaughan, 1987).

This species has been recorded foraging for insects flushed by grazing cattle and buffalo, in a manner similar cattle egret, and has been observed fishing off the backs of hippopotamuses (Dean and Macdonald, 2010). It has also been recorded feeding in association with banded mongooses ; when a band of mongooses began hunting frogs in dried mud at the side of a pool of water a pair of hamerkops attended the feeding group, catching frogs that escaped the mongooses (Steyn, 1991).

2.6. Breeding

The strangest aspect of hamerkop behavior is the huge nest, sometimes more than 1.5 m across, and strong enough to support a man's weight. When possible, it is built in the fork of a tree, often over water, but if necessary, it is built on a bank, a cliff, a human-built wall or dam, or on the ground. A pair starts by making a platform of sticks held together with mud, and then builds walls and a domed roof. A mud-plastered entrance 13–18 cm wide in the bottom leads through a tunnel up to 60 cm long to a nesting chamber big enough for the parents and young. Nests have

been recorded to take between 10 and 14 weeks to build, and one researcher estimated that they would require around 8000 sticks or bunches of grass to complete. Nesting material may still be added by the pair after the nest has been completed and eggs have been laid. Much of the nesting material added after completion is not sticks, but an odd collection of random items including bones, hide, and human waste (Kahl, 1967)

Pairs of hamerkop are compulsive nest builders, constructing three to five nests per year whether they are breeding or not (Wilson *et al., 1987).* Both members of the pair build the nest, and the building of nests may have a function in creating or maintaining the pair bond between them (Wilson and Wilson, 1986). Barn owls and eagle owls may force them out and take over the nests, but when the owls leave, the pair may reuse the nest. Owls may also use abandoned nests (Martin and Broekhuysen, 1961), as may snakes, small mammals such as genets, and various birds, and weaver birds, starlings and pigeons may attach their nests to the outside. A few reports exist of hamerkops nesting close together, including in Uganda, where 639 nests were seen in an area of 8 km^2 ; even if each pair had made seven nests, this would mean 80 pairs were nesting in that area. The species is not treated as colonial, as it does not habitually nest close together, but is not thought to be highly territorial, either. Even where pairs have home ranges that are more spread out those home ranges overlap and the boundaries are poorly defined (Wilson *et al.*, 1987).

Breeding happens year-round in East Africa, and in the rest of its range, it peaks at different times, with a slight bias towards the dry season. Pairs engage in a breeding display, then copulate on the nest or on the ground nearby. The clutch consists of three to seven eggs which start chalky white, but soon become stained. The eggs measure 44.5 mm × 33.9 mm on average, and weight around 27.8 g, but considerable variation is seen. Egg size varies by season, by the overall size of the clutch, and from bird to bird. Both sexes incubate the eggs, but the female seems to do most of the work. Incubation takes around 30 days from the first egg being laid to hatching, eggs are laid with intervals of one to three days, and they hatch asynchronously (Elliot, 2017).

Both parents feed the young, often leaving them alone for long times. This habit, which is unusual for wading birds, may be made possible because of the thick nest walls. The young hatch covered with grey down. By 17 days after hatching, their head and in a month. They first leave

the nest around 44 to 50 days after hatching, but continue to use the nest for roosting at night until they are two months old (Arvind and Rajiv, 2004).

2.7. Conservation status

This species has an extremely large range, and hence does not approach the thresholds for Vulnerable under the range size criterion (Extent of Occurrence <20,000 km2 combined with a declining or fluctuating range size, habitat extent/quality, or population size and a small number of locations or severe fragmentation). The population trend appears to be stable, and hence the species does not approach the thresholds for Vulnerable under the population trend criterion (>30% decline over ten years or three generations). The population size is very large, and hence does not approach the thresholds for Vulnerable under the population size criterion (<10,000 mature individuals with a continuing decline estimated to be >10% in ten years or three generations, or with a specified population structure). For these reasons the species is evaluated as least concern.

CHAPTER THREE

METHODOLOGY

3.1 Study area

The study area Lake Hora-Arsedi is located in Bishoftu town about 47 km south of Addis Ababa at 1850 m altitude. Like all the other volcanic crater lakes in this area, Lake Hora-Arsedi is a closed system, surrounded by very steep and rocky hills and cliffs. The lake has both indigenous and exotic flora, terrestrial and aquatic fauna including a variety of birds (Betre Alemu, 2000). Lake Hora-Arsedi is a small lake with surface area of 1.03 km2 and it is a double crater with a maximum depth of 38 m (north crater) and 31 m (south crater) and a mean depth of 17.5 m (Betre Alemu,2000)

Plate 4. Study Site (Direct shoot)

The region around the lake is characterized by moderate rainfall, varingaround 850 mm per annum, high incidence of solar-radiation and low relative humidity (Rippey and Wood, 1985). It also has two rainy seasons, the short rain season from February to April and the long rain season from June to September. Currently, the foot path constructed during the late Emperor Haile Selassie along the water edge of Lake Hora-Arsedi where tourists and locals enjoyed hitchhiking has been submerged in most part of the shore after 2003 (Brook Lemma, 2011) . Similarly, on the entrance of Ras Hotel on the northern side, there is a submerged house whose roof is used as a perching site by birds like hamerkop and Egyptian geese.

The portion of the lake located at the front of Ras Hotel consists of abundant vegetation cover on the shallow shore edge .And around Irecha place consists of few vegetation on the edge of shoreline but also has dense Acacia dominated vegetation nearby. And also the other sides of the lake possess shallow shore line edge with very few vegetation and sparsely distributed Acacia on the nearby cliffs.

3.2 Materials and Methods

3.2.1. Materials

In this study the data collection was done by direct, consecutive and periodic observation of the species therefore; Binoculars was used to observe feeding behavior and activity patterns of Hamerkop without disturbing the species natural environment. Electronic stop watches required to control duration of each and every activity observed throughout the whole data collection events. Data sheets, Note books, Markers and Pens were used to record observations of the study.

3.2.2 Methods

Preliminary survey was conducted before starting the actual research to assure the existence of the species and to identify preferable site. According to data gathered during preliminary survey, part of the lake around Irecha place was identified as preferable site. The site consists of two groups of the species one with twelve group members and other with ten members.

Scan sampling method was used to the study feeding behavior and activity patterns of hamerkop that occurred in the selected survey site of Lake Hora Bishoftu. Data collection conducted for seven months (January -July). Dry season months were January-May 2019 and Wet seasons

were June and July 2019. Four days a month totally for 28 days data collected. Each days of data collection were classified in to three different phases. Early in the morning (7:00_9:00 am), Afternoon (12:00 pm–2:00 pm), and late afternoon (4:00-6:00 pm). Each observation in each phase was done by observing the species for ten minutes followed by recording.

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CHAPTER FOUR

RESULTS

4.1. Foraging in Hamerkop

The result showed that during the dry season hamerkop mainly consumed fish scrap (57.4%). In addition worm (18.19%), fish (10%) and insects (7.59%) were consumed during this time. However, amphibians (6.7%) were consumed the least during this season During the wet season hamerkop mainly consumed worm (32.5%). In addition to that fish scrap (26.25%), fish (25%), and Reptiles (11.66%) were consumed during this time. However insects (4.58), was consumed the least during this season (Figure 1)

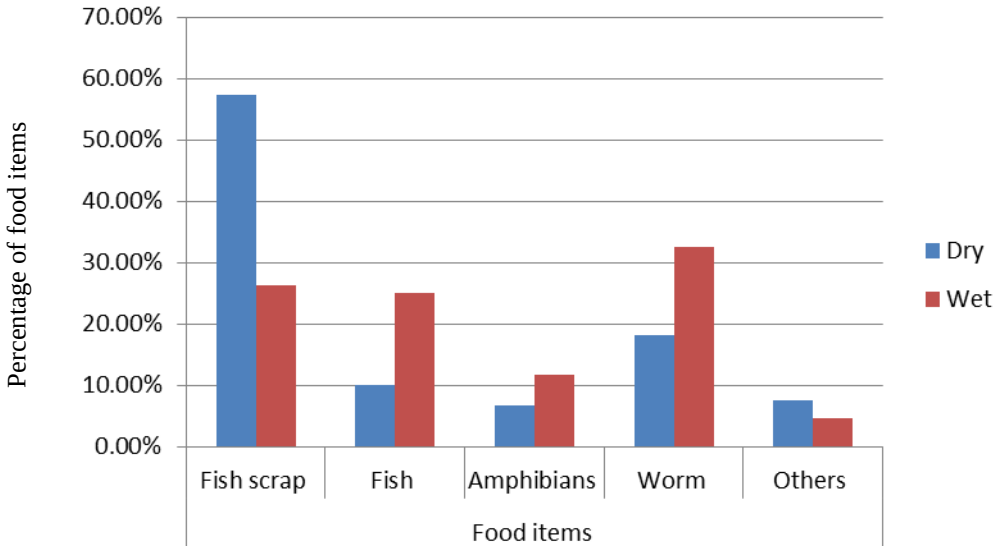

Figure 1. Percentage of food items consumed by hamerkop

4.1.1. Foraging in dry season

Four different types of feeds taken in the morning of dry season. The total number of feeds shows that; Fish scraps became first with 91 feeds out of total , next to it Worm with 24 feeds out of total , then Fish with 10 feeds out of total and finally others like insects became the least feeded item with 7 feeds out of total feeds.

Total number of feeds in the morning of dry season months shows that; the highest feed taken at May, next to it at January, then at April, next to it at March and finally the least feeds taken at February.

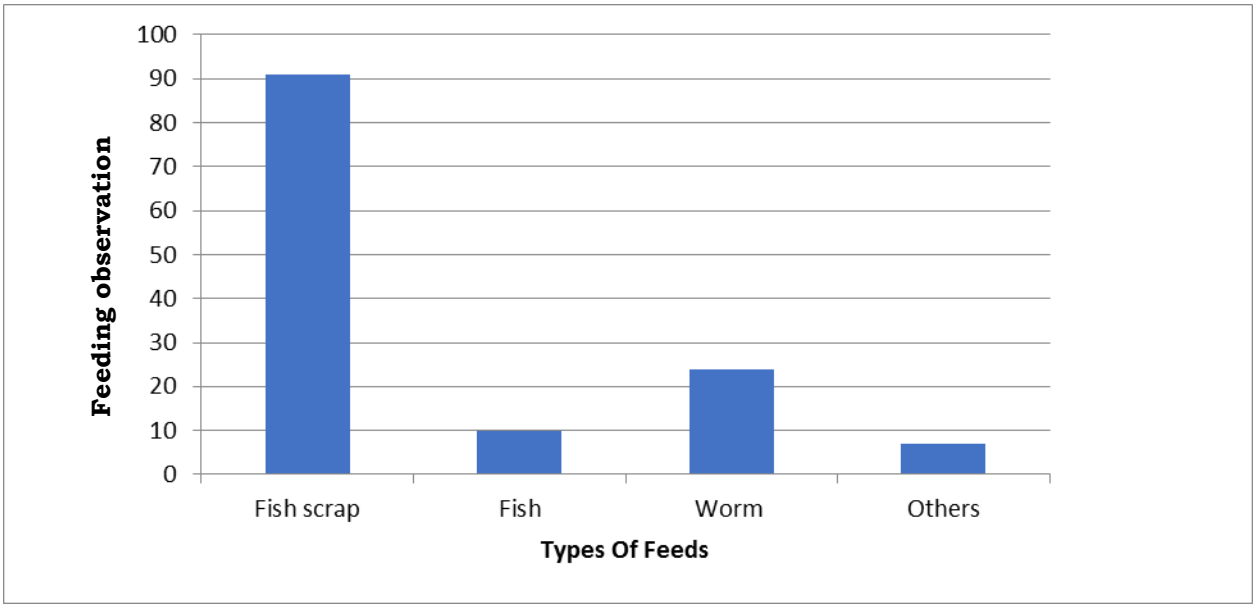

Figure 2 .Types of Feeds in the morning

Five different types of feeds taken in the afternoon of dry season. The total number of feeds shows that Fish scraps became first with 91 feeds out of total feeds, next to it worm with 38 feeds, then Reptiles with 28 feeds and finally Fish and others like Insects became the least feeded items both with 21 feeds out of total.

According to total number of feeds in the afternoon of dry season months the highest feed taken at March, next to it April, then May, next to it February and finally the least feed taken at January.

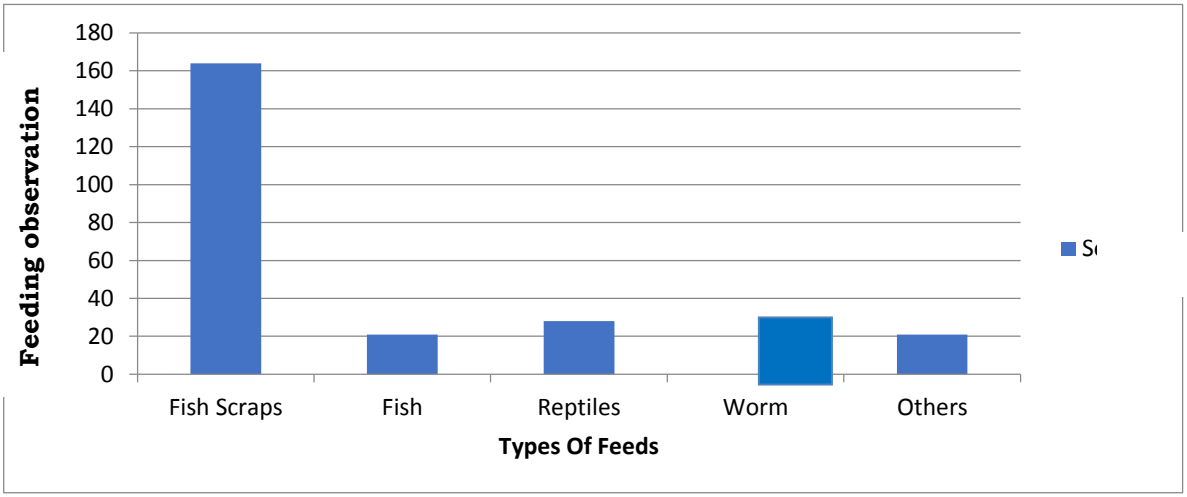

Figure 3.Types of feeds at noon

Five different types of feeds taken in the late afternoon of dry season. The total number of feeds shows that Fish scraps became first with 96 feeds out of total, next to it Worm with 40 feeds, then Fish with 27 feeds, next to it others like Insects with 12 feeds and finally Reptiles became the least feeded item with 10 feeds out of total feeds.

According to the total number of feeds in the late afternoon of dry season; the highest feed taken at January, next to it May, then April, next to it February and finally the least amount of feed taken at March.

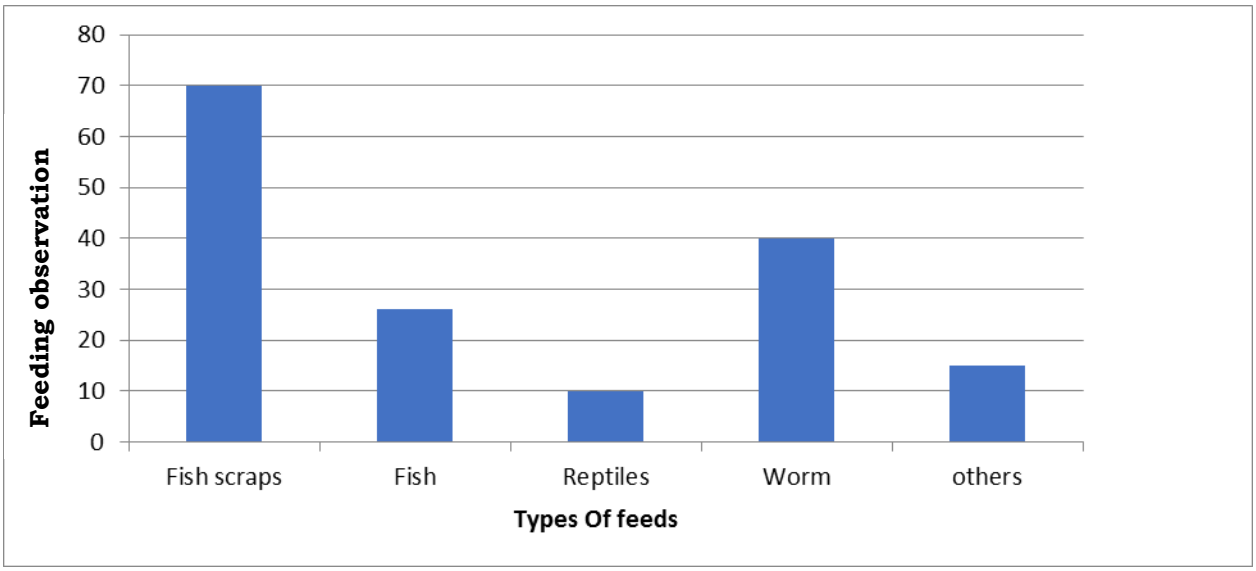

Figure 4. Types of feeds in the late afternoon

4.1.2. Foraging in wet season

Three different types of feeds taken in the morning of wet season in the morning. The species feeds on worms became first with 20 feeds out of total, next to it Fish with 17 feeds, and finally the species take 3 feeds on other like insects.

According to total number of feeds of wet season months in the morning the species feeds a little bit more on June than July.

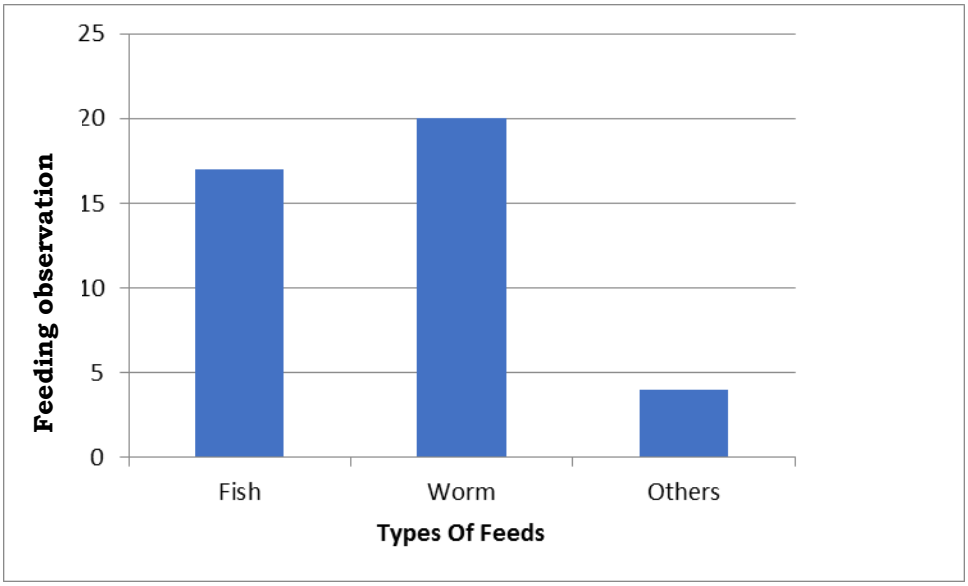

Figure 5 . Types of feed in the morning

Five different feeds taken in the noon of wet season .The species feeds on Fish scraps became first with 45 feeds out of total feeds, next to it Worm with 27 feeds, then Fish with 25 feeds, and finally others like Insects with 1 out of total feed became the least feed taken by the species.

According to the total number of feeds of wet season in the afternoon the species feeds much more in June than in July.

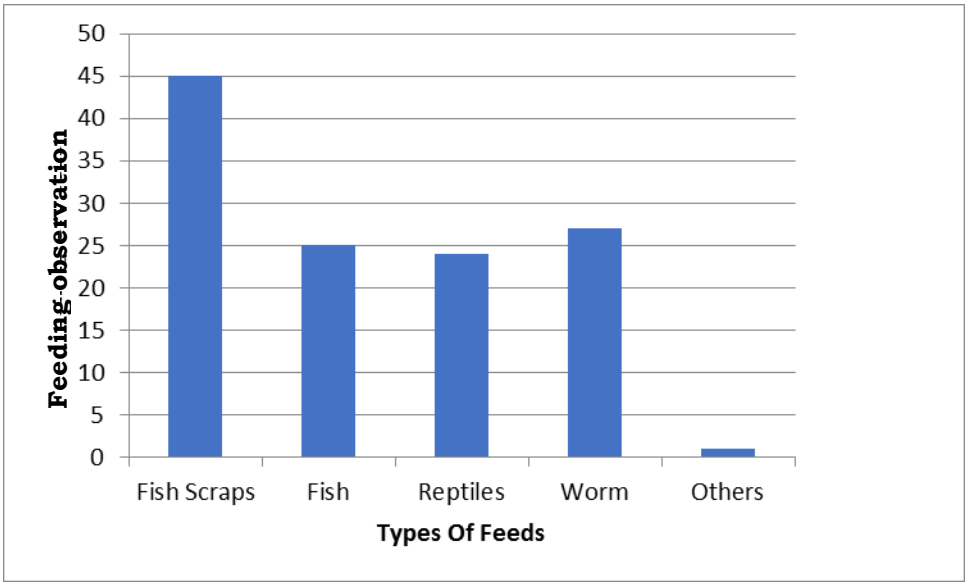

Figure 6.Types of feeds at noon

Five different feeds taken in the late afternoon of wet season. The species feeds on Worms became first with31 feeds out of total, next to it Fish scraps and Fish both with 18 each, then Others like Insects with 6and finally Reptiles with 4 became the least taken item by the species .

According to total number of feeds of wet season months in the late afternoon the species feeds much more in June than July.

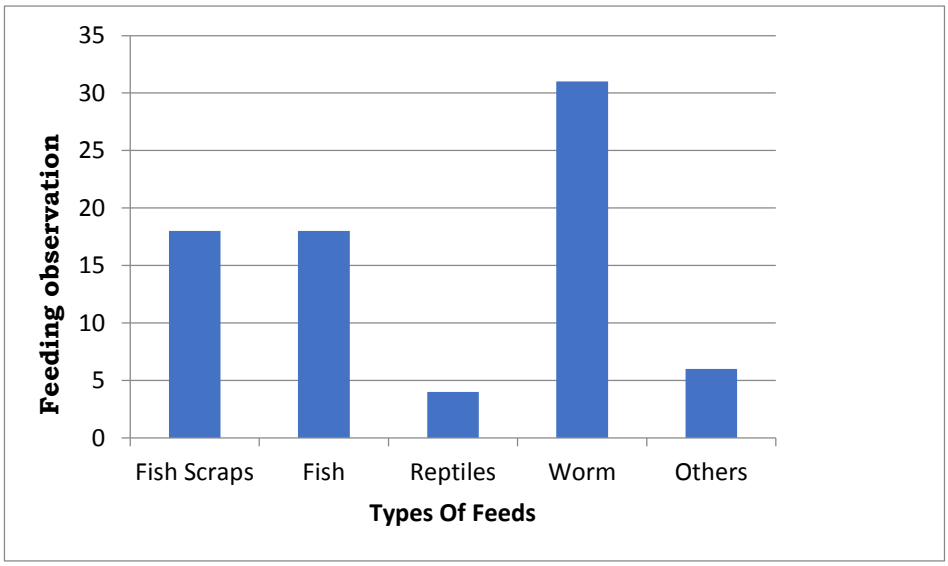

Figure 7. Types of feeds in the late afternoon

4.2. Activity patterns

During the study period eight activities were observed :(1) Feeding :the time spent by birds in capturing the prey and maneuvering them into the mouth prior to swallowing, (2) Resting : perching birds that were sleeping or dozing , with the head retracted and eyes closed, (3) Preening : consisted of all forms of comfort movements including feather shaking, wing flapping, bill cleaning, bill scratching, body and tail shaking, (4) Bathing : partial or whole body of birds sunk in to water, followed by shaking the the whole body to remove the water, (5) Stepping : walking slowly or fast from one feeding spot to another, (6) Scanning : birds perching in the upright position and scanning their surrounding actively, (7) Flying : the time spent by birds in flight, very often in pursuit of prey and (8) Calling and mounting : courtship displayed among members of the group.

4.2.1. Activity patterns in dry season

Throughout the study period eight different activities were performed by hamerkop. The result indicated that feeding comprised (33.9%) of the activity time during the dry season. In addition stepping (18.12%), scanning (15.9%), flying (11.83). resting (8.13%), preening (7.89%), calling and mounting (3.32%) were performed by hamerkop during the dry season. However, bathing (0.86%) was performed the least during this season.

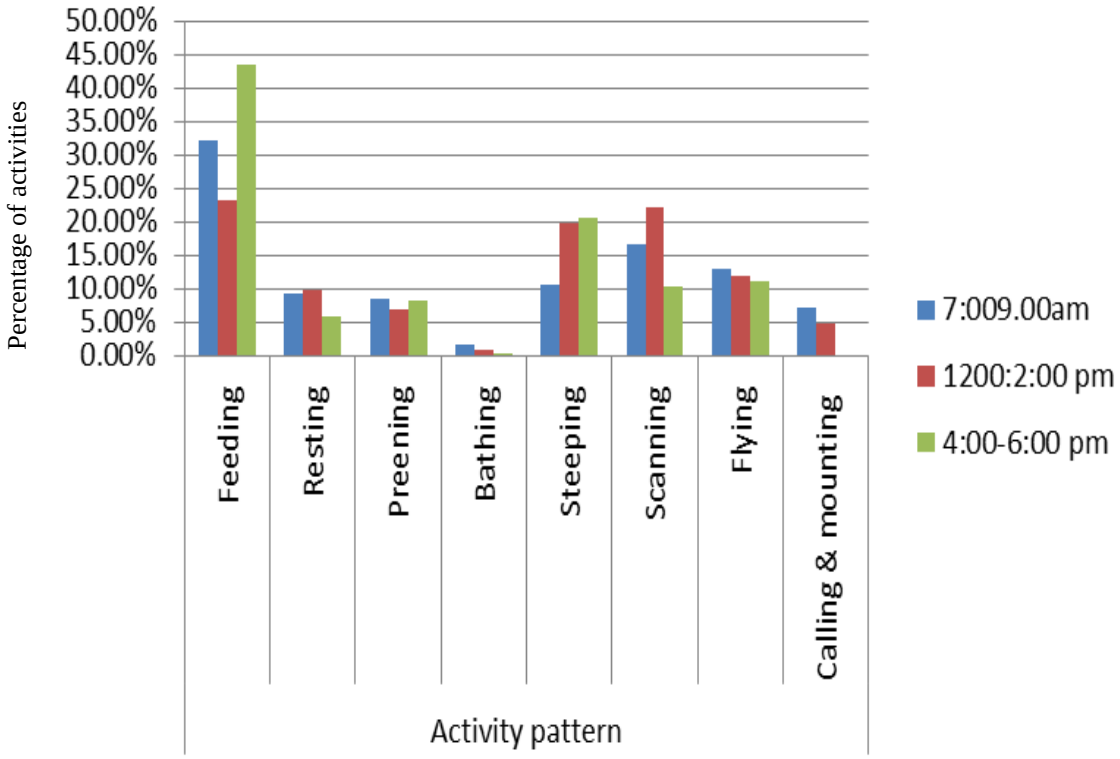

Figure 8. Percentage of the activities during the dry season

Eight activities were done in the morning of dry season. Total number of activities shows that; Feeding became first with 56 activities out of total, next to it Scanning with 30 activities, then Flying with 23 activities, next to it Stepping with 18 activities, then Resting with 17 activities, next to it Preening with 15 activities, then Calling and mounting with 13 activities and finally Bathing with 3 activities became the least performed activity in the morning of dry season.

According to total number of activities which were done in the morning of dry season months: May became the first with the highest activities performed, next to it March, then April and next to it February and finally January became a month in which least activities performed.

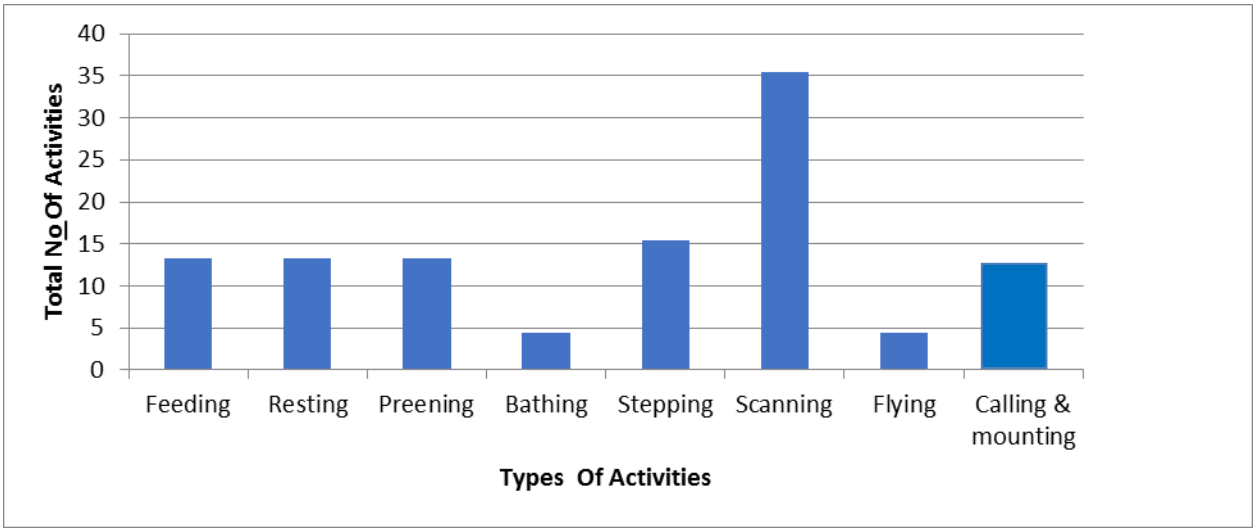

Figure 9. Types of activities in the morning

Eight activities were done in the rnoon of dry season. Total number of activities shows that Feeding and Stepping both became first with 66 activities each next Scanning with 63 activities, then Flying with 34 activities, next to it Resting with 28 activities, then Preening with 20 activities, next to it Calling and mounting with 14 activities, and finally Bathing with 3 became the least performed activity.

According to total number of activities which were done in the afternoon of dry season months; February and May became first in both of which highest activities done similarly, next April, then March and finally January became a month in which least activities performed.

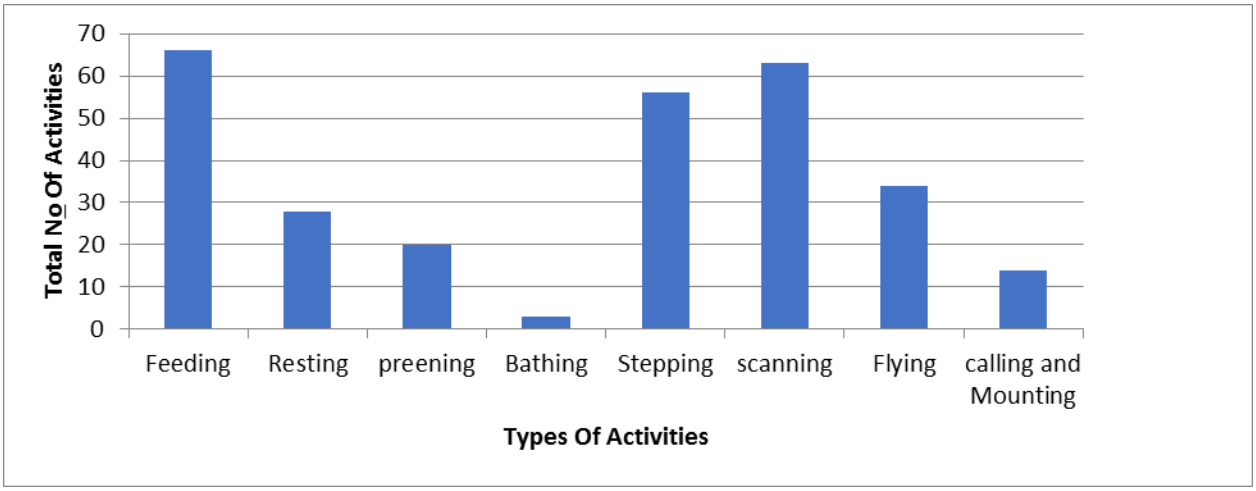

Figure 10. Types of activities at noon

Eight activities were done in the late afternoon of dry season. Total number of activities shows that Feeding became first with 153 activities out of total, next to it Stepping with72 activities, then Flying with 39 activities, next to it Scanning with 36 activities, then Preening with 29 activities, next to it Resting with 21 activities, then Calling and mounting with19 activities and finally Bathing with 3 became the least performed activity.

According to the total number of activities which were done in the late afternoon of dry season months; February became first in which highest activities done, next to it May, then January, next to it April and finally March became a month in which least activities performed.

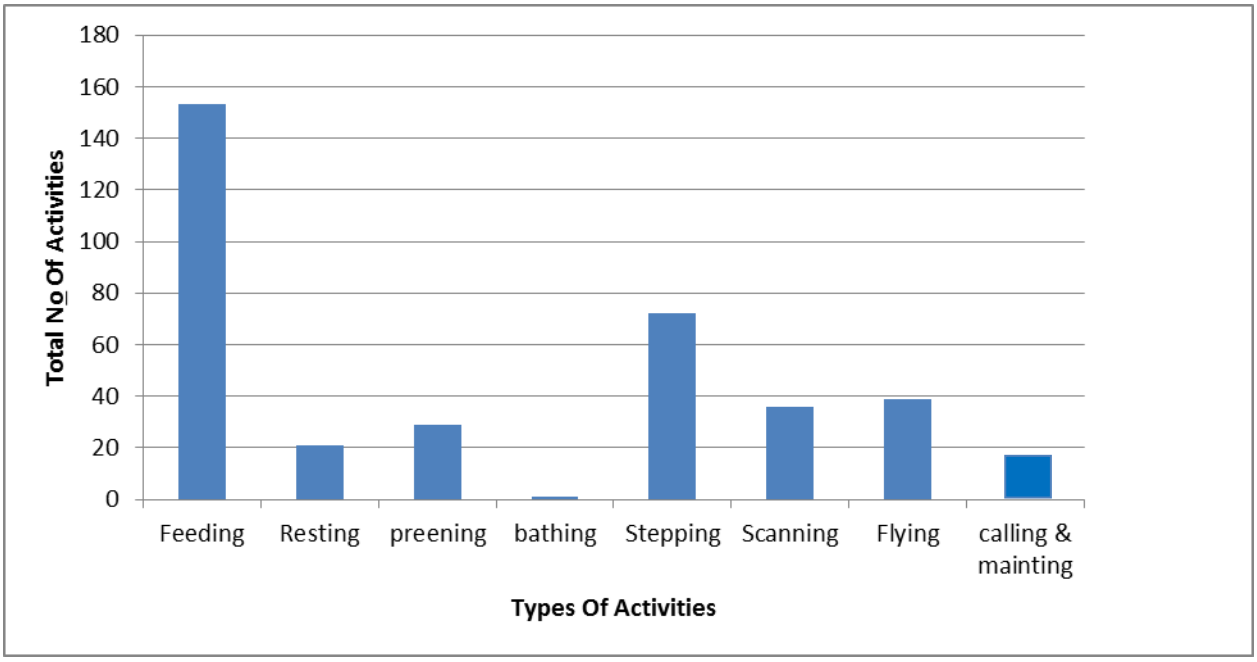

Figure 11.Types of activities in the late afternoon

Eight activities were done in the late afternoon of dry season. Total number of activities shows that Feeding became first with 153 activities out of total, next to it Stepping with72 activities, then Flying with 39 activities, next to it Scanning with 36 activities, then Preening with 29 activities, next to it Resting with 21 activities, then Calling and mounting with19 activities and finally Bathing with 3 became the least performed activity.

According to the total number of activities which were done in the late afternoon of dry season months; February became first in which highest activities done, next to it May, then January, next to it April and finally March became a month in which least activities performed.

4.2.2. Activity patterns in wet season

The result showed that feeding with (23.3%) became the highest performed activity next it scanning with (18.42%) became second highly performed activity during this season . Beside to this stepping (15.71),resting(11.92),flying(11.65),preening(11.38),calling and mounting(6.23 %) were performed during this season .However bathing (1.35%) was performed the least during this season.

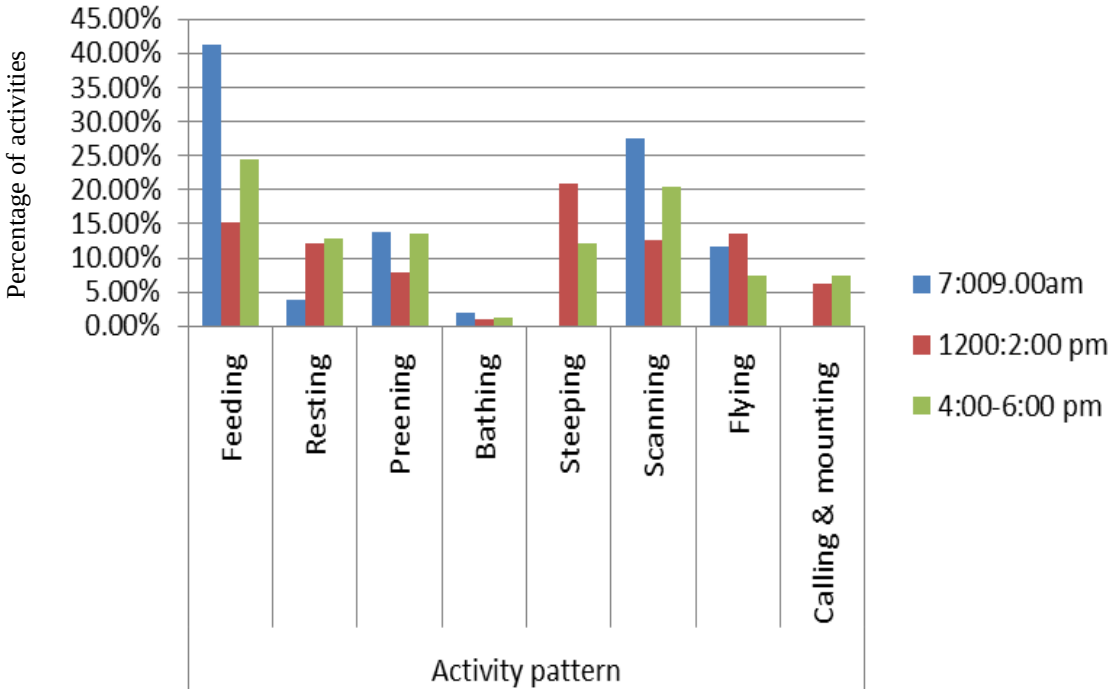

Figure 12. Percentage of activities during the wet season

Six different activities done by the species in the morning of wet season . Feeding became first with 21 out of total activities, next to it Scanning with 14 activities ,then Preening with 7 activities, next to it Flying with 6 activities, then Resting with 2 activities and finally bathing with 1 and it became the least activity performed by the species .

According to total number of activities done in the months of wet season at the morning more activities were done in July than June.

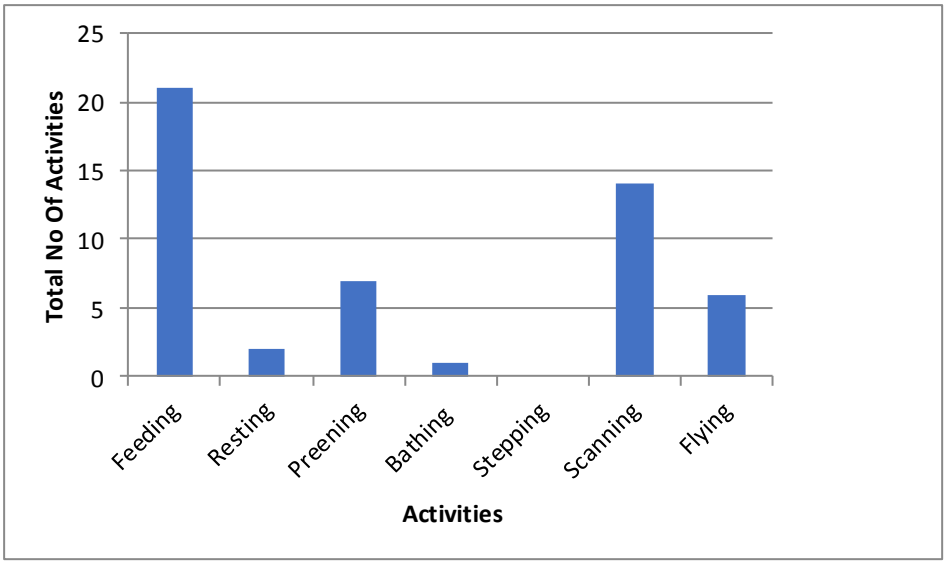

Figure 13. Types of activities in the morning

Eight done by the species in the afternoon of wet season .Stepping became first with 40 activities out of the total activities, next to it Feeding with 29 activities, then Flying with26 activities, next to it Scanning with 24 activities, then Resting with 23 activities, next to it Preening with15 activities, then Calling and mounting with 12 activities and finally Bathing with 3 became the least performed activity by the species.

According to total number of activities done in wet season month's afternoon more activities done in June than July.

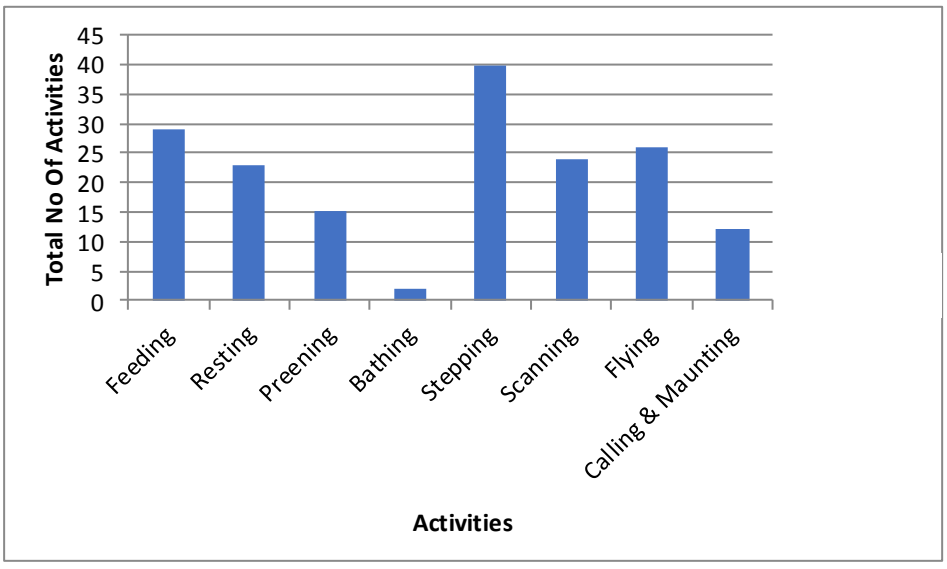

Figure 14. Types of activities at noon

Eight activities were done in wet season late afternoon . Feeding became first with 36 out of total activities, next to it Scanning with 30, then Preening with 20, next to it Resting with 19, then Stepping with 18, next to it Flying and Calling and mounting with 11 each and finally bathing with 2 and it is the least activity performed by the species.

According to total number of activities done in wet season months late afternoon more activities done in June than July.

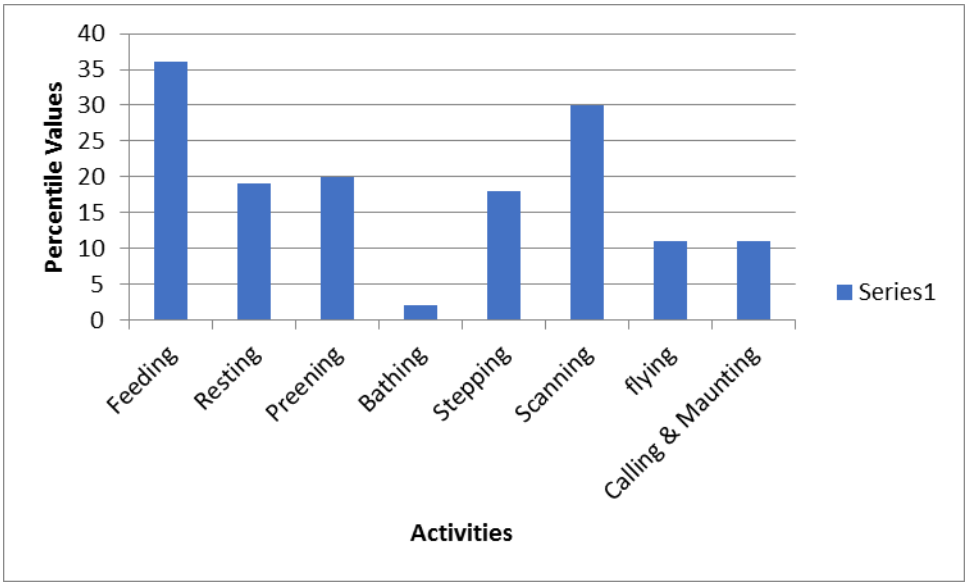

Figure 15. Types of activities in the late afternoon

CHAPTER FIVE

DISCUSSION

The result indicated that hamerkop mainly feeds on fish scrap during the dry season. This may be due to the adequate supply of discarded fish scrap during this time. In addition to that fish scrap was easily available and it was not energy consuming activity that does not require searching, capturing and processing compared to other food items. The hamerkop waits until the fishermen discarded the fish scraps. Most of the time fishermen became alert on fishing activity during early morning and late afternoon. However, amphibians were consumed least in this season as it was not available in the area. Beside to that, if hamerkop captures a frog it does not swallow it directly. Rather it soaks the prey in water several times and try to swallow it again and again through the lengthy process. Therefore due to this other tasks such as searching, capturing and processing prey item, hamerkop least fed on amphibians during the dry season. Kahl (1967) had reported that hamerkops might feed on discarded offal to some extent and captive hamerkops readily consumed scraps of raw meat.

During the wet season hamerkop mainly feeds on worms. This could be due to reduction of fishery activities and hence low amount of discarded fish scrap. The hamerkop look for alternative food item for survival and they tend to create water current by their legs and search for worm. Beside to this fish and amphibians were consumed by hamerkop. Kushlan (1978) stated that the wading birds forage using two basic methods: visual foraging and tactile foraging. Hamerkops are tactile and visual foragers and have both morphological and behavioral adaptations to facilitate this feeding. However, insects were least consumed in this season because scarcity and the presence of few bird species which effectively competes to fed on insects.

Hamerkop actively feeding during early morning and late afternoon during both dry and wet seasons. This could be due to active fishing activity during the morning and the low human disturbance during the late afternoon hours. However they also feed during noon actively in the dry season. This implied that feeding was the most important activity. Unless the species fulfills the nutrients requirement for existence, it was difficult to survive that was why hamerkop focus on feeding than other activities. On the feeding grounds, water birds distribution is largely

determined by the distribution of food, the substrate type and the distance from feeding area to roosting site in species which utilize different sites for feeding and roosting (Goss-Custard, 1970). On the other hand bathing was the least performed activity during both dry and wet seasons and hamerkop tends to perform other activities such as preening and resting rather than bathing as other activities.

CHAPTER SIX

CONCLUSION AND RECOMMENDATION

5.1. Conclusion

During the study, no potential threats were observed on the species. The species lives friendly with its environment and it was beneficial in cleaning the environment as it consumed fish scraps thrown away by fishermen.

Hamerkop during the dry season the majority of its feeds lies up on fish scraps due to it is easily accessed food item. However, amphibians were least consumed food item during the dry season. During the wet season the species also consumed different fed items. Where the highest amount of its food falls on worm. This implies that in wet season, as there was shortage of fish scraps the species shift to feeding on worm.

Feeding was the highest performed activity and this shows that the species spend much of its time on feeding rather than other activities. Generally, there was no potential threat which endanger the species in the area.

5.2 Recommendations

Based on the findings and in order to provide hamerkop with conducive environment

- The fishery activity should become well organized and there will be large amount of fish production due to this there will be enough amounts of Fish scraps and unwanted Fish types given to hamerkop.
- The study area should become more protected and conserved by doing this we can assure the well-being of the species in its natural habitat.

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Appendices

Appendices A: Feeding Behavior Data Sheet

No. of ind	Total Feed	Phase	Hours	Obs.	Fish scraps	Fish	Reptiles	Worm	Grass	Others	Remark
		1	7:00-9:00 AM	7:00-7:10							
				7:15-7:25							
				7:30-7:40							
				7:45-7:55							
				8:00-8:10							
				8:15-8:25							
				8:30-8:40							
				8:45-8:55							
		2	12:00AM-2:00PM	12:00-12:10							
				12:15-12:25							
				12:30-12:40							
				12:45-12:55							
				1:00-1:10							
				1:15-1:25							
				l:30-r:4D							
				1:45-1:55							
		3	4:00 -6:00 Pm	4:00-4:10							
				4:15-4:25							
				4:30-4:40							
				4:45-4:55							
				5:00-5:10							
				5:15-5:25							
				5:30-5:40							
				5:45-5:55							

Appendices B: Activity pattern

Data Sheet

No. of ind	Phase	Hours	Obs.	Feeding	Resting	Preening	Bathing	Stepping	Scanning	Flying	Calling & mounting	Others	Remarks
	1	7:00-9:00 AM	7:00-7:10										
			7:15-7:25										
			7:30-7:40										
			7:45-7:55										
			8:00-8:10										
			8:15-8:25										
			8:30-8:40										
			8:45-8:55										
	2	12:00AM-2:00PM	12:00-12:10										
			12:15-12:25										
			12:30-12:40										
			12:45-12:55										
			1:00-1:10										
			1:15-1:25										----
			1:30-1:40										
			1:45-1:55										
	3	4:00 -6:00 Pm	4:00-4:10										
			4:15-4:25										----
			4:30-4:40										
			4:45-4:55										
			5:00-5:10										
			5:15-5:25										----
			5:30-5:40										
			5:45-5:55										