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# POPULATION STATUS AND ACTIVITY PATTERN OF HAMERKOP (*SCOPUS UMBRETTA*) IN LAKE HORA-ARSEDI, BISHOFTU, ETHIOPIA

Solomon Mengistu[1] and Afework Bekele[1,*]

**ABSTRACT**: A study on the population status and activity pattern of hamerkop (*Scopus umbretta*) was carried out along the shore of Lake Hora-Arsedi, Bishoftu, Ethiopia. Data were collected during the wet and dry seasons during 2013/2014. Point count method was used to study the population status. Repeated observations and focal animal sampling methods were used to study the activity patterns. Data were analyzed using descriptive statistics, and results were compared with Chi-square test and one way ANOVA. The difference in the total number of hamerkops counted during the dry and wet seasons was not statistically significant ($\chi^2$=3.56, p=0.059). The species preferred fish scraps particularly the head parts discarded by fishermen. Resting (47.5%) was the most important diurnal activity, followed by scanning (20.7%) and feeding (13%) whereas calling and mounting was the minimum activity recorded during the study period. Feeding activity reached its peak (16.4%) during late afternoon (15:00–18:00) and lowest (6%) during mid-day (12:00–15:00). Resting and scanning were the commonly frequented behaviour in all the time blocks. Further ecological studies on hamerkop should be conducted to get additional information and facilitate conservation measures in the study area.

**Key words/phrases**: Activity pattern, Hamerkop, Lake Hora-Arsedi, Status.

## INTRODUCTION

Hamerkops (*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). Hamerkops are generally water birds that occur along swamp edges or marshes, ponds, rock pools, lakesides and sluggish rivers and streams. This wading bird resembles a heron or a stork, but it is currently placed in the pelican and cormorant group Pelecaniformes, although it is classified into Ciconiiformes (storks, herons, egrets, ibises and spoonbills) by other authorities. This species is the only member of its taxonomic family (Scopidae) and genus (*Scopus*).

[1] Department of Zoological Sciences, College of Natural and Computational Sciences, Addis Ababa University, P.O. Box 1176, Addis Ababa, Ethiopia. E-mail: solmersi@gmail.com; afeworksimegn@gmail.com
* Author to whom all correspondence should be addressed.

Both male and female hamerkops are about 56 cm long. They are dull-brown, short-legged water birds with a distinctive hammer-shaped head (https://animalcorner.co.uk/animals/hammerkop-bird). Thick, rear-facing plumage sweeps the back behind the head. They have a thick, straight black bill, black medium-length legs with three long toes forward on their feet and a toe behind (https://www.aboutanimals.com/bird/hamerkop). Both the legs and neck are shorter than most wading birds so they feed mainly in shallow water. The beak is deep with a groove along the side. This also helps in feeding. This bird consumes frogs and tadpoles by stirring and shuffling in shallow water (Kahl, 1967). In flight, they capture food from the water surface. Crustaceans, worms and insects are also consumed. The species is well known for its extraordinary huge domed nests, which are usually located on larger trees (Brown *et al*., 1982). It builds the biggest nest of any bird in Africa (www.edinburghzoo.org.uk/animals-and-attractions/animals /hamerkop). The pair builds the nest together by collecting twigs (Liversidge, 1963). Although enormous, the nest is accessible only by a small, narrow entrance hole.

In spite of the wide range of distribution, there are few studies on life history (Cowles, 1930), nesting (Liversidge, 1963), observations on behaviour (Kahl, 1967), copulation (Cheke, 1968), nest building (Wilson and Wilson, 1986) aspect of reproduction ecology (Wilson *et al*., 1987), growth of nestling (Wilson *et al*., 1988) and nest site selection (Kopij, 2005) of hamerkops. In Ethiopia, studies on different aspects of this animal are lacking. Information on the activity pattern of birds is especially important as the prevalence of a specific activity is likely to be related to its energetic cost, and ultimately because costs of the activities themselves are likely to have a major influence on the evolution of foraging behaviour (Kacelnick and Houston, 1984). Understanding the habitat and status of the bird is the first step for comprehensive conservation strategy (McGowan and Gillman, 1997).

With global increase in human population, habitats for wading birds are rapidly shrinking. The hamerkop (*Scopus umbretta*) is one of the species that is poorly studied. Information about population status and basic ecological requirements of hamerkops is indispensable to better understand the species. Lake Hora-Arsedi is an ideal place to study hamerkops because the birds nest, roost, and forage in this habitat. The objectives of this study were to determine population status, activity pattern, and foraging behaviour of hamerkops in Lake Hora-Arsedi, Bishoftu, Ethiopia.

## MATERIALS AND METHODS

### 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 $km^2$ 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 (Fig. 1).

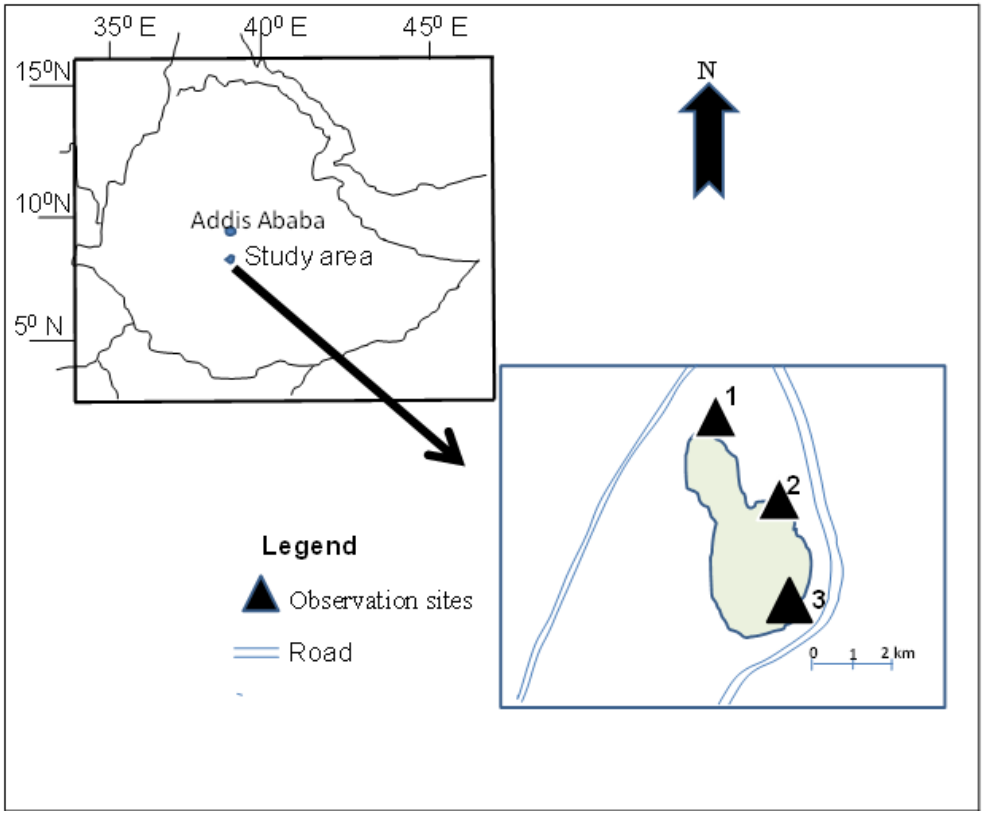


Fig. 1. Map of Lake Hora Arsedi and the study sites.

The region around the lake is characterized by moderate rainfall, varying around 850 mm per annum, high incidence of solar radiation and low relative humidity (Rippey and Wood, 1985). It has two rainy seasons, the short rain season from February to April and the long rain season from June to September. Currently, the footpath constructed during the late Emperor

Haile Selassie along the water's edge of Lake Hora-Arsedi where tourists and locals enjoyed hitchhiking has been submerged in most parts 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 hamerkops and Egyptian geese.

## Methods

Preliminary survey was conducted before starting the actual research to identify various foraging sites. The study area was divided into three sites based on the habitat preference of the bird and shore depth and vegetation of the lake. Site 1 is at the front of Ras Hotel. It consists of abundant vegetation cover on the shallow shore edge and partially flooded house (used as perching site by hamerkop) while Site 2 is around Irecha place which consists of few vegetation on the edge of shoreline but also has dense *Acacia* dominated vegetation nearby. Site 3 has shallow shoreline edge with very few vegetation and sparsely distributed *Acacia* on the nearby cliffs. Data collection was conducted during the dry (November 2013 to January, 2014) and wet (short rainy seasons i.e., February to March, 2014) seasons.

To survey the population, point count method was used by standing at a particular point for a fixed time using direct observation through binoculars (Bibby *et al*., 1998). To minimize disturbance during counting, silent movement followed by 3 to 5 min of waiting period was allowed (Hosteler and Main, 2001). Quantitative data to determine the population size were collected twice a day, morning (6:30 to 10:00 a.m.) and late afternoon (4:30 to 6:00 p.m.). These were the periods where most of the avian species were most active (Sutherland and Gosling, 2000).

## Activity pattern

The activity pattern of hamerkop was observed by using 10×50 binoculars and the duration of activities was measured with an electronic stopwatch. Each day was divided into four time blocks: early morning (06:00–09:00), late morning (09:00–12:00), mid-day or afternoon (12:00–15:00) and late evening (15:00–18:00). Flock and individual bird movements were taken into account during switching between observation points to avoid collecting information on the same individual twice. The pattern of observation in each time block was: in each one hour, there were three 15-minutes continuous monitoring periods followed by a 5-minutes break. During each 15-minutes period, only one bird was monitored. The time spent in different activities was calculated and from these values, the

percentage of time spent was estimated for each activity during different time blocks of the day. Data were converted into percentage time spent for each activity following Hutto (1990). The activities were divided into seven major categories: (1) Feeding: the time spent by birds in capturing the prey and maneuvering them into the mouth prior to swallowing, (2) Flying: the time spent by birds in flight, very often in pursuit of prey, (3) Scanning: birds perching in an upright position and scanning their surrounding actively, (4) Resting: perching birds that were sleeping or dozing, with the head retracted and eyes closed, (5) Preening: consisted of all forms of comfort movements including feather shaking, wing flapping, bill cleaning, bill scratching, body and tail shaking, (6) Stepping: walking slowly or fast from one feeding spot to another and (7) Calling and mounting: courtship displayed among members of the groups.

## Foraging behaviour

Focal sampling method (Altmann, 1974; Kumar, 2001) was used to study various feeding and foraging behaviours of the hamerkop that occurred in different selected survey sites of Lake Hora-Arsedi. Focal sampling consisted of watching an individual for 10 min. Using this method, data on the type of food items consumed were grouped as tadpoles, frogs, fishes and invertebrates. Actively feeding individual was selected as a focal bird and attempts were made to cover different individuals found in various feeding sites. Time spent for foraging, activity carried out during foraging time of the day and lengths of perching site were recorded. Individual bird was followed at a distance of 5 to 15 m. Data were collected early in the morning from 6:30 to 10:00 a.m. and late in the afternoon from 2:00 to 6:00 p.m. when most of the avian species were active during the wet and dry seasons (Williams and Arlott, 1980; Buskirk and McDonald, 1995). Time allocated in various foraging activities was derived from the recorded data to formulate the time budget of the hamerkops that was foraged in three selected survey sites.

## Data analyses

Data collected were analyzed using SPSS version 16 computer software program using descriptive statistics, chi-square test and one-way ANOVA. Kruskal-Wallis test was performed to compare activities between the study sites.

## RESULTS

The results indicated that the largest population of hamerkops was recorded during the dry season (61.1%) with the largest population at site 1 (40.3%) followed by site 2 (12.5) and site 3 (8.3). During the wet season, similar highest record of hamerkop population was observed at site 1 (25%) followed by site 2 (9.7%) and site 3 (4.2%), respectively.

On average, a total of 36 ± 6.43 hamerkops were observed during the wet and dry seasons. The number of birds in site 1 was the highest, followed by site 2 and least in site 3 during both seasons (Table 1). The difference in the total number of hamerkops counted during the wet and dry seasons was not statistically significant ($\chi^2$=3.56, df=1, p=0.059). However, there was a marked difference in the number of birds counted at different sites ($\chi^2$= 34.083, df=2, p<0.001).

Table 1. Counted individuals of hamerkops at Lake Hora-Arsedi.

| | Study sites | | | |
|---|---|---|---|---|
| **Season** | **Site 1** | **Site 2** | **Site 3** | **Total** |
| Dry | 29 | 9 | 6 | 44 |
| Wet | 18 | 7 | 3 | 28 |
| Mean | 23.5 ± 7.78 | 8.0 ± 1.41 | 4.5 ± 2.12 | 36.0 ± 6.43 |

Feeding comprised 13% of the activity budget over the study period. Resting was the most important diurnal activity in all time blocks, followed by scanning and feeding (except at mid-day) whereas calling and mounting was the minimum activity recorded in all time blocks during the study period. The maximum time (16.4%) devoted to feeding was during the late afternoon (15:00–18:00) and the lowest (6%) at mid-day (12:00–15:00). Resting and scanning were frequent behaviours in all the time blocks (Table 2).

During the study period, hamerkops were observed calling and false mounting among groups of minimum 9 and of maximum 34 individuals. Only a single true mounting was observed and one or two mounting was performed at a time during this study.

Table 2. Mean percentage of diurnal time spent in various activities by hamerkop in different time blocks.

| | Time of Day (h) | | | |
|---|---|---|---|---|
| **Activity pattern** | **06:00–09:00** | **09:00–12:00** | **12:00–15:00** | **15:00–18:00** |
| Calling and mounting | 2 | 1.8 | 1.6 | 1.3 |
| Feeding | 15 | 14.9 | 6 | 16.4 |
| Flying | 5.9 | 5 | 3.2 | 6.1 |
| Preening | 5.2 | 4.7 | 10.9 | 3.3 |
| Resting | 45.2 | 43.6 | 57.6 | 43.2 |
| Scanning | 19.6 | 23.7 | 18 | 21.4 |
| Stepping (Walking) | 7.1 | 6.3 | 2.7 | 8.4 |

Data on the diurnal activity patterns of hamerkops at different sites recorded throughout the study period were grouped into 7 major activities (Fig. 2). Overall, hamerkops spent 47.5% of their diurnal time on resting, which varied between the sites (53.3% in site 1, 51.5% in site 2 and 39.6% in site 3) ($\chi^2$=14.613, df=2, p=0.001). Resting was the most important activity in all the three study sites. The percent time spent in stepping (walking) ($\chi^2$= 12.277, df=2, p=0.002), resting ($\chi^2$=14.613, df=2, p=0.001), calling and mounting ($\chi^2$=14.981, df=2, p=0.001), scanning ($\chi^2$=12.012, df=2, p=0.002) and preening ($\chi^2$=11.755, df=2, p=0.003) differed significantly by sites. Calling and mounting was the least activity performed at site 3 (0.6%), whereas stepping (walking) was the most activity carried out at site 3 (16.3%).

Direct observation, video and film images revealed that hamerkops are carnivores. The species preferred fish scraps particularly the head parts discarded by fishermen (Plate 2). At site 3, they were observed feeding on small fish, tadpoles and invertebrates in shallow edges of the lakes (Plate 1). They were observed frequently dipping the discarded fish scraps of the head parts before they swallowed at sites 1 and 2.

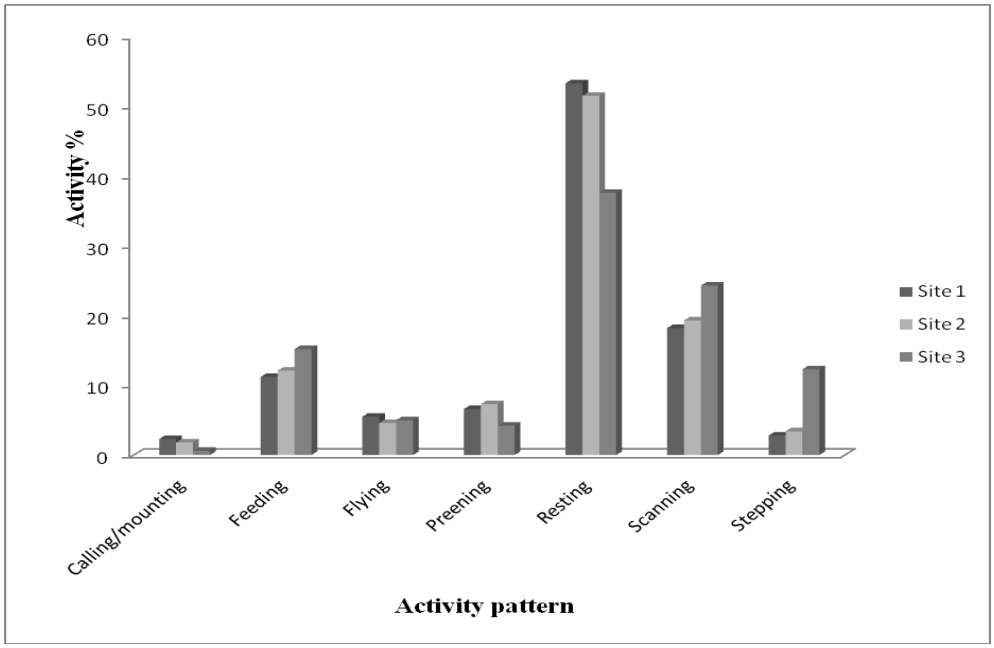


Fig. 2. Percentage time spent in various activities by hamerkops at different study sites.

Plate 1. A hamerkop searching for prey at site 3.

Plate 2. Fish scraps discarded by fishermen at site 2.

On average, the time taken by birds to swallow discarded fish scraps (head parts) is less than a minute which accounted for 53.3%, between one and two minutes (36.7%) and above two minutes (10%) (Table 3).

Table 3. Time taken to swallow fish scraps (the head parts) by hamerkops.

| **Time taken to swallow fish scraps in minutes** | **Mean (in second)** | **%** |
|---|---|---|
| <1 | 44.4 ± 10.511 | 53.3 |
| <2 | 94 ± 18.885 | 36.7 |
| ≥ 2 | 172 ± 42.962 | 10.0 |

## DISCUSSION

The number of birds counted varied among the sites. Willard (1977) suggested that the distribution of wading birds in an area is determined by the abundance of prey and ability of birds to exploit these preys. Hence, the greater number of hamerkops in sites 1and 2 might be due to the high availability of discarded body parts of fish by fishermen. Hamerkops perched on half submerged unroofed house at site 1 up to more than 30 individuals and waited for the fishermen to feed on the discarded fish scraps. The favourite food items of hamerkops under natural condition are frogs and tadpoles (Kahl, 1967). However, a trial and error learning may lead individuals to prefer food they deal with more easily, and learning of such skills would presumably be rapid and foraging behaviour can be culturally transmitted over generations in the wild (Fox and Young, 2012).

Kahl (1967) had reported that hamerkops might feed on discarded offal to some extent and captive hamerkops readily consumed scraps of raw meat. Large aggregations of wading birds form at sites of high prey availability (Kushlan, 1976), which is in line of what was observed at sites 1 and 2. At sites 1 and 2, most hamerkops (90%) spent less than 2 minutes to swallow fish scraps (nutritious head parts). This rewarded the bird with sufficient protein and energy conservation unlike searching frogs, fish, tadpoles or invertebrates at site 3, which took much time and expenditure of energy. According to Kaminski and Prince (1981), time budget allocation appears to be strongly determined by the ecology of the animal, such as the availability and energy content of the food item. Feeding on frogs, fish, tadpoles and invertebrates on shore was not an easy task. It took more time walking/stepping and stirring to shuffle the concealed prey to sight. According to optimal foraging theory, it is assumed that animals maximize their food intake while minimizing the overall costs of obtaining it, such as energy and time devoted to searching, capturing, and processing. Hence, the shorter duration of foraging condition and longer resting duration at sites 1 and 2 compared to site 3, perhaps indicate better foraging conditions. Wading birds may reach a point of satiation, after which there is limited need to continue foraging, even though foraging opportunities remain (Fox and Young, 2012). On the other hand, hamerkops at site 3, spent less time in resting, preening, and calling/mounting to compensate for foraging bouts. That is the main reason why the overall percentage time spent in resting was so high in our study. There was switch of birds between the study sites which overshadowed the percentage time spent on feeding at sites 3.

Sacred ibis also was observed feeding on the discarded internal organs of the fish scraps. There was no antagonistic behaviour observed between the hamerkops and sacred ibis. Domestic cats and dogs were observed as potential competitors for fish scraps. As a result of this, these birds usually were feeding when cats and dogs were not close enough to cause any danger. As the fish catch by fishermen is reduced, the number of hamerkops at the study sites decreased. This agrees with Brown *et al*. (2001) who reported that species show a tendency to be confined to the habitat where they get their feeding and nesting sites. The tendency of hamerkops to forage in flocks was probably due to the availability of discarded fish scraps by fishermen. The activity pattern in birds can be influenced by food availability (Hutto, 1990). As the availability of food is reduced, individuals will be forced to leave the area.

At site 3, few hamerkops were observed. This might be due to unavailability of discarded fish scraps unlike sites 1 and 2. In this site, birds were observed feeding on small fish, tadpole and invertebrates at shallow edges of the lake. Kushlan (1978) stated that wading birds forage using two basic methods: visual foraging and tactile foraging. Hamerkops are visual and tactile foragers and have both morphological and behavioural adaptations to facilitate this feeding. They have large bills to handle and subdue their prey. At site 3, they quietly stand on the edge of shallow water waiting for the prey and quickly dip their bill to capture their prey. They were also observed picking invertebrates from parts of plants. They walk through the shallow water in search of prey. That is why stepping (walking) was maximum at site three compared to the other two sites. The other reason might be that it takes long time to satiate as they feed on small fish and invertebrates which are very difficult for the bird to collect. Moreover, at site 3, human disturbance is very common interfering with foraging activity of the birds.

The other factor for variation observed in population size of hamerkops was due to the availability of potential prey in nearby Chelaleka wetland. As the water recedes, the depth of Chelaleka becomes shallower attracting many wading birds. According to Gawlik (2002), preys are more available to wading birds in shallower (5–10 cm) than deeper water (20–30 cm), depending on the size of the species. This strong dependence on water depth for foraging means that optimal foraging conditions will be quite transient, both temporally and spatially. It is not only hamerkops that showed reduction in number but also Sacred ibis and pelicans particularly from February to March and were similarly reduced in individual number during the study at Lake Hora-Arsedi, Bishoftu. These months are usually characterized by small rainy seasons. However, during the present study, there was little rain to account for the variation observed. Moreover, the level of Lake Hora-Arsedi had receded to deeper edges and as a result, the shallow edges shrunk becoming deeper on edges leaving less foraging area for the hamerkops. That is the reason why fewer hamerkops were observed during February and March.

The activity pattern study showed that hamerkops fed more during late afternoon followed by morning and late morning. They mainly sit and wait for body parts discarded by the fishermen at sites 1 and 2. The feeding activity of birds was correlated with the availability of fish scraps that were discarded by fishermen. Fishermen actively catch fish early in the morning and late afternoon. On the other hand, at site 3, hamerkops forage along vegetation zones where the water depth is shallow. In this area, fishes were

common in larval, juvenile and adult forms. They walk in shallow water looking for prey, shuffling one foot at a time at the bottom or suddenly opening their wings to flush prey out of hiding or stood motionless watching for the prey and stabbing it when they show up. Since this activity is energetically costly compared to those at sites 1 and 2 where they simply sit and wait for fish scraps, as a consequence, few individuals were observed at site 3. On the feeding grounds, water bird 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). Similarly, the present study revealed that hamerkops spent less time on feeding. Particularly, at sites 1 and 2, hamerkops fed on fish scraps of the head parts which are nutritious resulting in less time spent on feeding. This would lead to reduced foraging activity but more resting and scanning time with renewed intensive foraging activity when fishermen discarded fish scraps.

Calling and false mounting were common behavioural activity performed in groups. They flap their wings and stand on the back of others during false mounting. False mounting might be a behaviour that is practiced in groups among the hamerkops to increase bond between members of the groups.

Hamerkops at site 3 were more vigilant scanning their environment as they stood on the edge of the lakes where some domestic cats were observed hunting ducks and their chicks. The hamerkops on *Acacia* tree spent more time preening and resting than those at site 3. High values for percentage of alert behaviour and scanning bouts in solitary individuals agree with the vigilance patterns of many birds (Carrascal *et al.*, 1990; Beauchamp and Livoreil, 1997). Sharing vigilance among more individuals, as seen in larger flocks, also allows individuals to devote more time to preening and resting. Sleeping was the major diurnal resting activity for the hamerkops during the study periods. Many researchers revealed that resting is a major mid-day activity of birds (Losito *et al*., 1990; Lee, 1997; Martinez, 2000). Myers (1984) indicated that water birds during the non-breeding season spent their day feeding, roosting and maintaining themselves with comfort activities. A small fraction of time was spent on aggressive behaviour, predator avoidance and commuting between a roosting and feeding areas. There was no or little aggressive behaviour observed even during consuming food among hamerkops. The species generally rests in dense shaded *Ficus* and *Acacia* trees and on rocks at the edges of the water.

Behavioural plasticity allows birds to readjust their foraging tactics as habitat conditions change. Maurer (1996) indicated that in a variable environment, combination of both morphology and behaviour determines resource use patterns. Hamerkops shifted their feeding habit accordingly. There were no conflict between fishermen and hamerkops and hence, habituation was apparent at sites 1 and 2, where fishermen often approached to within 10 m while hamerkops continued to feed on fish scraps. It is such plasticity in behaviour that was revealed in this study. They have developed a habit of dipping the fish head scraps in water before they swallow. This might reduce friction and cause the scraps to be slippery. They were observed even drinking water after they swallowed. Some bird species simply moisten their food to make swallowing easier (http://news.nationalgeographic.com). However, according to Kahl (1967), if water is available, these birds usually wash any food caught by holding it at the tip of the bill and dipping it repeatedly in the water before swallowing it. In this study, hamerkops dipped fish scraps repeatedly if swallowing was difficult. This might reduce friction and causes the scrap to be slippery as it is more easily swallowed when wet. A wading bird can select the most appropriate foraging behaviour for its needs, and the choice of a successful foraging behaviour should reinforce repeated use (Kushlan, 1978). That is why hamerkops became opportunistic to feed on fish scraps when their favourite food such as frogs and tadpoles become limited.

The study revealed that individual number of hamerkops varied among the study sites. The group size correlated with the availability of food and perching site. Hamerkops shifted their feeding strategy depending on the depth of the water and availability of fish scraps. As the fish harvest was reduced, some hamerkops moved to nearby Chelaleka wetland. Hence, there is an urgent need to manage fishing at Lake Hora Arsedi and conservation and management of potential feeding grounds such as Chelaleka wetland and perching site of these birds. The species generally rests on dense shaded *Ficus* and *Acacia* trees which are used as perching site as well as roosting and nesting sites. Protection of this potential habitat is very important to conserve the birds in general. Anthropogenic factors such as disturbance of foraging birds through activities such as walking on the shoreline, washing clothes along the lakes and religious gathering and sacrifice that pollute the lake and affect the ecology of the hamerkops should be curtailed. Indirect threat from human-associated predators such as cats and dogs which increased energetic cost to the birds as a result of escape flights related to disturbance avoidance should be considered. The ecosystem in the study

area is a site of tourist destination. It should be properly managed to conserve the bird diversity. Firewood collection should be prevented along the lake area to protect perching, nesting and roosting sites of the hamerkops and other bird species. Further study on the feeding, nesting and courtship behaviour of hamerkops should be carried out for further conservation of the birds.

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