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FORAGING ECOLOGY AND HABITAT ASSOCIATION OF BLACK-WINGED LOVEBIRD (*AGAPORNIS TARANTA*) IN ENTOTO NATURAL PARK AND BOLE SUB-CITY SITE, ADDIS ABABA

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ABSTRACT: A study on foraging ecology and habitat association of black-winged lovebird was carried out in Entoto Natural Park (ENP) and in Bole Sub-City, Addis Ababa from October 2008 to February 2009. In Entoto Natural Park area, 58.3% of the lovebirds were observed in shrubland habitat while in Bole Sub-City, 69.6% used farmland habitat. Lovebirds used fourteen different plant species in Bole Sub-City and five in Entoto Natural Park. 26.4% of the lovebirds in Bole Sub-City were observed foraging on *Zea mays* and 16.5 % on *Ricinus communis* while in Entoto Natural Park, 50% of these lovebirds used the berries of *Juniperus procera*. Among the identified foraging plant parts, fruit had 60% in Bole Sub-City and 66.6% in Entoto Natural Park. The threat for the habitat quality and food availability in Entoto Natural Park might be the fragmentation of natural habitats and domination of *Eucalyptus globulus* tree in the area.

Key words/phrases: Abyssinian lovebird; Distribution; Feeding.

INTRODUCTION

The black-winged lovebird (*Agapornis taranta*) also known as the Abyssinian lovebird is a small green bird of the parrot family and the largest of the lovebird genus of the Ethiopian plateau having a wing span of 95-110 mm (Urban, 1980; Alderton, 2003). It is widely distributed up to 3,800 m asl in the northwestern and southeastern highlands and along the Rift Valley, from southern Eritrea to Harar in forests and woodlands of *Hagenia, Juniper, Podocarpus, Olive, Acacia, Candelabra, Euphorbia, Combretum* and fig (Viverpol, 2001). This species commonly visit gardens, especially with seeded trees in Addis Ababa. Lovebirds fly in noisy flock, which number usually 5 to 10 individuals, although as many as 50-80 individuals may be present in larger flocks. Both sexes have a large bright red bill. The adult male can be distinguished by its red forehead and a ring of red feathers around the orbits. Adult female and immature are distinguished by the green head cover (Kenny, 1998; BirdLife International, 2006).

Food availability in habitats would vary widely within and between years,

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with major implications to reproductive success of birds. Birds select habitats where food items are easily available (Gammonley and Laubhan, 2002). They may select habitat based on their foraging habits and relative accessibility of specific nutrients, rather than overall food abundance (Gammonley and Laubhan, 2002). Foraging behaviour may also reflect variation in food availability relative to demand (Dobbs *et al*., 2007). Variations in food availability determine how birds use their habitat (Borghesio and Laiolo, 2004).

As cities grow and expand, the urban environment replaces and modifies a large proportion of the natural habitat (McKinney, 2002). Such habitat loss results in some of the highest rates of local extinction of a range of native fauna, including avifauna (Vale and Vale, 1976; McKinney, 2002). Of the three leading causes of species endangerment (urbanization, agriculture and interaction with non-native species), urbanization has highest adverse effects (Czech and Krausman, 1997). However, in most cities, limited native vegetation is still available either as remnants or in sub-urban gardens (Germaine *et al*., 1998). There are a number of bird species which survive in the urban matrix. Gardens are a characteristic feature of sub-urban areas and the presence of different bird species may be related to both the floristic composition and structure of these areas (Green, 1984; Germaine *et al*., 1998). In this context, the objective of the present study was to assess the foraging ecology and habitat association of the black-winged lovebird (*Agapornis taranta*) in Entoto Natural Park and in Bole Sub-City area.

MATERIALS AND METHODS

Study area

The study was carried out in Entoto Natural Park (ENP) which covers 1.3 x 10^7 m^2 on the southeast facing slopes of Mt. Entoto and in Addis Ababa Bole sub-city, Kebele-14/15 Administration office (which extends up to 'Semit' Road) covering 524,690 m^2. Among the ten sub-cities under Addis Ababa Administrative Region, Bole sub-city is one of the largest. Entoto Natural Park lies between the northern limit of the city of Addis Ababa at around 2600 m asl and the track along the ridge of the mountain which rises to over 3,100 m asl at coordinates of 09°11'N and 38°45'E (Birhanewold Gebremariam and Abdela Biru, 1998).

Like many of the Ethiopian plateau, Entoto Natural Park consists of volcanic rocks reddish rhyolite, trachytes, tuff, welded tuff and black glassy obsidian (Fishpool and Evans, 2001; BirdLife International, 2008). The natural vegetation is Afro-montane forest types with woodland and open

meadows. The vegetation composition of natural forest is dominated by *Juniperus procera*, *Olea europaea cuspidata*, scattered *Hagenia abyssinica*, *Hypericum revolutum, H. quartinianum, Podocarpus falcatus* and *Acacia abyssinica*, with *A. negrii* in some of the more distributed valley (BirdLife International, 2008). In addition *Casuarina equisetifolia*, *Vernonia amygdalina* and *Rosa abyssinica* were also identified during the study period. However, at present, most of the Entoto Mountain range is covered by the introduced eucalyptus (*Eucalyptus globulus*) plantation.

The escarpment shows bimodal rainfall: a short rainy season from February or March to April or May and a long rainy season from July to September (EWNHS, 1996; BirdLife International, 2008). The highest rain intensity occurs in July-August. The average annual temperature and rainfall at the apex of Entoto are about 14^{o}C and 1400 mm, respectively. Farmers in Entoto cultivate barley and raise cattle and sheep. Despite their close proximity to the city of Addis Ababa, their system of farming has been only little affected by modern practices. Thus, the habitats along the escarpment are diverse, including forest, bushland, eucalyptus plantations, cultivated fields, grassy meadows, rocky slopes and cliffs, streams and marshes (EWNHS, 1996; Fishpool and Evans, 2001). Over 200 species of birds are known to occur in Addis Ababa and adjacent areas (Observations and records, Atkins, 1996). Out of these, 115 species have been recorded from Entoto Natural Park, of which 33 are highland biome species.

Five habitat types were distinguished in the ENP: mixed forest (dominated by *Juniperus procera*), shrubland, *Eucalyptus* plantation, grassland and open forest based on BirdLife International (2008) category. But the Bole sub-city was classified into farmland (Maize crop cultivation dominant) and garden area (dominated by trees and fruit plants) based on the vegetation cover (Urban, 1980; Viverpol, 2001).

Addis Ababa is situated in the high plateaus of central Ethiopia in the North-South oriented mountain systems neighboring the Rift-Valley. It is crossed by numerous streams and surrounded by hills, well wooded, especially with eucalyptus trees, and crossed by broad avenues. *Zea mays* (corn), *Ricinus communis*, *Juniperus* spps, *Vernonia amygdalina*, *Rubus apetalus*, *Musa sapientum*, *Casuarina equisetifolia*, *Acacia saligna*, *Callistemon citrinus*, *Hibiscus rosa-sinensis*, *Peresicaria senegalensis*, *Melia azedarach*, *Morus alba* and *Sesbania sesban* are some of the vegetation that were identified during study in the Bole Sub-City area. It is located at latitude 09° 02'N and longitude 38° 44'E. It is the largest city in Ethiopia, with a population of

3,384,569 according to the 2008 population census. Despite its proximity to the equator, Addis Ababa enjoys a mild, Afro-Alpine temperate and warm temperate climate. The average annual temperature is between 16-24 °C and it receives an average of 1255.2 mm rainfall per year. The city lies at the foot of Mount Entoto. From its lowest point, around Bole International Airport, at 2,300-2500 meters above sea level in the southern periphery, the city rises to over 3,000 meters in the Entoto Mountains to the north. Its high elevation gives the city a mild, pleasant climate.

The city is decorated with historical scene buildings and with open spaces. The day to day life activities of the city's population is predominantly based on different sorts of occupation. Besides the residents of rural parts of Addis Ababa, the city dwellers also participate in animal husbandry and cultivation of gardens.

Methods

A stratified random sampling technique was used for selecting the actual sites for sampling through line transects (Sutherland, 1996; Bibby *et al*., 1998). The study areas were stratified according to habitat types, and the sampling units within the habitats were determined and assigned on the basis of area coverage and vegetation type. Around 25% of the Bole Sub-city study site and 35% of the Entonto natural park habitat areas were covered for sampling. Vegetation types and area coverage were estimated in all census zones to see the lovebirds forage and their habitat association (Nur *et al*., 1999). Point transect count technique was employed to examine foraging ecology and habitat association of the lovebirds following Sutherland (1996). Fixed radius point transect count was conducted standing at a particular point for a fixed time (5-10 minutes); 25 m radius in the forest and 50 m in the open habitats using direct observation (Bibby *et al*., 1992).

To record the foraging behaviour, repeated observations (Hartley, 1953) or point sample was used. It is perfectly suitable for this sort of study when compared to other commonly used methods. The study areas were searched systematically, stopping when foraging birds were encountered. Precaution was taken not to alter the behaviour of the birds or to repeat observations on the same individual (Niemuth *et al*., 2006). To minimize disturbance during study, silent movement was followed, and 3 to 5 minutes of waiting period was allowed to settle down from any disturbance (Bibby *et al*., 1992; Sutherland, 1996; Hosteler and Main, 2001). For each bird, 5 second observation was made recording the plant species on which it was foraging. When a single individual, pair or flock was seen feeding, it was considered

as one observation (Bibby *et al*., 1992; Bibby *et al*., 1998). Foraging, singing and perching of individuals were recorded. For a plant species, records were made at different layers of a tree. When plants became difficult to be identified in the field, the specimens, in which the bird foraged were collected and further identified at the National Herbarium of Addis Ababa University.

Data were collected early in the morning (6:30 a.m. to 10:00 a.m.) and in the afternoon (4:00 p.m. to 6:00 p.m.) when the study species was active (Williams and Alrott, 1980; Buskirk and McDonald, 1995). The study was carried out from October 2008 to February 2009 and the total period spent in data collection was four months for eight study periods in both study sites. The data was analyzed using descriptive statistics.

RESULTS

Black-winged lovebirds were observed foraging on 14 species of plants in Bole Sub-City, while they used only five plant species in Entoto Natural Park (Table 1). Out of the 91 feeding observations in Bole Sub-City, the highest percentage frequency (26.4%) was on *Zea mays* (corn plants) followed by *Ricinus communis* (16.5%) and *Juniperus* species (12.1%). Only 1.1% of each of these lovebirds foraged on *Melia azedarach*, *Morus alba* and *Sesbania sesban*. However in Entoto Natural Park, out of 14 feeding observations, 50% was spent mainly foraging on berries of *J. procera* and only 7.1% of each on *Vernonia amygdalina* and *Rosa abyssinica* (Table 1). Higher number of lovebirds was observed foraging *Zea mays* and *R. communis* in the Bole Sub-City site and berries of *J. procera* in Entoto Natural Park. About 2.2% of lovebirds were also observed foraging on insects on building walls in Bole Sub-City study site.

Among the foraged plant parts, 60% were fruit, 20% seeds, 13.3% flowers and 6.7% unidentified plant parts in the study site of Bole Sub-City (Table 1). Although the abundance of birds was very few in Entoto Natural Park, among the foraged plant parts, 66.6% was observed foraging on fruits, 16.7% seeds and 16.7% flowers. Plant species, *C. equisetifolia* and *V. amygdalina* were observed being foraged by birds in both study sites (Table 1).

Table 1 Food items and observed frequency of *A. taranta* in the two study sites.

Study site	Species	Foraged plant parts				frequency of foraging	Percentage
		Fruits	Seeds	Flowers	Un*		
Bole Sub-City	*Zea mays* (corn)	-	✓	-	-	24	26.4
	Ricinus communis	✓	-	-	-	15	16.5
	Juniperus spps.	✓	-	-	-	11	12.1
	Vernonia amygdalina	-	✓	-	-	9	9.9
	Rubus apetalus	✓	-	-	-	7	7.7
	Musa sapientum	✓	-	-	-	6	6.6
	Casuarina equisetifolia	✓	-	-	-	4	4.4
	Acacia saligna	✓	-	-	-	3	3.3
	Callistemon citrinus	✓	-	-	-	3	3.3
	Hibiscus rosa-sinensis	-	-	✓	-	2	2.2
	Peresicaria senegalensis	-	✓	✓	-	2	2.2
	Melia azedarach	✓	-	-	-	1	1.1
	Morus alba	✓	-	-	-	1	1.1
	Sesbania sesban	-	-	-	✓	1	1.1
	Insects* (building walls)	-	-	-	-	2	2.2
	Percentage	60	20	13.3	6.7	91	100
Entoto Natural Park	*Juniperus procera*	✓	-	-	-	7	50.0
	Acacia abyssinica	✓	-	-	-	3	21.4
	Casuarina equisetifolia	✓	-	-	-	2	14.3
	Vernonia amygdalina	-	✓	-	-	1	7.1
	Rosa abyssinica	✓	-	✓	-	1	7.1
	Percentage	66.6	16.7	16.7	-	14	99.9

Un*= Unidentified plant parts, Insects*= Foraged from building walls

Among the five identified vegetation types in Entoto Natural Park, lovebirds were restricted to the mixed forest and shrubland habitats. Very few species were observed in the grassland, eucalyptus tree and open forest habitat types. In Bole Sub-City study site, they were observed in farmland and garden habitats (Fig. 1). In Entoto Natural Park, 58.3% of the birds used shrubland habitat, 38.0% mixed forest, 1.4% open forest, 1.2% grassland and 1.1% eucalyptus tree habitats. While in Bole Sub-City study site, 69.6% used farmland habitat and 30.4% garden (Fig. 1).

People living in and around Entoto Natural Park area were observed visiting the area for firewood collection. In Entoto Natural Park, farmers were also

observed grazing their livestock and cultivating land for barley.

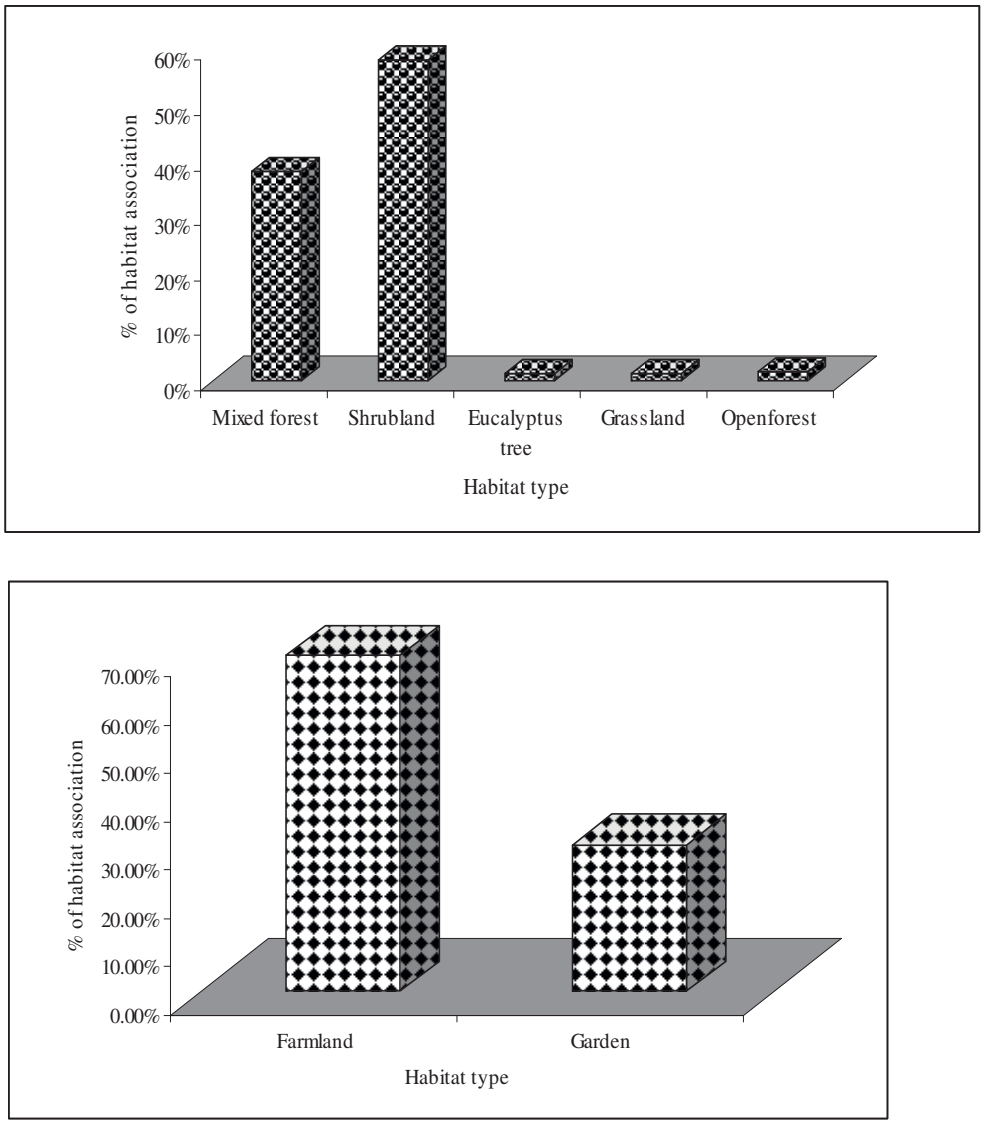

Fig. 1. Habitat association (%) of black-winged lovebirds in: A) Entoto Natural Park and B) Bole Sub-City study areas.

DISCUSSION

Birds are sensitive to land-use changes (Boren *et al.,* 1999). They are known to respond quickly to environmental changes (Furness and Greenwood,

1993). The study on black-winged lovebirds in the Entoto Natural Park area indicated that this species might be negatively influenced by modification of the habitat. The modification of the habitat has led to the shift in the foraging range of these lovebirds to the nearby areas. Modification of the natural environment affects the abundance of the species and in extreme cases, may lead to local extinction (Heywood, 1995).

Population levels of birds depend on the existence and conservation of foraging habitat. As observed in the lovebirds foraging activity and habitat association in the study, availability of food may be the most important factor limiting the distribution and abundance of birds (Donnelly and Marzluff, 2004) as observed in the lovebirds' foraging activity and habitat association. Food gathering strategies were directly related to the availability of resources in the given habitat (Adeyemo and Ayodele, 2005). In addition to the availability of food, different factors may also determine how birds use their habitat (Karr and Freemark, 1983; Canaday, 1996). Birds may adjust their foraging behaviour to cope with variable constraints like territory maintenance and looking for mating opportunities (Dobbs *et al*., 2007). The range of species expand and contract, and abundance patterns change through time. Ranges can expand when suitable new habitat becomes available or when population pressure forces migration to new areas (Lohmus, 2003). Thus in Entoto Natural Park, the limited population of the lovebirds observed on foraging might be associated with the destruction of foraging vegetation.

The study birds were observed mainly around the shrubland habitat than the other four habitat types in Entoto Natural Park because most foraging plant species might occur in such habitat. Many fruit eating birds visit frequently this type of habitat (Fishpool and Evans, 2001; BirdLife International, 2008). Urban areas are characterized by high levels of disturbance and environmental modification, which can affect bird populations and community patterns (Rebele, 1994; Blair, 1996). Although people disturb birds, their presence did not considerably alter their visit. According to Donnelly and Marzluff (2004), birds respond to the spatial heterogeneity and distribution of vegetation. The vegetation heterogeneity has helped lovebirds to be frequently observed in urban garden and crop plantation areas. These areas were dominated by *Z. mays* and *R. communis*.

Distribution of birds is highly governed by availability of resources and vegetation composition. As vegetation changes along complex geographical area, a particular species may appear, increase in abundance or decrease and

disappear (Lee and Rotenbery, 2005). Distribution and abundance of birds should be affected in similar ways by the degree of specialization in ecological requirements (Cofre *et al.,* 2007). The present study shows that the vegetation composition is better in Bole Sub-City compared to Entoto Natural Park. Therefore, if vegetation in urban gardens could be managed to promote a diversity of native bird species, it would be ideal as valuable secondary habitats for conserving native bird populations (Green, 1984; Germaine *et al*., 1998).

The present study indicates that the threat for the habitat quality and food availability in Entoto Natural Park study area might be due to habitat destruction and high domination of introduced *E. globulus* plantation (it needs further study). The Ethiopian Heritage Trust is trying to restore the indigenous flora of Entoto Natural Park by uprooting eucalypts and planting indigenous trees.

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