East African Cross-Border Biodiversity Project
"Reducing biodiversity loss at cross-border sites in east Africa"
Tanzanian Component – URT/ 97/G31

A survey of the avifauna of Chome Forest Reserve,

South Pare Mountains, north-east Tanzania

By

Marc Baker

2001

PANDA MITI
TAF
TUNZA MITI IKUTUNZE
TANZANIA ASSOCIATION OF FORESTERS

undp

GEF

F A O
FIAT PANIS
FAO

Acknowledgements

I would firstly like to thank Njano Mbilinyi for his assistance and patience in the field. I would also like to thank Lauren Persha and Jilos Jumamosi for their valuable field contributions. Many thanks to forest staff and villagers of Mhero for answering a number of questions and to all of the Crossborders Biodiversity Project staff at the offices in Arusha and Same for their assistance, especially Mr. John Salahe, Mr. Katana Kalage and Dr. Alan Rodgers. Thanks to Lauren Persha for providing assistance with GIS maps.

October, 2001.

Cover picture: Chome forest reserve west

Contents

1. Executive Summary

Chome Forest Reserve, the largest forest block in the South Pare mountains, is situated between the North Pare mountains and the West Usambara mountains in north-eastern Tanzania at 4º10' – 4º25'South, 37º 53' – 38º East. The forest reserve covers an area of 14,213 hectares of various forest types and montane grassland from an altitude of 1,250m to Shengena peak at an altitude of 2,462m.

The UNDP / GEF Crossborder Biodiversity Project aims to reduce biodiversity loss at specific crossborder sites in East Africa where it concentrates on forest reserves within three districts in Tanzania, each chosen for their specific forest ecosystems.

In order to make an accurate assessment of the avifauna, a number of techniques were employed. Observations were carried out in different areas within the forest habitat, as well as in the surrounding woodland and grassland. Species were identified by sight and by call. Mist netting allowed for the sampling of less conspicuous species which inhabit the ground and shrub layer. Point counts with a 20 metre fixed radius were carried out over three areas within the forest reserve, allowing a census of the different forest types.

Four surveys of Chome Forest Reserve, were made between November 1999 and March 2001, giving a total of 25,860 net metre hours (nmh) at three ringing sites (Saseni, Kanza and Shengena). In total, 188 birds were ringed, representing 24 different species.

During these surveys, ninety four species have been recorded in Chome Forest Reserve, of these 20 were forest dependant generalists (f), 29 forest dependant specialists (ff), 4 species associated with grassland (g), 1 species associated with woodland (Lead-coloured Flycatcher) (wd), 7 palearctic migrants (p) of non-forest habitats and 31 widespread (w) species. A total of 72 fixed radius point counts were carried out in three main areas of the forest. The results indicate that while there are some species that were present in all of the forest types within the forest reserve, there are some which seemed to prefer the lower sub-montane forest on the eastern side of the reserve.

The results of a statistical comparison of the similarity of the forest specialist avifauna (ff) known to occur on the geographically 'close' montane forests of Kilimanjaro, Taita Hills, West Usambaras and North Pares, indicated that the South Pares were more similar to the W. Usambaras, whilst the North Pare mountains were more closely linked to Kilimanjaro and the avifauna typical of the central east African Highlands. The Taita hills showed their highest similarity to the South Pare mountains and not to Kilimanjaro or the North Pares.

Chome Forest Reserve qualifies as one of Tanzania's important bird areas due to the presence of two species. South Pare White-eye, endemic to the South Pare Mountains and listed as vulnerable. The second species of importance is Hunter's Cisticola (restricted range species, Endemic bird area 109). In addition to these species of global importance, the habitats within Chome Forest Reserve support 12 species of regional importance as defined by Bennun *et al* (1996).

The most significant threat to Chome Forest Reserve as a viable conservation and water catchment area, is the persistent and large scale logging of mainly *Octotea usambarensis* (Camphor). As in other forest reserves, paths created in the process of removing planks from pit-fall sites, are then used by hunters and trappers for access into previously inaccessible areas of forest. Other threats to biodiversity in Chome are poaching, which includes the hunting of duiker's, Black and White Colobus monkey and Bush Pig. In a recent threat reduction assessment (TRA) of Chome Forest Reserve (Baker *et al*, 2001 internal report) it became clear that the level and intensity of threats to this ecosystem is relatively unknown. It is recommended that the biodiversity project uses its available resources to survey, document and rank these threats in order to form a realistic idea of priorities and intensities of threats that can be used to form an action plan to tackle them.

2. Introduction

2.1. Locality

Chome Forest Reserve, the largest forest block in the South Pare mountains, is situated between the North Pare Mountains and the West Usambaras in north-eastern Tanzania at 4º10' – 4º25'S, 37º 53' – 38º 00'E (Map 1). Gazetted in 1951, the reserve covers an area of 35,292 acres 14,213 hectares (gazetted figure) of various forests types and montane grassland, from an altitude of 1250m to Shengena peak at an altitude of 2,462m, the highest point in the Pare and Usambara Mountains. The forest consists of four main types; sub-montane forest on the eastern ridge between 1250 – 1600m. Montane forest above 1500m with a drier type on the lower slopes and rain-shadow areas, and a wetter type covering 60% of the reserve on the eastern slopes and mainly in valleys on the western slopes (Lovett and Pócs, 1993). Elfin forest occurs above 2300m on the highest ridges. Large areas of heath and grassland, with secondary heath and grassland replacing dry montane forest following fire.

2.2. Climate and geology

Weather systems are bi-modal, the long rains moving in from the south-east during October too June. Rainfall is estimated at 3000mm on the wetter, eastern side of the Shengena mountains, the dryer western slopes, heath and montane grassland receive an estimated 1500 – 2000mm, with mist effect at higher altitudes (Lovett and Pócs, 1993). The dry season is between June and September, with light rainfall occurring at higher altitudes. Temperatures vary with rainfall, from a minimum of 15ºC in July to 20ºC in February. Soil types vary with topography, acidic lithosols predominate on ridges with ferralitic latosols on the slopes. On the Chome-suji Plateau (western grasslands), hitosols have developed in depressions under the heath and bog vegetation (Lovett & Pócs, 1993). The Shengena range was formed by faulting uplift some 25-100 myr ago (Hamilton, 1989 in: Stanley, 1998) and consists of gneiss and migmatite precambium crystalline basement rocks (Lovett & Pócs, 1993).

2.3. Ecology of Chome Forest Reserve

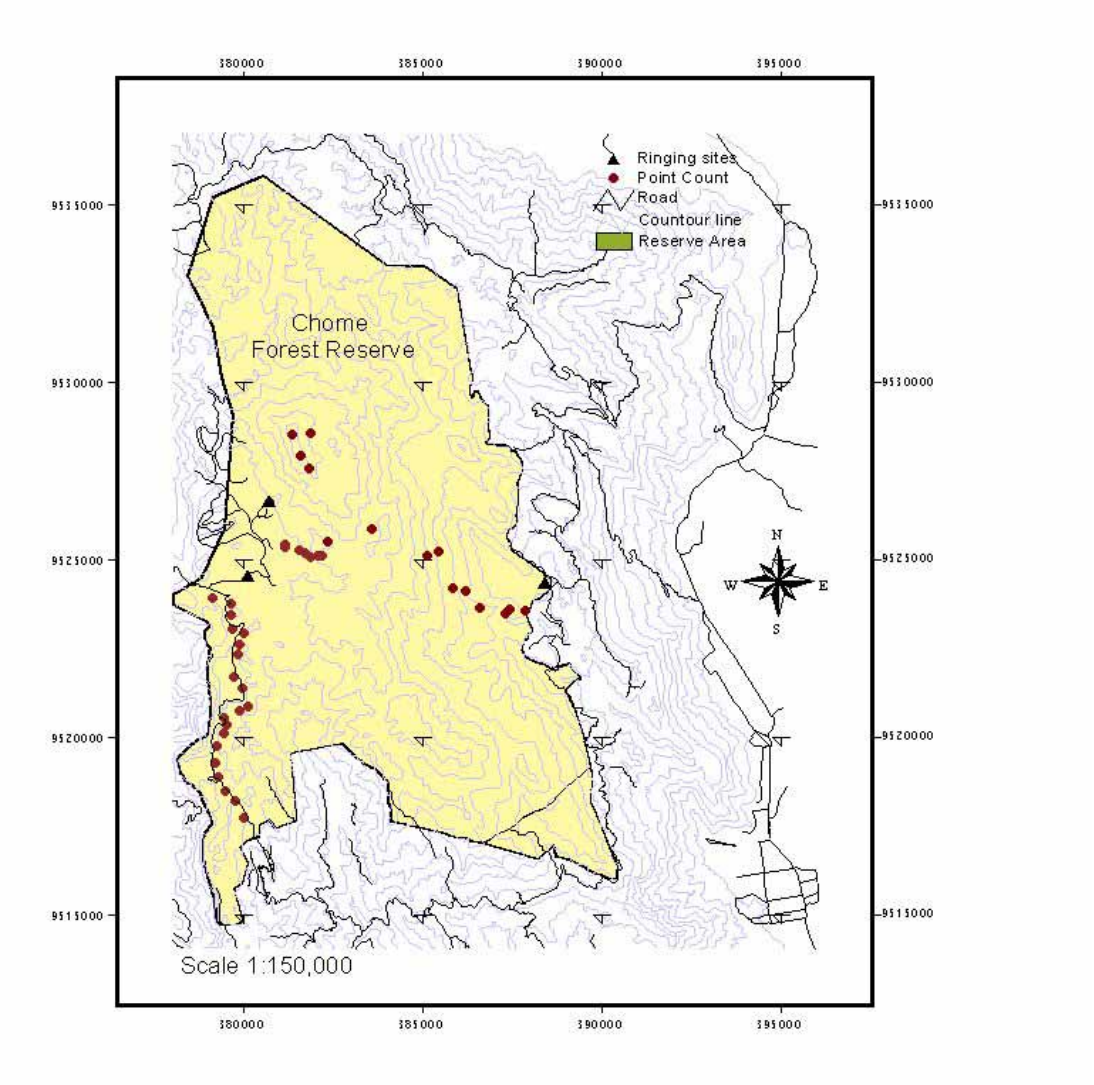
The forests of the Eastern Arc Mountains of Tanzania, are well known for their levels of biotic diversity and endemic taxa (Lovett and Wasser, 1993). Although the aviafauna of the east and West Usambara mountains has been studied in detail in the past (Moreau, 1966, Lovett and Wasser, 1993) little attention has been focused on the Pare mountains. Previous studies in Chome have been based on collections and brief visits, some systematic surveys of rodents has been carried out Stanley *et al* (1996, 1998). There has been no systematic study of the forests avifauna.

Due to the position of the Shengena range on a north south axis, the vegetation of Chome Forest Reserve varies considerably in relation to its rainfall (rainfall comes from the south east) and altitude. On the wetter eastern side of the forest reserve, between 1250m – 1600m, sub-montane forest, dominated by *Parinari excelsa* occurs, the exact area of this vegetation type is unknown. Montane forest covers most of the reserve above 1500m, with a dryer type on the lower slopes and rainshadow areas, the wetter type covering 60% of the reserve, mainly on the extensive eastern slopes. Lovett & Pócs, (1993) describe the vegetation types;

The dryer montane forest is dominated by *Albizia gummifera*, *Macaranga kilimandscharica, Teclea nobilis* and *Xymalos monospora*. In the wetter montane forest, logging has altered the species composition, in the less accessible areas such as Shengena Peak, *Ocotea usambarensis* is the dominant emergent tree with *Podocarpus latifolius* and *Chrysophyllum gorongosanum*. In the more accessible and thus exploited areas *Macaranga kilimandscharica* and *Polyscias fulva* dominate. Above 2300m the upper montane forest community is greatly influenced by mist effect. The tree composition is similar to that of montane forest that predominates this reserve however the canopy is lower (10-15m). On ridges and summits (Shengena), Elfin forest dominates, trees species include; *Rapanea melanophloeos* and *Schefflera myriantha* that form a canopy at 3-5m.

Two species of primates are known to occur; The eastern arc race of Angola Pied Colobus *Colobus angolensis* (*palliatus*) and Gentle Monkey (Blue Monkey) *Cercopithecus m. mitis*. A pair of Harvey's Duiker *Cephalophus harveyi* was recorded once near Shengena Peak. Twelve rodent species are known to occur (Stanley *et al*, 1998) with results suggesting lower densities at higher elevations (Stanley *et al*, 1996), Zanj Elephant Shrew *Rhynchocyon petersi* occur at an estimated density of 16.26 animals per square kilometre (Coster, 2001). According to the Wapare, Bush Pig *Potamochoerus larvatus* only occur in the northern quarter of the reserve, where they are hunted for food and persecuted for crop damage. Buffalo are not known to occur in Chome Forest Reserve.

Map 1. GIS Map of Chome Forest Reserve showing ringing and point count sites.



2.4. Aims and rationale of avifauna survey

The UNDP / GEF Crossborder Biodiversity Project aims to reduce biodiversity loss at specific crossborder sites in East Africa. The project concentrates on forest reserves within three districts in Tanzania, each chosen for their specific forest ecosystems. Chome Forest Reserve is the focal point within Same District, here the Biodiversity project is focusing its efforts to reduce illegal extraction of timber, whilst meeting the socio-economic needs of the Wapare people.

In order to make an accurate assessment of the focal area, a current appraisal of the flora and fauna is required to provide baseline data. For logistical reasons certain taxa are chosen as biological indicators. Of these birds 'are' the best known, most easily studied and are relatively conspicuous. In order to make an accurate appraisal of the avifauna of the forest reserve, a team of two trained ringers and two volunteers were assembled to carry out a series of assessments. This was done using standard mist netting, observation and fixed radius point counts.

3. Methodology

Literature Survey

The first description of the South Pare White-eye by Schater & Moreau in 1934 indicates that Moreau was sending collectors there in the early thirties. Some of the early Anderson collections in the 1950's were published by Britton, P.L. (1978), which although include the Pare mountains do not include many forest birds. Recent systematic studies of the avifauna of Chome Forest Reserve are limited to Feldsa, J and Rabol, J (1995). The species lists of Mount Kilimanjaro and the West Usambara mountains have been provided by the Tanzanian Bird Atlas (Baker & Baker *in press*). Species list for the North Pare mountains uses baseline data from Cordeiro and Kiure, 1995. The species list for Taita Hills uses baseline data from Brooks *et al* (1998). Standard texts on the region's avifauna were used throughout.

Field Methodology

- **Observation**

General observations were carried out at all times. Observations were carried out in different areas within the forest habitat, as well as in the surrounding woodland and grassland. Species were identified by sight and by call; the latter being particularly the case for nocturnal birds and some of the more inconspicuous passerines.

- **Mist netting**

Mist netting allowed for the sampling of less conspicuous species which inhabit the ground and shrub layer. As mist netting only samples to 2m above ground, this method was useful in surveying birds of lower strata. The number of mist nets used reflected what it was considered both practical to monitor and necessary to provide an accurate assessment of avifauna within the forest reserve. All birds caught were fitted with a standard National Museum of Nairobi ring and standard bio-metric measurements were taken; tarsus, wing, bill, tail length and weight. These data along with brood patch (scored; 0=none, 5=full) and moult data was then stored by the Tanzanian Ringing Scheme to allow monitoring of both species and individual birds if they are re-captured at a later date.

- **Fixed radius point counts**

Point counts[1] with a 20 metre fixed radius were carried out over three transects within the forest reserve to allow a census of different forest types and different areas. Point counts were carried out across the altitude gradient and the associated variation in vegetation structure. All point counts followed established paths or tracks within the reserve for ease of repetitive monitoring. 1:50,000 topographic maps and UTM co-ordinates[2] were used throughout.

[1] Point counts are a useful method of surveying forests, and when repeated over a specific area or altitude gradient can be useful in assembling a list of species present in a localised area. When using a fixed radius, an index of relative abundance can be produced, indicating which species are widespread across either an altitude gradient, or are present in different forest types. It must be noted however that there are several biases such as the behaviour of individual birds and abiotic effects such as weather. Observer bias is reduced by using the same two observers throughout. The estimation of 20m is considered accurate within 2m (+/- 10%) having little effect in homogenous habitat.

[2] Universal Transverse Mercator (UTM) is a metric grid system used on most large and intermediate scale land topographic charts and maps. This method is preferred over lat/long data due to accuracy and ease of use when working with the standard 1:50,000 topographic maps.

Transect 1. Fifteen point counts starting from the forest edge (UTM. 37380676E 9526595N) at the western grassland area near Mhero (1942m) along a path to Shengena Peak (2462m).

Transect 2. Thirty point counts starting from the forest edge (UTM. 37381120E 9525405N) at the western grassland area near Mhero (1942m) along a path to the forest reserve boundary at Kanza (UTM. 37 387851E 9523513N) on the eastern side of the forest reserve.

Transect 3. Twenty point counts starting from the junction of to road to the western grassland area near Heisha on the Bwambo to Suji road, (UTM. 379109E 9523884N) to forest edge (UTM. 379999E 9517703N)

Point counts were carried out every 250m. On arrival at the location, a period of 5mins was allowed to avoid the effects of any disturbance caused by the observer. During this period a GPS reading was taken and habitat structure noted. Each count was carried out over 10 mins, during which species were either recorded by call or observation and noted as near (N)(distance from observer <20m) or far (F)(distance from observer >20m). Recording species within a fixed radius of 20m is useful in concentrating on those species that are in the immediate area (fixed radius) thus habitat type. All point counts were carried out by the same two observers. For point counts along transect 3 the distance between counts was changed to every 500m.

Data Analysis

Species lists

All species lists are compiled in taxonomic order following Dowsett and Dowsett-Lamaire (1993), and given a Tanzanian number (Tz No) following Baker & Baker (2000). The Britton number (bno) follows Britton (1980). Species are assigned an ecological type based on the following definitions;

Forest-dependent specialists (FF) are species that are restricted and dependent on the forest for all of their life cycle within this geo-ecological region. This includes the availability of food and suitable nesting sites. These species are dependent on the forest ecosystem, their abundance and populations may be greatly altered by disturbance within the forest, or the area surrounding it that causes significant variations in temperature, moisture, wind speed or floristic structure.

Forest dependant non- specialists (F) are species that occur within forests and depend on it for part or all of their life cycle, however these species may occur in non-forest habitats in different geo-ecological regions. This includes forest species that migrate between varying forest types and although 'considered' montane, may occur in coastal and lowland gallery forest. Many of these species may be able to survive in cleared areas within a few kilometres of the forest. This 'overspill' effect is poorly understood and it may be likely that these populations would be affected by disturbance within or surrounding the forest which would possibly increase some populations whilst decreasing others.

Forest-non dependent (Fn) are species that may be recorded in forests, although not dependent on the forest for any part of their life cycle. However, it may be likely that the removal of the forest would directly or indirectly alter species populations, as some forest-non dependent species may be dependent on forest edge for seasonal movement or feeding. Forest non-dependant species are split into the following categories;

i. Usually occurs in woodland (wd)
ii. Usually occurs in grassland (g)
iii. Palearctic migrant (p)
iv. Widespread (w); Includes some inter-African migrants, 'fly-by' species such as raptors, storks and those species loosely associated with forest edge.

4. Results

4.1. Summary of results

During the four surveys of Chome Forest Reserve, 25 survey days were completed, beginning in November 1999 and concluding in March 2001. A total of 25,860 net metre hours (nmh) have been completed at the three ringing sites (Saseni, Kanza and Shengena) (map1). A total of 188 birds were ringed, representing 24 different species (Ringing results section 4.2. Appendices Table 9).

Overall, 94 species have been recorded in Chome forest reserve, of which the following is a breakdown into the previously defined 6 main ecological types (Appendices, Table 10); 20 forest dependant generalists (f), 29 forest dependant specialists (ff), 4 species associated with grassland (g), 1 species associated with woodland (Lead-coloured Flycatcher) (wd), 7 palearctic migrants (p) of non-forest habitats and 31 widespread (w) species, which includes many of the 'fly-by' raptors.

A total of 72 fixed radius point counts were carried out in three main areas of the forest. The main aim was to systematically record species that may only occur in either the wetter, and lower altitude sub-montane forest on the eastern side of the reserve around Kanza (1250 – 1350m), and the higher altitude forest types (elfin forest and giant heath) along ridges and around Shengena peak (>2350m); as well as the more disturbed montane forest along the Bwambo to Suji road.

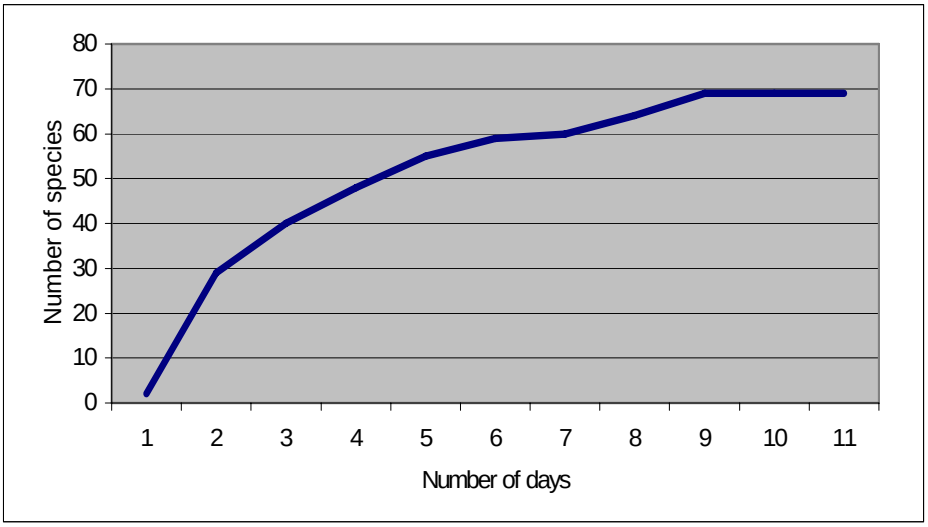
The results in section 4.3. indicate that while there were some species that were present in all of the forest types within the forest reserve, there were also several species which seemed to prefer the lower sub-montane forest on the eastern side of the reserve. In addition there were a number of species which were distributed relatively evenly across the montane forest, but were not recorded in the sub-montane forest.

The analysis in section 4.4. used statistical software to look at the similarity between Chome Forest Reserve and the geographically 'close' isolated montane forest environments of the North Pare mountains, the South Pare mountains, West Usambara Mountains, the Taita Hills and Mount Kilimanjaro. This analysis tests the similarity of these sites as defined by their forest specialist avifauna. It was found that the South Pares were more similar to the West Usambaras and the avifauna of the 'eastern arc' whilst the North Pare mountains were more similar to Mt. Kilimanjaro.

Table 1. Mist-netting and observation data summary for Chome Forest Reserve November 1999 – March 2001. Percentages are given where relevant.

	West November 99 Saseni	**East November 99 Kanza**	**West June 2000 Saseni**	**West Feb/March 01 Shengena**	**Overall Totals**
Man-days	5	3	6	11	25
Net-metre-hours (nmh)	2124	2880	5904	14,952	25,860
No individual Birds caught	47	12	39	90	188
No of birds in moult	5 (11%)	1 (8%)	3 (8%)	55 (61%)	-
No species caught	14	7	14	19	-
Birds caught per nmh	0.022	0.004	0.006	0.006	
Number ff species (obs, caught)(% of total)	22 (33%)	8 (30%)	24 (45%)	25 (35%)	-
Number of Species recorded	65	26	53	69	-

Figure 1. Species accumulation curve for the final 11- day survey of Chome Forest Reserve 26th February 01 – 8th March 01.



The accumulation curve figure 1, indicates that if the survey was to continue it is unlikely that many new species would have been recorded during this survey.

4.2. Ringing Results

The results are summarised in Table 9 (appendices). The commonest caught species were Mountain Greenbul (n= 26), South Pare White-eye (n=25), Cabanis Greenbul (n=22), Olive Thrush (n=16), Starred Robin (n=16) and White-tailed Crested Flycatcher (n=16) (Table 9). However, the distribution of these captures was not equal. Species such as Forest Batis and Peters Twinspot were only recorded by observation and mist netting on the lower eastern side of Chome Forest Reserve, in sub-montane forest, while Oriole Finch, was only recorded around Shengena (2100m) where a male, a female and (suspected) subadult bird were caught.

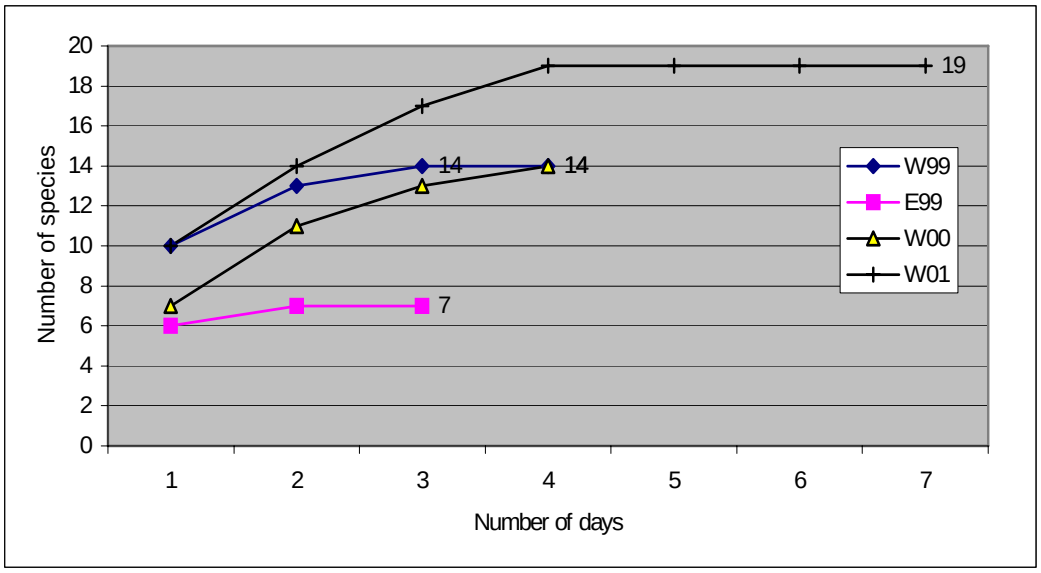
Mountain Greenbul was recorded at both of the ringing sites on the western side of the forest reserve, but absent from the lower eastern side near Kanza (Map 1). Although a greater number of this species was recorded at Shengena (n= 15) (1.0 birds/ 1000 nmhs), at Saseni (November 1999) 3.29 birds/ 1000 nmhs was recorded, a capture rate three times greater than Shengena. The distribution and thus capture rate of South Pare White-eye was related to the time of year not area or habitat. At Saseni (November 1999) 21 individuals were caught and ringed (9.8 birds/ 1000 nmhs) whilst at the same locality in June 2000, this species was absent.

Cabanis Greenbul was recorded at all sites with an even capture rate (χ^2 = 1.39 birds/ nmh); Saseni November 1999 = 0.47 birds/ 1000 nmhs, Saseni June 2000 = 1.18 birds/ 1000 nmhs, Shengena Feb / March 2001 = 0.80 birds/ 1000 nmhs and Kanza November 1999 = 0.69 birds/ 1000 nmhs. This seems to indicate that this bird is evenly distributed across the forest types within reserve, from 1300m to 2200+ metres in sub-montane and montane forest. Striped-cheeked Greenbul, which was recorded only once in Chome Forest Reserve, was by caught at Shengena (February, 2001). Yellow-bellied Greenbul was also recorded only once by mist netting at Saseni in November 1999.

Olive Thrush, which was caught at both sites on the western side of the reserve, was absent from the lower eastern side of the reserve, the greatest capture rate being at Saseni, June 2000 (0.94 birds/ 1000 nmhs). White-tailed Crested Flycatcher, a sub-canopy and understory bird was recorded at all sites (Saseni, November 1999= 1.41 birds/ 1000 nmhs, Saseni, June 2000= 0.84 birds/ 1000 nmhs,

Shengena Feb / March 2001 = 0.53 birds/ nmh) on the western side of the reserve, but absent from the lower eastern side of the forest reserve.

Figure 2. Species accumulation curves from ringing data for all surveys. West 99 (W99, n=14) and West 00 (W00, n=14) at Saseni, East 99 (E99, n=7) at Kanza and West 01 (W01, n= 19) at Shengena.



The species curves for W01, W99 would indicate that if the ringing effort were increased it would have been unlikely that many more species would have been encountered. W00 shows an increasing curve, thus more species may have been expected at that time if effort was increased.

4.3. Summary of Point counts

Results of the point counts are given in tables 5, 6 and 7. Transect 1 (table 5); a total of 15 point counts were carried out, starting at the forest edge near the western grassland area (1942m) along a path to Shengena Peak (2462m), the highest point in the reserve. A total of 57 individuals were recorded, of which 23 were different species (mean = 3.8 species per count). The greatest number of species recorded at a single count was 10, at point count 10 in closed forest. The most species poor habitat was the giant heath (point count 12, n=2, species = Starred Robin and Mountain Greenbul) and the Elfin forest (UTM 37381863E, 9528523N. Altitude 2462m) (point count 13, n=1 species = Bar-throated Apalis and point count 14, n= 2, Bar-throated Apalis and Black Roughwing). Overall, the commonest recorded species was the highly vocal Hartlaubs Turaco (n=6, Near (N)=2 Far (F) =4), however the species recorded most often within the fixed radius of 20 metres were Bar-throated Apalis (n= 5, N=5), White-tailed Crested Flycatcher (n=5, N=5) and Mountain Greenbul (n=5, N=5).

Transect 2 (table 6); a total of 30 point counts were carried out, starting at the forest edge near the western grassland area (1942m) along a path to the forest reserve boundary at Kanza, on the lower (1250m) and wetter eastern side of the forest reserve. A total of 117 individual birds were recorded of which 32 were different species (table 6)(mean species per count = 3.9). The greatest number of species recorded at a single point count was 8 at point count 17 in closed forest. The most species poor habitat was the Elfin forest at point counts 24 (n=1, species = Bar-throated Apalis) and 25 (n=0)(UTM. 37385095E, 9525053N, Altitude 1811m). It should be noted that at point counts 27 and 28 no species were recorded, this was possibly due to heavy rainfall encountered at those locations. The commonest recorded species were Mountain Greenbul (n=14, N=13, F=1) and White-tailed Crested Flycatcher (n=14, N=6, F=8). Black-headed Apalis, African Hill Babbler and Red-faced Crimsonwing were only recorded on the lower eastern side of the forest (1250m).

Transect 3; a total of 20 point counts were carried out starting from the junction to the western grasslands near Heisha, on the Bwambo to Suji road (UTM. 379109E 9523884N) to the forest edge (UTM. 379999E 9517703N), 6.5km due south. Out of a total of 74 records, 26 species were recorded (table 7) (mean species per count = 3.7). The greatest number of species recorded at a single count was 8, at point count 2, in regenerating forest following burn, and this included forest edge species. The commonest recorded species were White-tailed Crested Flycatcher (n=9, N=6, F=3), Bar-throated Apalis (n=8, N=8), Yellow-throated Warbler (n=7, N=7) and Starred Robin (n=7, N=7).

4.4. A comparison of the forest dependant avifauna that is known to occur on the Pare and West Usambara Mountains, Taita Hills and Mount Kilimanjaro.

Definitions of the montane forests of interest

This comparison of the distribution of montane forest avifauna considers the previous definition of the main montane forest groups by Moreau (1966) and Lovett and Wasser (1993). Moreau considered there to be two main montane forest groups within the region of interest, based on the similarity of avifaunal diversity between the sites; the Kenyan Highlands and the Tanzanian – Malawi mountains.

The Kenyan Highland group included the northern Kenyan mountains of Kulal and Marsabit, the Aberdares and Mt. Kenya south to the mountains of northern Tanzania; the Crater Highlands, Mbulu Highlands, Mt. Kilimanjaro and Mt. Meru. This montane group was centred on the mountains of eastern Tanzania. Moreau included the Taita Hills and Mt. Kasigau in south-east Kenya in this group. Both the North Pare and South Pare mountains in northern Tanzania, south through the eastern arc forest islands of the Usambaras, Ngurus, Ukagurus, Ulugurus and Uzungwas to the Southern Highlands into Malawi.

Based on an increase in the knowledge of the fauna and flora known to occur on these, and other montane forests, Lovett & Wasser (1993) re-defined these montane forest groups. The Kenyan Highlands became the Central East African Mountains, which, although broadly similar to the previous definition by Moreau, now included the Taita Hills, Mt. Kasigau and the Pare Mountains, previously included by Moreau (1966) in the ‘eastern arc’. The Tanzania – Malawi group became the eastern arc, this removed the Pare Mountains (north and south), Taita Hills, Mt. Kasingau and most of the Malawi mountains (Lovett & Wasser, 1993). The West Usambara Mountains becoming the northern limit of this group, the Uzungwa Mountains the southern limit.

This present analysis is based on the increased knowledge now available of Chome Forest Reserve, the largest forest block in the Pare Mountains. This analysis uses a list of 57 forest specialist species (ff) (Species list: Appendices, table 8.) which have so far been recorded on the montane forests of interest. The analysis[3] is carried out using spearmanns rank (sr.) correlation to test the relationship between samples, and Bray-Curtis (bc.) cluster analysis. Bray-Curtis classifies objects judged to be similar according to distance or similarity measures. Bray-Curtis similarity uses group-average clustering, giving a useful hierarchy of clusters which compare the forest specialist species composition of the more recent volcanic mountain of Kilimanjaro and the northern eastern arc mountains of; North Pare, South Pare (Chome FR.) the West Usambaras and Taita Hills.

[3] The analysis is carried out using Biodiversity Professional, an analytical system devised by Neil McAleece, Natural History Museum, London.

Table 2. Summary of forest dependant (forest specialist, forest generalist) species found on the mountain sites.

Mountain sites	Total forest dependant species	Forest specialists (ff)	Percentage of forest dependant species which are forest specialists	Number of forest specialist species only recorded at mountain site
S.Pare (Chome)	48	31	63	1 (Endemic)(some consider race)
N.Pare	37	25	67	-
Taita Hills	46	23	47	3 (Endemic)(some consider race)
Kilimanjaro	58	33	55	3 (Central E.A Mountain Species)
W. Usambara	70	45	64	7 'eastern arc' (one endemic)

Clearly the West Usambara mountains has a greater number of forest dependant (n=70) species and forest specialist species (n= 45). Seven of these are 'eastern arc' species with the West Usambara forests representing the northern limits of their known range.

Table 3. The results of Spearman's rank correlation coefficient, used to test for a relationship between forest specialist species composition. 1= 100% correlation, 0= no correlation.

	S.Pare	N.Pare	Taita	Kilimanjaro	W.Usambara
S.Pare	1.	*	*	*	*
N.Pare	0.5225	1.	*	*	*
Taita	0.432	0.3701	1.	*	*
Kilimanjaro	0.553	0.7137	0.3618	1.	*
W.Usambara	0.6305	0.553	0.3285	0.4347	1.

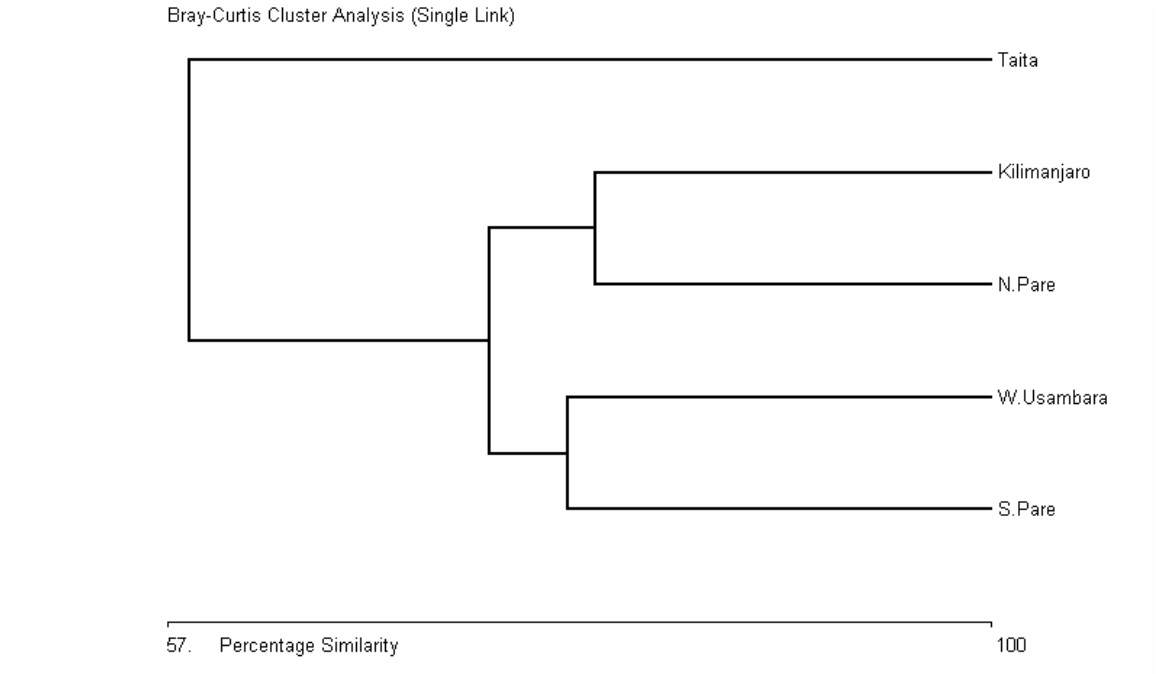
The highest correlation is shown between the North Pare mountains and Mount Kilimanjaro (n= 0.713), the South Pares and West Usambara mountains showing the second highest correlation (n= 0.630). The Taita Hills highest correlation is to the South Pares (0.4772). This correlation is shown more clearly by the dendrogram, figure 3.

Table 4. The results of Bray-Curtis cluster analysis, used to test for the percentage similarity between the forest specialist species composition known to occur at each of the sites.

Similarity Matrix					
	S.Pare	N.Pare	Taita	Kilimanjaro	W.Usambara
S.Pare	*	66.6667	58.1818	73.8462	77.9221
N.Pare	*	*	50	79.3103	65.7143
Taita	*	*	*	53.5714	50
Kilimanjaro	*	*	*	*	69.2308
W.Usambara	*	*	*	*	*

The greatest percentage similarity (80%) is between Kilimanjaro and the North Pare mountains, as indicated by spearmanns rank correlation (sr.0.713). The second highest similarity is between the South Pare and the West Usambara mountains (78%) (sr. 0.63). As with spearmanns rank correlation, the Taita hills show the greatest similarity to the South Pare mountains.

Figure 3. Dendrogram, showing the percentage similarity of forest specialist (ff) species.



All sites show a similarity of greater than 50% (sr. 0.3285) (Taita Hills and West Usambara mountains) (table 3/4). Clearly there is a defined split between the similarity of the forest specialist avifauna of Kilimanjaro and the North Pare mountains (Kili / N.Pare = 79%, sr.0.713) and the avifauna of the West Usambara and South Pare mountains (W.Usambara / S.Pare =78%, sr.0.63).

5. Discussion

Point Counts

By limiting the recording of species to a 20m fixed radius when in dense forest, it allows the removal of certain bias, such as, the highly vocal forest species; Hartlaub's Turaco and Tropical Boubou, as well as those species which 'generally' occur above the canopy (for example; forest raptors and Black Roughwing).

The most widespread species to occur across all the count areas (map 1) were Bar-throated Apalis, Mountain Greenbul and White-tailed Crested Flycatcher. Bar-throated Apalis was the only species to be recorded in the Elfin Forest near Shengena Peak (table 5, point counts 13 and 14) and on the path to Kanza (table 6. Point count 24). This habitat would suit this birds behaviour, of skulking in low undergrowth. As noted by mist-netting and general observation, Black-headed Apalis, African Hill Babbler and Red-faced Crimsonwing were only recorded on the lower eastern side of the forest reserve. The eastern arc race of Yellow-throated Warbler (*minullus*) was recorded in forest edge and forest interior in both the Kanza point counts (Transect 2.)(n=10) and on the Bwambo to Suji road (Transect 3.) (n=7) indicating that it occurs throughout the forest reserve.

All species lists in the appendices were compiled in order of species accumulation, and thus at a basic level indicates the pattern of species distribution across the point count sites. Table 5 shows the species distribution across the altitude gradient to Shengena Peak, here we can see that Sharpes Starling, Cape Robin Chat and Dusky Flycatcher were only recorded at the forest edge. Although this is ecologically indicative of Cape Robin-Chat, a forest edge species, it is unusual for Dusky

Flycatcher which is usually found throughout forest stratum where it occurs. However, Sharpes Starling, which is a forest canopy species generally ranges widely over forests were it occurs.

Also outlined by the order of species accumulation, is that species such as White-tailed Crested Flycatcher, Cabanis Greenbul and Mountain Greenbul occurred throughout the montane forest, but were not recorded in the forest edge and higher altitude elfin forest (This includes the lower altitude elfin forest noted in transect 2). The west to east transect (Transect 2, table 6) across the forest reserve, indicates species which are widespread across the forest reserve such as White-tailed Crested Flycatcher and Mountain Greenbul , as well as those which are restricted to the wetter and lower eastern side of the reserve such as Black-headed Apalis, the last species to be recorded.

Comparative analysis

This analysis uses the list of forest specialist species compiled by this author, the taxonomy of which follows Dowsett & Dowsett-Lamire (1993). Specifically Bray-Curtis cluster analysis, as with spearmanns rank correlation, indicates that when these environs are defined by the similarity of there forest specialist avifauna, the South Pares are more similar to the W. Usambaras and the east-coast escarpment forests (eastern arc), whilst the North Pare mountains are more closely linked to Kilimanjaro and the avifauna typical of the central east African Mountains. The Taita hills show the highest similarity to the South Pares (sr.0.477) (bc.57%)(figure 3). These results would agree more with Moreau (1966) than with Lovett and Wasser (1993) in defining the grouping of these mountains.

The differences lie in the treatment of the North Pare and South Pare mountains as belonging to two distinct groups. The findings in this report would suggest that while the North Pare mountains has more affinities with the central highlands group, the largest forest block in the South Pares, Chome Forest Reserve, has a much closer affinity to the avifauna of the West Usambara mountains (table 3, 4, figure 3). This similarity between the South Pares and the West Usambaras arises due to the presence of Shelly's Greenbul, White-chested Alethe, Red-capped Tailorbird and Slender-billed Starling.

Shelly's Greenbul occurs in Kenya and Uganda, the Eastern Tanzanian race *roehli* ranging from Songea and Njombe in the southern highlands to the Usambaras and the South Pare mountains (Britton, 1980). It is not known to occur in the North Pare mountains, Taita Hills and Kilimanjaro.

White-chested Alethe is a common resident of the undergrowth of highland forest in eastern Tanzania, the race *usambarae* ranging from Mahenge and Uzungwa to the Usambaras and the South Pare mountains (representing the northern limit of its range) Britton (1980).

Slender-billed Starling is a bird of forest edge and favours waterfalls and cliffs. Although locally numerous in east Africa, predominately in the central Kenyan highlands (Britton, 1980), it has been recorded in Tanzania from the Iringa Highlands and the Uluguru Mountains (Britton, 1980). A single record from the West Usambaras (Aug, 1978) (Zimmerman *et al*, 1996) has just been confirmed by a further recorded sighting (Codiero, N *pers comm*).

There are an additional nine species that occur on the West Usambaras but have not been recorded in the South Pare mountains which prompts the question why. Firstly, species such as Fischer's Turaco, Green Barbet, Pale-breasted Illadopsis and Dark-backed Weaver are found in the regions coastal forests, were, in general the conditions are wetter and considerably warmer. Where the lower limit of sub-montane forest in Chome is 1250m, at Ambangulu in the West Usambaras the forest is as low as 800m and thus there is a considerable difference in temperature, humidity, wind and other factors that are well known to restrict species distribution. Studies have shown that the biologically richest zone in the Usambaras is between 800m and 1200m (Newmark, 1998; from Newmark, 1993), and it is this 'zone' in which these species occur, or may at least require and thus offering one hypothesis as to why they do not occur on the South Pare Mountains. One of the most obvious reasons for this split in

avifaunal diversity is the 'Mkomazi gap', 40 kilometres of dry acacia woodland, which represents a serious barrier for even the most 'robust' forest species.

6. Conclusions and Recommendations

6.1. Importance of Chome Forest Reserve for bird conservation

Chome Forest Reserve qualifies as one of Tanzania's important bird areas (IBA 63 South Pare Mountains, Baker & Baker, *in press*) due to the presence of two species. South Pare White-eye, endemic to the South Pare Mountains. This species was caught at Saseni (results section 4.2) and observed elsewhere in forest edge. This species is listed as vulnerable (Category 1 – Globally Threatened species)(Fishpool, 1997)(Important Bird Areas of Tanzania, Baker & Baker, *in press*). The second species of importance is Hunters Cisticola (Category 2 – restricted range species, Endemic bird area 109) (Fishpool, 1997, Baker & Baker, *in press*).

In addition to these species of global importance defined in terms of the level of threat, Chome Forest Reserve supports 12 species of regional importance. These definitions seek to outline species that are either; Regionally-Near Threatened, defined by Collar *et al* (1994) as being very close to vulnerable. Regional Responsibility, defined by Bennun (1996)[4] as species with at least 90% of their range or population within the political boundaries of East Africa and/or with populations dependant on a very few significant sites for breeding or during migration. Globally Restricted Range species are defined by (ICBP, 1992) as having a global range of < 50,000 square kilometres. Due to these definitions, these species should be considered in conservation policy and planning, as any action within the area of concern may effect their population levels.

The following is a list of those species which have been recorded in Chome, their status following Bennun (1996);

Species	**Status**
Mountain Buzzard	Regionally Near-Threatened
Lemon Dove	Regionally near-threatened
Hartlaubs Turaco	Regional responsibility
Giant Kingfisher	Regionally near-threatened
Cinnamon Bee-eater	Regional Responsibility
Moustached Green Tinkerbird	Regional Responsibility
Shelly's Greenbul	Regional Responsibility
Mountain Greenbul	Regional Responsibility
White-chested Alethe	Regional Responsibility
Evergreen Forest Warbler	Regionally near-threatened
Eastern Double Collared Sunbird	Regional Responsibility

Chome Forest Reserve represents the northern limit of White-chested Alethe (see discussion, comparative analysis), one of the species listed above. Although not threatened this species is of conservation concern as outlined above. The race of Yellow-throated Warbler *minullus* is restricted to the South Pares, Taita Hills and the eastern arc forests as far south as the Uluguru Mountains. It is locally common in Chome Forest Reserve.

6.2. Conservation threats

On the eastern and western boundaries of the reserve, extensive and repeated burning is eroding the forest edge and associated habitats. Lovett and Pócs (1993) state that secondary heaths and grassland follow fire in dry montane forest and now occupy large areas between 1600 to 2000m. On recent burn, species poor habitat dominated by bracken invades and any natural regeneration is eroded

[4] Birds to watch in East Africa: A preliminary Red Data list

further by cattle. In many areas the forest reserve boundary, planted with Eucalyptus species following demarcation (in the 1950's), does not represent the boundary of actual forest cover[5]. Areas such as the western grasslands, are, in terms of avifauna, species poor. Black Wattle is now growing close to the forest edge in areas following burn, and may represent an invasive species problem. Fire, whether intentional to increase and maintain grazing areas, or accidental, usually caused by uncontrolled burning during land preparation for agriculture, are the main threats to the forest edge. Cattle grazing inside the forest reserve boundary may prevent regeneration in some areas.

The most significant threat to Chome Forest Reserve as a viable conservation area and water catchment is the persistent and large scale logging of mainly *Octotea usambarensis* (Camphor). It should be noted that it is not just the removal of this dominant tree species from the forest, and the effects that this may have on the health of the ecosystem that are damaging. Considerable damage is done in the process of removing the tree. Areas of burn within the forest, mainly along ridges in the dry elfin forest are considered to be started accidentally at pit-fall sites where they spread rapidly due to the large amounts of litter. As in other forest reserves, paths created in the process of removing planks are then used by hunters and trappers for access into previously inaccessible areas of forest. In communication with local authorities it is well known that people using military vehicles have been responsible for creating an illegal 'supply and demand' activity.

Other threats to biodiversity in Come Forest Reserve are poaching, which includes the hunting of duiker, black and white colobus monkey and bush pig for local consumption. Illegal trapping of Hartlaubs Turaco for the bird trade, has been mentioned by the crossborder biodiversity project FPO for Same District, Mr. Katana Algae. No evidence was found and this species does seem to remain numerous. Fuel wood collection and pole cutting is considered a threat in some areas of the forest (Baker *et al*, 2001 internal report).

6.3. Recommendations

The importance of Chome Forest Reserve in terms of its value to global and regional avian diversity is clear and although some work on the small mammals (Stanley *et al*, 1996, 1998) and botanical surveys (Phillipson, *in press*) have been carried out, the flora and fauna of Chome Forest Reserve remains poorly studied. Further studies of the flora and fauna will certainly add considerably to the knowledge of this eastern arc block.

More important however than an increased knowledge of the biodiversity at this site is an increased knowledge of the threats and at what intensity they are occurring. In a recent threat reduction assessment of Chome Forest Reserve (Baker *et al*, 2001 internal report) it became clear that the level and intensity of threats to this ecosystem is unknown. It is now possible with the availability of accurate geographic positioning systems (since May 2000), and the recent availability of geographic information system software with digitised maps of the forest reserve to produce an accurate picture of actual events.

A three-week data collection survey by the forest division, supported by the biodiversity project would provide a clearer picture of immediate threats, this would then allow a more 'realistic' approach to conservation planning at this site. Forest reserve staff, which have been trained in GPS use by the biodiversity project could be put into the field to collect data on pitfall sites (age and use), paths and tracks (age and use) and areas of burn and grassland. Once plotted to a digitised map of the reserve, a picture of areas of immediate concern could be outlined and a better knowledge of intensity of threats could be established. Combined with data on the avifauna (UTM point counts) and botanical collections (UTM 50 tree tallies), this information could be mapped and used as a monitoring tool to look at present effects and future trends.

[5] Large amounts of grassland are not mentioned in the gazzettment notice, in conversations with botanists the estimated age of the western grasslands, also known as the Chome-suji Plateau (Lovett and Pócs, 1993) is twenty years.

References

Baker, M., Persha, L and Rodgers W.A. (2001) Threat Reduction Assessment (TRA) for Chome Forest Reserve. *UNDP/GEF Biodiversity Project Internal Report.*

Baker, N.E and Baker, E.M. (in press) Important Bird Areas of Tanzania.

Baker, N.E and Baker, E.M. (in press) Tanzania Bird Atlas.

Baker, N.E and Baker, E.M. (2000) The birds of Tanzania: A working checklist

Bennun, L and Njoroge, P. (1996) Birds to watch in East Africa: A preliminary Red Data List. *The National Museums of Kenya*

Britton, P,L. (1978). The Anderson collection from Tanzania. Scopus 2: 77-85

Britton, P,L. (1980) Birds of East Africa, their habitat, status and distribution. *East Africa Natural History Society*

Brooks, T., Lens, L., Barnes, J., Barnes, R., Kihuria, J.K. and Wilder, C. (1998) The conservation status of the forest birds of the Taita Hills, Kenya. *Bird Conservation International*.

Collar, N.J. (1994) Red data books, Action Plans and the need for site-specific synthesis. *Species 21-22:132-133*

Cordeiro, N.J and Kiure, J. (1995) An investigation of the forest avifauna in the North Pare Mountains, Tanzania. *Scopus 19: 9-26*

Coster, S. (2001) The status of *Rhynchocyon petersi* in Chome Forest. *School For International Training*

Dowsett, R.J and Dowsett-Lemaire, F. (1993) A contribution to the distribution and taxonomy of Afrotropical and Malagasy birds. *Tauraco Research Report Nº5. Tauraco Press*

Feldsa, J and Rabol, J. (1995) Variation in Avian communities between isolated units of the Eastern Arc montane forests, Tanzania. *Le Gerfaut* 85: 3-18.

Fishpool, L.D.C (1997) Important Bird Areas in Africa, IBA Criteria. *BirdLife international.*

Lovett, J.C and Pócs, T. (1993) Assessment of the Condition of the Catchment Forest Reserves, a Botanical Appraisal. *Catchment Forestry Project, Dar-es-Salaam*

Lovett, J.C and Wasser, S.K (1993) Biogeography and ecology of the rain forests of eastern Africa. *Cambridge University Press.*

Moreau, R.E. (1966) The Bird Faunas of Africa and its islands. *Academic press*

Newmark, W,D. (1998) The Ambangulu Forest, West Usambara Mountains, Tanzania: a threatened Eastern Arc forest. *Oryx,* 29, 212-214

Stanley, W.T.,Goodman, S.M and Hutterer, R. (1996) Notes on the insectivores and elephant shrews of Chome Forest, South Pare Mountains, Tanzania. *Zoologische Abhandlungen* ***Band 49 nr.8***

Stanley, W.T.,Goodman, S.M and Kihaule, P.M. (1998) Results of two surveys of rodents in the Chome Forest Reserve, South Pare Mountains, Tanzania. *Zoologische Abhandlungen* ***Band 50 nr.11***

Zimmerman D.A., Turner D.A, and Pearson D.J. (1996) Birds of Kenya and Northern Tanzania. *Russel friedmann.*

Appendices

Table 5. Starting from the forest edge (UTM. 37380676E 9526595N) at the western grassland area near Mhero (1942m) along a path to Shengena Peak (2462m).
Table 6. Starting from the forest edge (UTM. 37381120E 9525405N) at the western grassland area near Mhero (1942m) along a path to the forest reserve boundary at Kanza (UTM. 37 387851E 9523513N) on the eastern side of the forest reserve.
Table 7. Starting from the junction to the western grasslands near Heisha on the Bwambo to Suji road (UTM. 379109E 9523884N) to forest edge (UTM. 379999E 9517703N)
Table 8. Comparative list of Forest specialist species on Mt. Kilimanjaro, West Usambara, southPares, North Pares, Taita Hills and Kilimanjaro.
Table 9. Ringing Results
Table 10. Total species recorded in Chome Forest Reserve by time of year and locality.

Table 5. List of species recorded during point counts starting from the forest edge (UTM. 37380676E 9526595N) at the western grassland area near Mhero (1942m) along a path to Shengena Peak (2462m).

Species in order of accumulation	1 Fe 1935m	2	3	4	5	6	7	8	9	10	11	12	13 2462m	14	15 2474m	Total	near (<20m)	far (>20m)
Sharpes Starling	/															1	1	-
Black Roughwing	/													/	/	3	3	-
Robin Chat	/															1	1	-
Dusky Flycatcher	/															1	1	-
Bar-throated Apalis	/	/			/								/	/		5	5	-
Eastern Double-collared Sunbird	/										/					2	2	-
Evergreen Forest Warbler	/	/						/		/						4	2	2
White-tailed Crested Flycatcher		/	/	/					/	/						5	5	-
Harlaubs Turaco		/				/		/	/	/	/					6	2	4
Trobical Boubou		/					/	/	/	/						5	1	4
Cabanis Greenbul				/						/	/					3	3	-
Ruppell Robin Chat					/			/		/						3	3	-
Moustached Green Tinkerbird						/		/	/							3	1	2
Mountain Geenbul						/		/	/	/		/				5	5	-
Yellow-throated Warbler							/	/								2	2	-
African Wood Owl								/								1	1	-
Olive Thrush									/							1	1	-
Olive Woodpecker									/							1	-	1
South Pare White-eye										/						1	1	-
Lemon Dove										/						1	1	-
Bar-tailed Trogon											/					1	-	1
Starred Robin												/				1	1	-
European Swallow															/	1	-	1
Totals	7	5	1	2	2	3	2	8	7	10	4	2	1	2	1			

Table 6. List of species recorded during point counts starting from the forest edge (UTM. 37381120E 9525405N) at the western grassland area near Mhero (1942m) along a path to the forest reserve boundary at Kanza (UTM. 37 387851E 9523513N) on the eastern side of the forest reserve.

Species in order of accumulation	1 Fe	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	Total	near (<20m)	far (>20m)
Common Waxbill	1																																1	1	
Dusky Flycatcher	1																																1	1	
Malachite Sunbird	1																		1														2	2	
Mountain Greenbul	1		1		1	1	1		1	1			1	1	1		1	1				1							1				14	13	1
Wallers Starling	1																																1	1	
Cinnamon Bracken Warbler	1																																1	1	
White-tailed Crested Flycatcher		1					1	1	1	1	1	1	1	1		1					1		1			1			1				14	6	8
Evergreen Forest Warbler				1		1			1		1					1	1												1	1	1	1	10	3	7
Yellow-throated Warbler				1	1	1	1	1					1		1						1	1	1						1				11	10	1
Brown Forest Warbler				1																													1	1	
Eastern Double-collared Sunbird				1	1	1					1					1	1	1															7	5	2
Shellys Greenbul				1																													1	1	
Tropical Boubou					1					1						1	1																4	1	3
Bar-throated Apalis					1			1														1		1									4	3	1
Moustached Green Tinkerbird						1					1																						2	2	
Starred Robin						1			1	1	1	1			1		1	1															8	8	
White-chested Alethe						1																											1	1	
South Pare White-eye									1																								1	1	
Crowned Eagle									1									1															2		2
Olive Woodpecker									1								1																2	1	1
Cinnamon-breasted Bee-eater										1																							1		1
Olive Thrush										1													1										2	2	
Mountain Buzzard											1	1	1																				3		3
Hartlaubs Turaco											1					1	1			1	1	1			1			1	1		1	10	8	2
Tambourine Dove														1	1																		2		2
Bar-tailed Trogon																1							1										2	1	1
Black Roughwing																	1												1		1		3	1	2
Lemon Dove																		1															1		1
African Hill Babbler																													1				1	1	
Olive Pigeon																														1			1		1
Black headed Apalis																														1	1		2	2	
Red-faced Crimsonwing																															1		1	1	1
Total Species	6	1	1	5	5	7	3	3	7	6	7	3	4	3	4	6	8	5	1	1	3	4	4	1	1	1	0	0	5	4	3	5	117		

Table 7. List of species recorded during point counts starting from the junction to the western grasslands near Heisha on the Bwambo to Suji road (UTM. 379109E 9523884N) to forest edge (UTM. 379999E 9517703N)

Species in order of accumulation	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total	near (<20m)	far (>20m)
Bar-throated Apalis	1	1	1	1						1					1		1		1		8	8	
Stonechat	1																				1		1
Cabanis Greenbul	1																		1		2	2	
Cape Robin Chat		1																			1		1
Eastern Double Collared Sunbird		1	1								1							1	1		5	3	2
Citril Finch		1					1														2	2	
Stonechat		1																			1		1
Evergreen Forest Warbler		1																			1		1
Mountain Yellow Warbler		1																			1		1
Black Roughwing		1	1				1														3	2	1
Mountain Greenbul				1	1											1		1			4	4	
Yellow-throated Warbler					1		1		1	1	1			1		1					7	7	
White-tailed Crested Flycatcher					1		1	1		1			1	1	1				1	1	9	6	3
African Hill Babbler						1	1				1					1					4	2	2
Olive Sunbird						1															1	1	
Starred Robin						1		1		1		1			1	1	1				7	5	2
Tropical Boubou							1	1		1				1							4	1	3
Black-fronted Bushshrike									1												1	1	
Shellys Greenbul										1							1		1		3	2	1
Black Sparrowhawk													1								1	1	
Scaly-throated Honeyguide														1							1	1	
White-chested Alethe															1						1	1	
South Pare White-eye																1		1	1		3	2	1
Bar-tailed Trogon																1			1		2	1	1
Dusky Flycatcher																	1				1	1	
Total species	3	8	3	2	3	3	6	3	2	6	3	1	2	4	4	6	4	3	7	1	74		

Table 8. list of the 57 Forest specialist (ff) species have been recorded on Mt. Kilimanjaro, the Taita Hills and West Usambara Mountains, the South Pare Mountains (Chome Forest Reserve) and North Pare Mountains. This list is used in the comparative analysis (section 4.4.)

TZ No	Bno	English name	Scientific name	S. Pare (Chome)	N.Pare	Taita Hills	Kilimanjaro	West Usambaras
51	52	Green Ibis	Bostrychia olivacea				/	
105	106	Great Sparrowhawk	Accipiter melanoleucus	/		/	/	/
108	110	Rufous Sparrowhawk	Accipiter rufiventris			/	/	/
116	124	Mountain Buzzard	Buteo oreophilus	/	/	/	/	/
298	337	Lemon Dove	Aplopelia lavata	/	/	/	/	/
307	357	Tambourine Dove	Turtur tympanistria	/	/	/	/	/
313	366	Red-fronted Parrot	Poicephalus guliemi				/	
324	378	Fischer's Turaco	Tauraco fischeri					/
325	379	Hartlaubs Turaco	Tauraco hartlaubi	/	/	/	/	/
406	463	Bar-tailed Trogan	Apaloderma vittatum	/	/		/	/
459	531	Green Barbet	Stactolaema olivacea					/
462	551	Moustached Green Tinkerbird	Pogoniulus leucomystax	/	/	/	/	/
504	591	Olive Woodpecker	Dendropicos griseocephalus	/	/		/	/
573	702	Shelleys Greenbul	Andropadus masukuensis	/				/
574	704	Mountain Greenbul	Andropadus nigriceps	/		/	/	/
576	703	Stripe-cheeked Greenbul	Andropadus milanjensis	/	/	/	/	/
592	720	Cabanis' Greenbul	Phyllastrephus cabanis	/		/		
593	727	Olive Mountain Greenbul	Phyllastrephus placidus		/		/	/
609	793	Olive Thrush	Turdus olivaceus	/	/		/	/
615	796	Orange Ground Thrush	Zoothera gurneyi		/			/
Not Tz	793	Taita Thrush	Turdus helleri			/		
619	735	White-chested Alethe	Alethe fuelleborni	/				/
620	782	Starred Robin	Pogonocichla stellata	/	/	/	/	/
626	788	Sharpe's Akalat	Sheppardia sharpei					/
628	760	Usambara Akalat	Sheppardia montanus					/
665	835	Cinnamon Bracken Warbler	Bradypterus cinnamomeus	/			/	/
666	833	Evergreen Forest Warbler	Bradypterus mariae	/	/	/	/	/
703	909	Brown Forest Warbler	Phylloscopus umbrovirens		/		/	
704	906	Yellow-throated Warbler	Phylloscopusruficapilla	/		/		/
Not Tz	828	Taita Aplis	Apalis fusicigularis			/		
754	828	Bar-throated Apalis	Apalis thoracica	/			/	/
764	898	Red-capped Tailorbird	Orthotomus metopias	/				/
790	950	Forest Batis	Batis mixta	/	/		/	/
806	970	White-tailed Crested Flycatcher	Eliminia albonotata	/		/		/
807	971	Crested Flycatcher	Trochocercus cynomelas		/	/		/
810	766	Spot-throat	Modulatrix stictigula					/
814	677	Pale-breasted Illadopsis	Trichastoma rufipennis					/
816	671	African Hill Babbler	Alcippe abyssinica	/	/		/	/
842	1089	Banded Green Sunbird	Anthreptes rubritorques					/
845	1112	Eastern Olive Sunbird	Nectarinia olivacea	/	/	/	/	/
879	1132	Montane White-eye	Zosterops poliogaster		/		/	/
880	1132	South-Pare White-eye	Zosterops winifredae	/				
Not Tz	1132	Taita White-eye	Zosterops silvana			/		
917	1005	Fulleborn's Black Boubou	Laniarius fuelleborni					/
920	1017	Black-fronted Bush Shrike	Malaconotus nigrifrons	/	/	/	/	/
921	1018	Four-coloured Bush Shrike	Malaconotus quadricolor			/		
937	1068	Kenrick's Starling	Poeoptera kenricki		/		/	/
938	1067	Waller's Starling	Onchychognathus walleri	/	/		/	/
941	1066	Slender Billed Starling	Onychognathus tenuirostris	/				/
954	1047	Abbott's Starling	Cinnyricinclus femoralis			/	/	
955	1049	Sharpe's Starling	Cinnyricinclus sharpii	/	/	/	/	/
1003	1161	Dark-backed Weaver	Ploceus bicolor					/
1006	9058	Usambara Weaver	Ploceus nicolli					/
1035	1223	Red-faced Crimsonwing	Cryptospiza reichenovi	/	/		/	/
1036	1224	Abyssinian Crimsonwing	Cryptospiza salvadorii				/	
1093	1281	Thick-billed Seedeater	Serinus burtoni		/		/	
1095	1279	Oriole Finch	Linurgus olivaceus	/			/	/
			Total species per site	**31**	**25**	**23**	**33**	**45**

Table 9. Summary of the 24 species ringed across all sites.

Species list	Ecological Type	Saseni West 99	Saseni West 00	Shengena West 01	Kanza East 99	Total
Lemon Dove	ff.	1	1	-	-	2
Olive Woodpecker	ff.	-	1	1	-	2
Shelly's Greenbul	ff.	2	-	3	-	5
Mountain Greenbul	ff.	7	4	15	-	26
Stripe-cheeked Greenbul	ff.	-	-	3	-	3
Yellow-bellied Greenbul	f.	1	-	-	-	1
Cabanis Greenbul	ff.	1	7	12	2	22
Olive Thrush	ff.	2	6	8	-	16
White-chested Alethe	ff.	-	-	3	-	3
Starred Robin	ff.	2	4	9	1	16
Evergreen Forest Warbler	ff.	-	1	1	-	2
Yellow-throated Warbler	ff.	2	1	6	-	9
Bar-throated Apalis	ff.	4	2	2	-	8
Dusky Flycatcher	f.	-	-	1	-	1
Forest Batis	ff.	-	-	-	1	1
White-tailed Crested Flycatcher	ff.	3	5	8	-	16
African Hill Babbler	ff.	2	1	-	-	3
Collared Sunbird	w.	-	-	-	1	1
Olive Sunbird	ff.	2	2	5	2	11
Eastern Double-collared Sunbird	w.	1	2	4	-	7
South Pare White-eye	ff.	21	-	4	-	25
Red-faced Crimsonwing	ff.	-	3	2	5	10
Peters Twinspot	f.	-	-	-	1	1
Oriole Finch	ff.	-	-	3	-	3
Total species ringed		**14**	**14**	**19**	**7**	

Table 10. Species list for Chome Forest Reserve

Ecological Type; Forest specialist (ff), Forest generalist (f), Palearctic migrant (p), Grassland (g) and woodland (wd). Remarks are given to outline racial splits.

TzNo	Bno	English name	Scientific name	Chome West Nov 99	Chome East Nov 99	Chome West June 00	Chome West Feb / March 01	Ecol. Type	Remarks
38	42	Hamerkop	Scopus unbretta			/		w	
43	46	Woolly-necked Stork	Ciconia episcopus	/			/	w	
97	96	Harrier Hawk	Polyboroides typus	/			/	w	
105	106	Great Sparrowhawk	Accipiter melanoleucus	/	/	/	/	f	
110	111	African Goshawk	Accipter tachiro	/	/			f	
115	122	Steppe Buzzard	Buteo buteo				/	p	
116	124	Mountain Buzzard	Buteo oreophilus	/		/	/	ff	Regionally-Near Threatened
118	120	Augur Buzzard	Buteo augur	/	/	/	/	w	
130	135	Crowned Eagle	Stephanoaetus coronatus	/	/	/	/	f	
143	160	Eurasian Hobby	Falco subbuteo				/	p	
144	152	African Hobby	Falco cuvierii	/			/	w	
147	148	Lanner Falcon	Falco biarmicus	/				w	
255	252	Common Sandpiper	Actitis hypoleucos	/	/		/	w	
296	339	Olive Pigeon	Columba arquatrix	/				f	
297	340	Eastern Bronze Naped Pigeon	Columba delegorguei	/	/	/	/	f	
298	337	Lemon Dove	Aplopelia lavata	/		/	/	ff	Regionally-Near Threatened
300	348	Dusky Turtle Dove	Streptopelia lugens				/	w	
301	351	Laughing Dove	Streptopelia senegalensis	/	/	/	/	w	
305	356	Emerald spotted Wood-Dove	Turter chalcospilos	/	/	/		w	
307	357	Tambourine Dove	Turtur tympanistria	/		/	/	ff	
325	379	Hartlaubs Turaco	Tauraco hartlaubi	/		/	/	ff	Regional Responsibility
337	399	Red-chested Cuckoo	Cuculus solitarius	/			/	w	
353	406	White-browed Coucal	Centropus superciliosus	/				w	
369	416	African Wood Owl	Strix woodfordii	/	/	/	/	f	
377	437	Montane Nightjar	Caprimulgus poliocephalus	/	/	/	/	f	nominate race on Kilimanjaro, guttifer in Usambaras
387	453	Scarce Swift	Schoutedenapus myoptilus	/		/		w	
405	463	Bar-tailed Trogan	Apaloderma vittatum			/	/	ff	
418	464	Giant Kingfisher	Megaceryle maxima		/			w	Regionally Near-Threatened
419	491	Little Bee-eater	Merops pusillus	/				w	
421	488	Cinnamon Bee-eater	Merops oreobates	/		/	/	f	Regional Responsibility
453	509	Silvery-cheeked Hornbill	Bycanistes brevis	/		/	/	f	
461	551	Moustached Green Tinkerbird	Pogoniulus leucomystax	/		/	/	ff	Regional Responsibility
484	596	Scaly-throated Honeyguide	Indicator variegatus				/	f	
504	591	Olive Woodpecker	Dendropicos griseocephalus		/		/	ff	race; kilimensis on Kilimanjaro and Usambaras
523	640	Black Roughwing	Psalidoprocne holomelas	/		/	/	f	
535	630	Red-rumped Swallow	Hirundo daurica	/		/		w	
543	634	European Swallow	Hirundo rustica				/	p	
550	991	African Pied Wagtail	Motacilla aguimp	/		/		w	
549	995	Mountain Wagtail	Motacilla torrentium			/	/	w	
552	981	African Pipit	Anthus cinnamomeus	/			/	g	
555	982	Long-billed Pipet	Anthus similis				/	g	
573	702	Shelleys Greenbul	Andropadus masukuensis	/	/	/	/	ff	Regional Responsibility. Race; roehli in Eastern Tanzania
574	704	Mountain Greenbul	Andropadus nigriceps	/		/	/	ff	Regional Responsibility. Race; usambarae in Usambara Mts., Pare and Taita. Nigriceps on Kilimanjaro
576	703	Stripe-cheeked Greenbul	Andropadus milanjensis	/			/	ff	
586	710	Yellow-bellied Greenbul	Chlorocichla flaviventris	/				f	
592	720	Cabanis' Greenbul	Phyllastrephus cabanisis	/		/	/	ff	
600	732	Yellow-vented Bulbul	Pycnonotus barbatus	/		/		w	
607	793	Olive Thrush	Turdus olivaceus	/		/	/	ff	

619	735	White-chested Alethe	Alethe fuelleborni			/	/	ff	Regional Responsibility. Eastern Arc endemic, race; Usambarae in Usambara and Pare Mts.
620	782	Starred Robin	Pogonocichla stellata	/		/	/	ff	nominate race on Kilimanjaro, roehli in Usambara and Pare Mts.
635	749	Cape Robin Chat	Cossypha caffra	/			/	f	
637	755	Ruppells Robin Chat	Cossypha semifura				/	f	race; intercedens on Kilimanjaro
647	784	Stonechat	Saxicola torquata	/		/	/	g	
650	783	Whinchat	Saxicola rubetra				/	p	rare palearctic migrant, few records from northern Tanzania
665	835	Cinnamon Bracken Warbler	Bradypterus cinnamomeus	/			/	f	
664	833	Evergreen Forest Warbler	Bradypterus mariae	/		/	/	ff	Regionally Near-Threatened race; usambarae in Usambara and Pare Mts. mariae on Kilimanjaro
685	843	Yellow Warbler	Chloropeta natalensis				/	f	formally 'Dark-capped'
686	844	Mountain Yellow Warbler	Chloropeta similis				/	f	Replaces natalensis at higher altitude (1850-3000+ m)
700	908	Willow Warbler	Phylloscopus trochilus	/			/	p	
701	904	Chiffchaff	Phylloscopus collybita				/	p	
704	906	Yellow-throated Warbler	Phylloscopusruficapilla	/		/	/	ff	
709	917	Blackcap	Sylvia atricapilla	/				p	
736	861	Hunter's Cisticola	Cisticola hunteri	/				g	Regional Responsibility.
751	828	Bar-throated Apalis	Apalis thoracica	/		/	/	ff	race; Pare Mts.; pareensis Kilimanjaro;griseiceps Usambaras; murina
762	821	Black-headed Apalis	Apalis melanocephala			/	/	ff	
764	898	Red-capped Tailorbird	Orthotomus metopias					ff	Fjeldsa & Rabol (1995)
781	936	Dusky Flycatcher	Muscicapa adusta	/		/	/	f	
786	946	Lead-coloured Flycatcher	Myioparus plumbeus		/			wd	Rare, fragmented distribution (ZTP)
788	955	Vanga Flycatcher	Bias musicus		/			f	Rare. No recent records in Usmabaras.(ZTP)
790	950	Forest Batis	Batis mixta		/			ff	race; ultimaon Kilimanjaro and Pare Mts.
806	970	White-tailed Crested Flycatcher	Eliminia albonotata	/	/	/	/	ff	race; subcaeruleus throughout mountains of eastern Tanzania, not recorded in Taita Hills.
805	968	Paradise Flycatcher	Terpsiphone viridis		/		/	w	
816	671	African Hill Babbler	Alcippe abyssinica	/	/	/	/	ff	
840	1080	Collared Sunbird	Anthreptes collaris	/	/	/	/	w	
842	1112	Eastern Olive Sunbird	Nectarinia olivacea	/	/	/	/	ff	
857	1108	Eastern Double-collared Sunbird	Nectarinia mediocris	/		/	/	w	Regional Responsibility
880	1132	South-Pare White Eye	Zosterops winifredae	/		/	/	ff	Regional Responsibility Endemic, some consider a race of poliogaster. IUCN Vulnerable
894	1029	Common Fiscal	Lanius collaris		/		/	w	
901	999	Black-backed Puffback	Dryoscopus cubla	/	/	/		f	
909	1022	Brown-crowned Tchagra	Tchargra australis	/		/	/	w	
914	1004	Tropical Boubou	Laniarius aethiopicus	/		/	/	ff	race; ambiuus on Kilimanjaro, sublacteus on Pare, Taita and Usambara Mts.
920	1017	Black-fronted Bush Shrike	Malaconotus nigrifrons	/	/	/	/	ff	Goldern and buff brested morphs occur
931	644	Drongo	Dicrurus adsimilis				/	w	
935	653	White-necked Raven	Corvus albicollis				/	w	
938	1067	Waller's Starling	Onchychognathus walleri	/		/		ff	
936	1064	Red-winged Starling	Onychognathus morio	/		/		w	
941	1066	Slender Billed Starling	Onychognathus tenuirostris				/	ff	Recorded in Ulugurus, East Usambaras in Tanzania
952	1049	Sharpe's Starling	Cinnyricinclus sharpii	/		/		ff	Recorded twice in West Usambaras (ZTP)
975	1159	Baglafecht Weaver	Ploceus baglafecht	/				w	
1035	1223	Red-faced Crimsonwing	Cryptospiza reichenovi	/	/	/	/	ff	
1037	1235	Peters' Twinspot	Hypargos niveoguttatus	/		/		f	
1048	1226	Common Waxbill	Estrilda astrild	/		/		g	
1052	1261	Red-cheeked Cordonbleu	Uraeginthus bengalus	/		/		w	
1074	1216	Pin-tailed Whydah	Vidua macroura				/	w	
1081	1283	East African Citril	Serinus hypostictus	/	/	/	/	w	
1095	1279	Oriole Finch	Linurgus olivaceus				/	ff	
			Total recorded per visit	66	26	53	69		