Filling the knowledge gaps
An ecological expedition to central Tanzania

21st January – 2nd February 2011

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1. INTRODUCTION

For the past half-century or more, global conservation goals have focused on saving endangered species and establishing protected areas, which now cover approximately 10% of the earth's land surface. While this protected area network creates a 'sink' of genetic variability, many species of vertebrate, especially the larger mammals, continue to decline. Tanzania is no different and this decline in some areas is not surprising, as many of the core protected areas include only a small portion of the annual migratory range of large herbivores, in other words, only part of the ecosystem that they require to survive. In 2009, the billionth African was born, and with this expanding human population we see an increase in conflict over land use and water resources between wildlife and people.

Tanzania - Country Facts	
Land Area	94.7 million ha.
Woodland (and forest)	35.3 million ha
Population	38.3 million
Population Growth	2.8%
GDP (USD)	933 per person
Largest income source	Agriculture (80% population)
Biocapacity	1.2 Global ha per person (below global average)
Ecological Footprint	1.2 Gobal ha per person (below global average)

In order to sustain biodiversity and to efficiently manage ecosystems, it is essential to monitor and reduce wildlife loss outside of core protected areas by encouraging local participation in conservation efforts. Data collection and monitoring is one of those processes, which are crucial to increasing our knowledge of vertebrate distributions and thus targeting conservation efforts towards vital landscapes, such as migratory corridors. The quantification and distribution of species outside protected areas and the determination of the factors governing wildlife population trends are therefore necessary for the implementation of successful conservation policies within Tanzania.

The Tanzanian bird atlas and Tanzanian mammal atlas both have conservation management objectives at the core of their philosophy, providing bird and mammal distribution data free of charge to land managers and government agencies, allowing them to make better policy decisions and to include environmental management at every level of planning.

1.1. STUDY AIMS AND OBJECTIVES

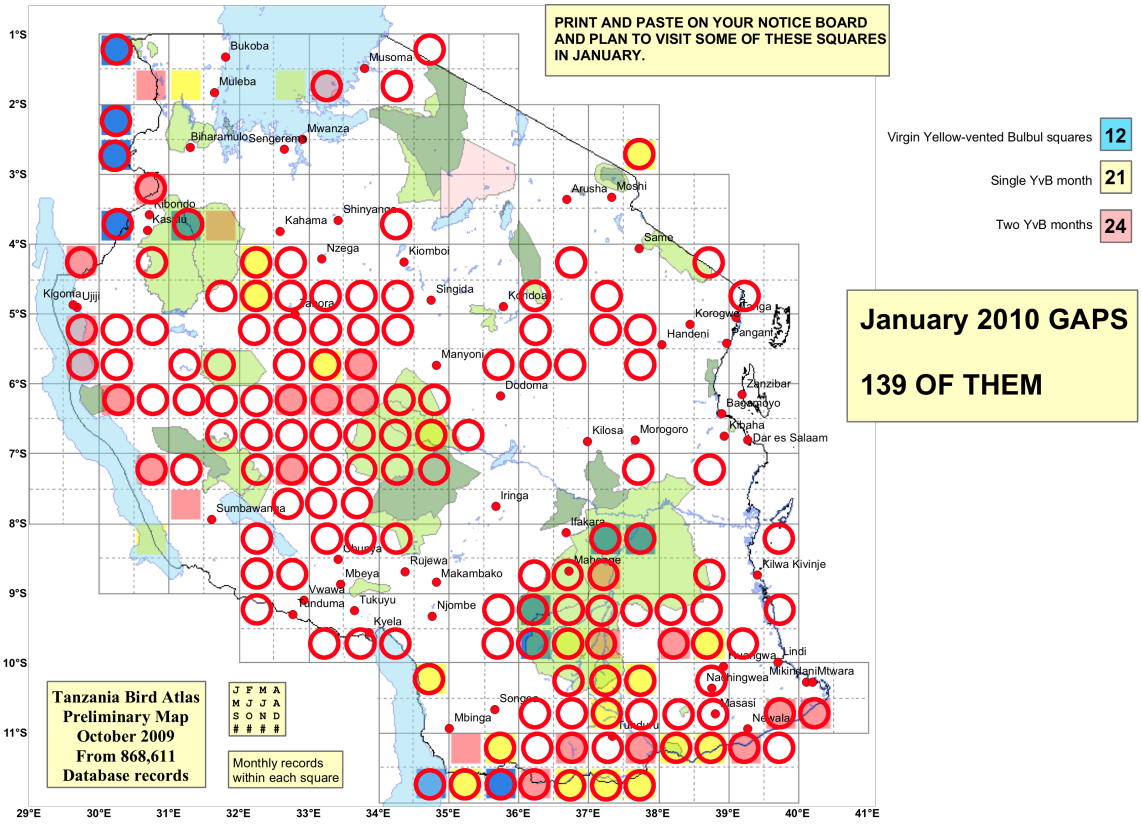
In order to establish the 'knowledge gaps' within Tanzania, we use the bird atlas map of yellow - vented bulbul *Pycnonotus barbatus* (YVB) (also known as Common Bubul), a common and widespread generalist bird of Sub-Saharan Africa. This bird is a classic ecological indicator and is only absent from high montane forest and extreme desert. If we analyse records of presence or absence of this indicator species within tetrad squares across Tanzania, given that it should be recorded in all squares throughout the year, we are able to see the overall coverage of data records, and by doing this it is easy to identify the project's specific goals, which are now to fill these 'knowledge gaps'. By using negative data we are able to see the gaps both for specific species and for the months in which species are present, or absent (Map 1).

Rapid assessments of fauna can use different methods depending on environmental conditions and costs; therefore, the choice of an appropriate and efficient methodology is fundamental to maximize the cost–benefit ratio. Both direct and indirect methods can be used to survey birds and mammals, and this survey uses a combination of methodologies. It is worth noting that when adding species to the Tanzanian Bird Atlas, all squares visited provide the opportunity to expand our knowledge base, therefore all bird species are recorded at all times within an atlas square, including the journey to and from the target area. Once within the target area more specific methods are added to general observation to give a broader understanding and thus focus effort on poorly understood habitats.

The main objective of this survey was to record birds and mammals within the target area rather than finding animal population abundance estimates and densities that can be derived from a variety of aerial and foot survey techniques (distance and line transect sampling methods) and more intensive mark-recapture methodologies.

For large mammals aerial methods are excellent because in open areas such as savannahs, wetlands and open water, and like most surveys, they improve with sampling intensity and sampling quality (aircraft and observer capacity). Where visibility is limited (such as forests and woodlands) or in mixed habitat (forest-savannah mosaics), and time is short, the best results are obtained with line-transect foot surveys. Surveys on foot provide a good idea of realities on the ground; it allows the sampling of smaller mammals too and the assessment of human pressures (poaching and habitat degradation) in all types of habitats, in a way that aerial surveys and mark-recapture surveys cannot.

Map 1. Showing the data gaps within Tanzania for January 2010.



The objectives and study aims of this project are to support the ongoing efforts of the Tanzania Bird Atlas (TBA) and Tanzanian Mammal Atlas (TMA) by collecting data through private sector support. Following the survey all the data collected is collated and supplied free to both projects. Both projects in return acknowledge the support of the survey team and the private donors in written documentation and in writing.

1.1.2. Study Area

One of the major knowledge gaps in Tanzania is occupied by the Nyahua Mbuga and Itulu Forest Reserves (Wembere South Open Area[1]), situated north west of the Rungwa-Kizigo Game Reserve (see map 1). This is an area of extensive Brachystegia[2] woodland and forms the catchment for two major river systems, the Ugalla and Wembere. The Ugalla River flows west and joins the Gombe River to form the southern part of an extensive swamp system, Tanzania's largest Ramsar[3] site (Moyowosi - Malagarasi), a wetland of global importance for wildlife and people. This swamp system stretches north for 200km in a thin band of Papyrus swamp along the Gombe and Malagarasi Rivers. The Ugalla serves the Uvinza Salt mines before flowing into lake Tanganyika. The Wembere River flows north providing seasonal flood irrigation and direct water supply to a large population of people in the Shinyanga area of Tanzania, before flowing into the Lake Eyasi basin.

The study area is dominated by woodland along ridges with rank grassland in small pockets along drainages. The habitat is defined as; Combretum - Brachystegia - Pericopsis woodland. Dominant species include: *Combretum colinum, Combretum adenogonium, Brachystegia spiciformis, Pericopsis angloensis, Diplorynchos kondokapa, Xeroderris stuhlmanii, Tamarindus indica* and *Pterocarpus tintorius*. Within the survey area canopy height is approximately 15 – 20m with an average percentage cover of 60 – 80%.

1.2. TANZANIAN BIRD ATLAS

In Africa, bird atlases have been published with resolution as coarse as 1 degree for the Sudan (Nikolaus 1987) and as fine as 1/8th of a degree for Swaziland (Parker 1994). However, at the 5th Pan-African Ornithological Congress it was agreed that, to ensure conformity across the continent, the basic recording unit should be the 1/2º x 1/2º square (Ash & Pomeroy 1981). This recommendation has been followed by many countries and within the east-central Afrotropics atlases have been published for Kenya (Lewis & Pomeroy 1989), Uganda (Carswell et al. 2005), Malawi (Dowsett-Lemaire & Dowsett 2006) and Zambia (Dowsett et al. 2008) all based on the quarter-degree square with local variations as different opportunities have arisen. The East African Natural History Society established a mapping scheme for East Africa in the late 70s. It soon became apparent that coverage in Kenya was far in advance of Uganda and Tanzania and the emphasis shifted to efforts in individual countries.

In Tanzania initial mapping was based upon the now standard quarter degree square but the first field cards designed in 1985 included fields for monthly data and an abundance code. The rationale for the former was the requirement for seasonality records and the fact that most observers were resident and thus able to contribute regular data. Gathering abundance data in such large areas is problematic but it was felt at the time that an effort should be made in this regard and this has proved useful in identifying sites of importance for water birds where conservation values relate to numbers (Wetlands International, 2006). Ideally an Atlas will cover a fixed time period to allow comparisons with future surveys, highlighting any population changes and establishing trends.

[1] An open area is a defined parcel of land issued to a hunting company to manage and utilise for tourism hunting. In theory this affords some form of protectction, in practice this is dependant on the company operating in the area.
[2] Brachystegia is the generic name for many of the commonest tree species in the Zambezi Biome and is often referred to as Miombo Woodland. Miombo is the Kinyamwesi name for Brachystegia boemii.
[3] Ramsar – International convention on the protection of wetlands, identifies core wetlands

History of mapping bird species

The earliest handbooks for birds did not include maps, but just mentioned the few localities from where specimens had been collected and these were often very few indeed. One of the earliest regional handbooks to incorporate maps was The Birds of the Belgian Congo (Chapin 1932) which used maps for some species to show continental as well as regional distribution. Museum specimens carried details of their origins and as collections were enlarged such data were used to create distribution maps by "joining up the dots". Mackworth-Praed & Grant (1952-1973) used this method in their African Handbook of Birds, the maps being rather small and generally little more than thumbprints in the margins of the text. Meanwhile, in Europe mapping based on far larger collections was becoming more sophisticated, the first grid based book on bird distributions was The Atlas of Breeding Birds in Britain and Ireland (Sharrock, 1976) to which nearly 15,000 people contributed.

Although a handful of other flora had been mapped using grids by individual botanists working in limited areas. Since the 1960s many countries (and far smaller units) across the world have created grid based bird atlases using a variety of scales to suit the size of the country, region or county being mapped and the number of observers available to meet the required target.

By incorporating a year field, the Tanzania Atlas allows for this and population trends in reporting rates have already been used for conservation purposes (Morrison 2008, Baker 2008). Initially the locality field was used simply to define the square but this has evolved to allow site-based species lists for individual forests, lakes, protected areas etc. Creating species lists, abundancy codes and viability codes for protected areas has been further enhanced by adding a field to the database that allows ready access of data for any designated National Park or Game Reserve. Initially no allowance was made for day dates but these have been added to allow analysis of migration patterns.

At the time of writing there are 862,000 records entered on the database. 30,699 of these are breeding season records and 9,842 are egg months, the ultimate goal for breeding season definition. These records have come from almost 500 contributors and include some literature data deemed accurate enough to place within an Atlas square.

The 1/2º x 1/2º square covers approximately 2,500km^2, too large an area when trying to evaluate species ecological limits but covering even these 353 squares in Tanzania is a huge undertaking given the limited human resources available. Using a smaller unit such as the 1/4º x 1/4º would have been quite impossible. However the introduction of hand held GPS units in the mid 90s allowed far greater levels of accuracy and the use of altitude in helping to define the range of a species. Bird observations are now collected within 500m of a geo-referenced point and where possible a vegetation profile is created that will allow useful analysis between bird species and preferred habitats. This will be especially useful as ground-truthed data for analysis with satellite derived variables at the scale of 1km^2.

1.3. TANZANIA MAMMAL ATLAS

Tanzania has an extraordinarily rich mammal fauna, ranking 5th in Africa in overall mammal biodiversity. The Serengeti ecosystem alone boasts the highest diversity of ungulates in the world and the greatest density in Africa. The country's conservation record is exceptional; 15% of the country has been set aside expressly for the purpose of conserving biodiversity, and almost 25% is granted some level of protective status. The abundance of wildlife resources has spawned a large, rapidly expanding wildlife-related tourism industry, revolving around photographic safaris and sport hunting. Yet despite the importance Tanzania attaches to wildlife conservation, information on the distribution and status of many mammal species is limited. Wildlife surveys are restricted to the major national parks and game reserves, and generally only cover the larger species. This leaves huge areas of the country where very little is known about wildlife distribution and abundance. Many forested areas and remote village owned land have never been surveyed for instance, and many of the smaller, cryptic or nocturnal mammals are missed during surveys using traditional aerial or ground based techniques, so little is known about their status in the country. This project aims to fill in the geographic and taxonomic gaps in our knowledge of all of the larger mammals of Tanzania excluding the

rodents, bats, insectivores and aquatic mammals, which are generally difficult to find and can often only be identified in the hand.

The Tanzania Mammal Atlas, since it officially started in November 2005, aimed to help Tanzania meet its obligations under the International Biodiversity Conservation Action Plan for its mammal species. To achieve this, its focus was to strengthen national institutions and increase monitoring capacity and conserve mammal biodiversity by:

- developing capacity to monitor mammal distribution and status in areas where little information is available
- establishing protocols to monitor small and cryptic species
- collecting all existing information in a centralized database with data on the distribution status and, where possible, abundance, for all mammals excluding rodents, bats, insectivores and marine mammals given the difficulty of monitoring such species.

Whilst the Tanzania mammal atlas project is relatively new, its database has continued to expand to 21,600 sightings covering 87 of our target species. Moreover, a historical database for mammals has also been established with about 10,600 sightings of 70 species.

The coverage is much improved although there is still a bias towards protected areas where most survey work is undertaken. Twelve intensive camera trapping surveys have successful been conducted namely in Mahale National park (Oct-Dec 2005), Arusha National Park (March-May 2006), Serengeti National Park (May-July 2006), Minziro lowland forest (Aug-Oct 2006), Coastal Tanga Forests (Nov-Dec 2006), Burigi/Bhiharamulo Game reserve (July 2007) and Zaraninge/Saadani National Park (March-April 2007).

Others are Ukaguru Mountains-Mamiwa catchment forests (August 2007), Muhuwesi Forest reserve (October, 2007), Moyowosi Game reserve (November, 2007), Ufiome Mountains (January-February 2008) and Gelai game controlled area (March-April 2008). These surveys have significantly improved the coverage especially in areas with major information gaps.

2. METHODOLOGY

2.1. Birds

OBSERVATION

General observations were carried out at all times en route to and within the survey area. This included all the habitat types; woodland, grassland, wetlands and cultivated areas. 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 only samples to 2.5m 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. All birds caught by this technique were fitted with a standard Museum of Nairobi ring and the following 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 with the Tanzanian Ringing Scheme[4].

500M GEOREFRENCED SPECIES COUNTS

In order to survey all of the habitat types within the boundaries of the survey area, 500m georefrenced counts were conducted in marginal habitats such as wetlands, secondary habitats which consisted mainly of cultivated or burnt areas.

On arrival at the sampling point the following information was recorded;

i. Habitat: A brief description of the surrounding vegetation, particularly structure and stratification, a note was made as to fallen trees, amount of dead wood, or fruiting/flowering vegetation.
ii. UTM and Lat/Long coordinates.
iii. Time

SPECIES OF CONSERVATION CONCERN

Those species which are of particular conservation significance are indicated as Globally Near-Threatened (GNT) or Globally Vulnerable (GV) following Collar *et al*, (1994). Those species of regional concern are indicated as such.

SPECIES ECOLOGY

A note was made of the presence and absence of what are considered Miombo-specific species, as well as the structure of feeding parties within the habitats surveyed. This is of particular importance in Brachystegia woodlands where (non-breeding) feeding parties can constitute a bulk of the site records encountered and bird species encountered.

2.2. Mammals

Rapid faunal assessments can use different methods depending on environmental conditions and costs; therefore, the choice of a proper and efficient methodology is fundamental to maximize the cost–benefit ratio. Both direct and indirect methods can be used to survey mammals, but usually track census is the most effective method for detecting richness, followed by camera trapping and direct faunal count.

The purpose of this survey was to make a mammal checklist within the study area rather than finding animal population abundance estimates and densities that can be derived from a variety of aerial and foot

[4] The Tanzanian Ringing Scheme is based in Iringa, Tanzania.

survey techniques (distance and line transect sampling methods) and more intensive mark-recapture methodologies. Aerial methods are excellent for bigger mammals in open areas such as savannahs, wetlands and open water and like most surveys they improve with sampling intensity and sampling quality (aircraft and observer capacity). Where visibility is limited (such as forests and woodlands) or in mixed habitat (forest-savannah mosaics), and time is short, the best results are obtained with line-transect foot surveys. Surveys on foot provide a good idea of realities on the ground; it allows the sampling of smaller mammals too and the assessment of human pressures (poaching and habitat degradation) in all types of habitats, in a way that aerial surveys and mark-recapture surveys cannot.

For the purposes of this rapid faunal assessment exercise, the following techniques were employed.

OBSERVATIONS

Direct observations were carried out at all times within the survey area. This included all the habitat types; woodland, grassland, wetlands and cultivated areas. Species were identified by sight and by call when possible, especially at night.

TRACKS AND SIGNS

When direct observations are difficult, as in this particular case study, because of the thick miombo habitat, the low density of mammals, their timidity due to hunting, or when species are cryptic and nocturnal, animal tracks and signs provide the best indications for the presence (or movement through an area) and identity of a species.

During the survey tracking included ground spoor, scent, feeding signs, faeces, pellets, territorial signs, paths and shelter, vocal and other auditory signs and skeletal signs.

As the survey time was short the main objective was to indicate presence of species rather than distribution patterns or abundance. For this purpose tracks and signs were searched in places where they were expected to be found and that is along trails, dry river beds, on rocks, man-made gravel roads and paths used by a number of animals when moving from one area to another, clearings where animals feed as well as around waterholes where they come to drink and feed.

Prints

Prints provided the most detailed information on the identity and the activities of animals in the wild. Although in nature it is difficult to find two individuals of the same species with identical prints, there are “ideal” prints and patterns that help in the identification.

Species can be recognised by general characteristics, however, each individual’s spoor has its distinctions due to the age, mass, sex of the animal as well as the terrain. While the spoor of most of the larger mammals reveals the particular species to which they belong, those of smaller animals may indicate only the broader genus, family or order. (In Appendix 4 some species were identified as “genet”, “mongoose” and “duiker” for this reason).

Therefore, the smaller the animal and the more difficult it becomes to classify it. The clearest prints tend to be left in damp, slightly muddy earth, wet sand, on dirt roads or paths although one has to consider that the size could appear slightly bigger. Visualizing the shape of prints in soft sand is always difficult because the edges blur and, similarly, hard ground may only reveal claw marks.

Droppings

Faeces are amongst the most useful of these auxiliary signs as some are very specific (eg those of elephants are large and rounded). However, not all are easy to identify. Antelope tend to have similar shaped droppings, pellet-like, with a point at one end and an indentation at the other, so it can be hard to identify a particular species from this sign alone. In these cases checking distributions and giving a rough size of the animal (small, medium, large) is the best one can do.

Most mammal carnivores leave narrow, cylindrical droppings and they often reveal what an animal eats. Omnivores such as baboons show hair as well as seeds, carnivores show bone and hair. Hyaenas, and sometimes lions, produce droppings that are dry to a whitish crystalline form from high calcium content of their bone diet, whereas a civet's are characterized by a mixture of millipede shells, fruit pips, insect husks and fur and bone from tiny mammals they feed on.

Many animals use their faeces to mark their territories and a few latrines were found during the survey (rock and bush hyraxes, civettries). In these cases the animal, or more animals, return to the latrine which shows huge quantities of waste.

Feeding signs

During the survey we came across broken trees and branches, scattered grass tufts and stripped bark indicating the presence of elephants, also confirmed by droppings and prints. In some areas warthog, porcupine and aardvark activity was identified by the presence of holes and earth displacement due to the digging of ants and roots from the ground.

No signs of carcasses and skeletons indicating recent carnivore or scavenger activity were found.

Other signs

Aardvark holes were seen throughout the study area. Many different species including hyaena , warthog and mongoose are known to use old and abandoned holes. The tracks and droppings around the hole, and of course the size, gave an idea of which animal was using it. However, in most cases the holes were too old.

RECCES

During the survey, we walked 'recce-transects', in which transects (T) are straight lines intersected by recces (R) that are routes of least resistance between transects. Rs represent mainly human and animal trails and because trails tend to attract wildlife, they are better than Ts to establish species diversity, but cannot be used to extrapolate density estimates for an entire habitat.

As the aim of the project was to obtain a list of mammal species found in the area, the survey focused on Rs. To collect more data, Rs were carried out along animal trails where recent animal activity was observed, around holes and burrows, next to foraging areas (clearings in the woodland) and swamps where animals go to drink and feed.

CAMERA TRAPS

In the past few years using a remote triggering photographic camera as a surveying technique has become very popular especially for cryptic animals as well as for population studies of species which can be individually recognised by marks (Karanth, 1995; Carbone, 2001).

Camera trapping provides an important non-invasive tool for assessing presence of animal species in an area as well as patterns of abundance throughout space and time, activity patterns, habitat use and reproductive information. Despite the variety of field techniques that can be used for terrestrial mammal surveys, not all can be efficiently applied in every ecosystem. Some landscapes can be remote, steep and so densely vegetated that only a few methods can be applied. Although track surveys are efficient and usually involve low costs, they also depend on suitable conditions and trained personnel (Burnham et al., 1980; Smallwood and Fitzhugh, 1995), whereas camera trapping is efficient in almost any field condition and is not dependent on constant assistance or even experienced field staff (Rappole et al., 1985). Two Spypoint IR-6 infrared camera traps where used during the survey.

They were positioned on tree trunks at 30cm from the ground and on average 500m from each other. The location and placement of the cameras followed a random choice of sampling sites, however, to maximise the number of pictures and species they were placed along roads and trails which generally contained signs

and tracks indicating recent mammal activity. As the area covered during the survey was big and each day we moved to a different location, camera traps were positioned only during the night for an average time of 12 hours (7pm – 7am) per site.

Each camera was set to record 3 pictures per event, with an interval of 10 minutes, and each mammal photograph taken by the camera traps was considered a record. Although we baited the camera traps due to the lack of time and to maximise results, this methodology is considered a practical, non-intrusive way of sampling medium to large sized mammals with very little effort compared to alternative methods. Locations where cameras were installed had their position taken by a Garmin GPS (Global Positioning System) as shown in Appendix 3.

BAITING

A very useful technique to identify species in an area is through baiting, very effective to attract nocturnal animals as well as cryptic ones difficult to survey with direct methods. The type of bait can greatly affect the species and numbers of the catch but we mainly used dagàa (local dried fish) to attract carnivores to the camera traps. This was probably a limiting factor as tinned or dried food is not eaten regularly, if at all, by some species like shrews (Churchfield, 1990), and rodents detect food by its smell (Pennycuik & Cowan, 1990), and anything very pungent, like dagàa, might have not attracted certain mammals.

To provide a wider spectrum we sometimes baited with fruit and bread. A good idea would have been to collect local invertebrates for inclusion in the bait. It is worth remembering that baiting usually attract animals from neighbouring areas, giving a false impression of density and, perhaps, of relative species composition, but it is a very efficient technique for the purpose of this study.

3. RESULTS

3.1.1. Bird species recorded during the survey

A total of 323 species of birds from 948 observations were recorded during the survey, 21st January – 2nd February 2010, this includes the travel time from Arusha to the survey area and back to Arusha. This includes a variety of habitat types including wetlands, agricultural land, Acacia and Brachystegia woodlands. Within the specific target squares (survey area) a total of 94 species were recorded in Itulu Hills Forest Reserve (3306B), 81 species in Nyahua Mbuga Forest Reserve (3305D) and Swagala Forest Reserve (3206B) (Species list of woodland species recorded during transects, appendix II page 29). Of the species considerd specific to Miombo woodland[5] and more broadly the Zambezi biome, the species shown in table 1 were recorded during the survey.

Table 1. Miombo species recorded within the survey area.

Species	Observations
African Barred Owlet Glaucidium capenses	Several observations and recorded through call
Böhm's Spinetail Neafrapus boehmi	Recorded once only.
Racket-tailed Roller Coracias spatulata	Recorded several times.
Bennett's Woodpecker Campethera bennettii	Recorded several times.
White-breasted Cuckoo-Shrike Coracina pectoralis	Common in feeding parties.
Kurrichane Thrush Turdus libonyanus	Common.
Ruaha Chat Myrmecocichla (arnoti) collaris	Fairly common.
Miombo Rock-Thrush Monticola angolensis	Recorded once only.
Miombo Grey Tit Parus griseiventris	Recorded often in central part of Itulu Hills.
Rufous-bellied Tit Parus rufiventris	Recorded several times.
White-winged (Babbling) Starling Neocichla gutturalis	Common.

3.1.2. Species not recorded during the survey

Of particular interest are the bird species that are known to occur in Miombo woodland and are indicated as occurring there in the literature, but which were not observed within the study area. The absence of records for these species is potentially of as much significance to the survey findings as the recording of other Miombo-specific species.

Böhm's Flycatcher *Muscicapa boehmi*
Whilst Stevenson & Fanshawe note that the stronghold of this species in E. Africa is the Tabora area of Western Tanzania, the authors obtained this information from Britton[6], indicating this may not represent anything other than single historical records. This species is a miombo endemic with sporadic records throughout the western miombo areas of Tanzania, with a bias on areas of access (hence Tabora) rather than specific habitat. The bias for the records in 3103 A/B (see map) are due to a long term systematic bird survey[7] and does not necessarily reflect a stronghold for this species. This bird has been recorded every month at this location which suggests that it does not wander but is simply a quiet, inconspecous species.

Spotted Creeper *Salpornis spilonotus*
Within the area of interest, Britton states that this species is locally common in Miombo and where it has been recorded by MB, further north at Tulawaka, it can be common, activly foraging both in pairs, independantly and in feeding parties. Unlike the previous species which may have been overlooked, this is a conspicuous species. Even if it were breeding, during the survey period, and thus not joining feeding parties, it would likely have been recorded if it were present, unless population density is unusually low.

[5] This is within the East African part of their overall range.
[6] Britton, P.L. (1980) Birds of East Africa, their habitat, status and distribution. EANHS.
[7] Baker, M. (2010) Ecological Monitoring using avifauna, Tulawaka. Internal report to Barrick TZ. Ltd and Tanzania Bird Atlas records (Mike Taylor).

Interestingly this species seems to be absent in Tulawaka in late October suggesting some movement may occur. Knowledge of this species in Tanzania is limited.

Copper Sunbird *Cinnyris cuprea*
Britton mentions scattered locations for this species in Western Tanzania. Whilst a species of miombo woodlands it is often recorded near water and is often recorded in Papyrus swamps in Western Kenya, and in a range of habitats in nearby Rwanda, including degraded Miombo woodland and Commiphora woodland. Sunbirds are known to move, often large distances in search of flowering plants. This species is almost certainly migratory over unknown distances.

Miombo Double-collared Sunbird *Cinnyris manoensis*
Known to occur north to Mikumi, approx. 350km SE of Itulu Hills, but not recorded on our trip. This species is now split into to distinct populations.

Tropical Boubou *Laniarius aethiopicus*
Given its widespread distribution in E. Africa, and ease of identification from calls, it was surprising that this species was not recorded, even in thicker riverine woodland.

3.1.3. Notes on mixed-species foraging flocks (feeding parties) within the survey area

Mixed-species foraging flocks were very noticeable throughout the Itulu Hills and Nyahua Mbuga Forest Reserves, the flocks themselves were lively, diverse associations, often with interesting interactions including examples of mutualism, commensalism and parasitism.

A total of 577 observations were made during walking surveys, 430 of which were judged to be associating with heterospecific foraging flocks (Appendix II), and 147 were judged to be either lone birds or in monospecific foraging flocks. A total of 20 foraging flocks were observed. Of 90 species seen, 64 species were recorded at least once in mixed-species foraging flocks, and 50 species were recorded at least once as lone birds or in monospecific flocks. 40 species were encountered only in heterospecific flocks, and 26 species were encountered only as lone birds or in monospecific flocks. The number of species recorded in each foraging flock ranged from 4 to 17, with an average of 10.25 species observed per foraging flock (n=20).

The dynamics of Foraging Flocks

Presumably due to a lack of fruiting trees, grasses and seeds (possibly seasonal), the vast majority of foraging flocks consisted of largely insectivorous species. Occasional granivorous species associated with these flocks, such as Red-cheeked Cordon-Bleu *Uraeginthus bengalus* and Golden-breasted Bunting *Emberiza flaviventris*, and a small number of nectarivorous sunbird species were also seen feeding on flowers, usually Amethyst Sunbird *Chalcomitra amethystina*, although this species was also very often observed hawking for insects in the canopy. The leader species within the foraging flocks were often the larger, most vocal, social species within the woodland, such as White Helmet-Shrike *Prionops plumatus* (in 7/20 flocks), Babbling (White-winged) Starling *Neocichla gutturalis* (in 7/20 flocks) or Green Wood-hoopoe *Phoeniculus purpureus* (in 9/20 flocks), themselves in parties of 3-10 birds. These species tended to be at the front of the flock (i.e. closest to the direction of movement), and were often followed by other species if they changed direction. The only other lead species noted was Retz's Helmet-Shrike *Prionops retzii*. Interestingly, on just one occasion, Retz's Helmet-Shrike and White Helmet-Shrike were observed together (Jason Anderson), the latter were unusually silent, although it wasn't clear whether they were following the Retz's Helmet-Shrikes.

Small insectivorous 'gleaning' species, especially titmice and warblers, often kept close to the leader species, feeding both in the upper canopy and mid-canopy where this existed. Foremost among these were Green-capped Eremomela *Eremomela scotops* (in 9/20 flocks), White-bellied Tit *Parus albiventris* (7/20 flocks), Chinspot Batis *Batis molitor* (6/20 flocks), Yellow-bellied Hyliota *Hyliota flavigaster* (5/20 flocks) and Willow Warbler *Phylloscopus trochilus* (5/20 flocks). Other such species included Brubru *Nilaus afer*, Miombo Grey Tit *Parus griseiventris*, Rufous-bellied Tit *Parus rufiventris*, Grey Penduline-Tit *Anthoscopus*

caroli and Red-faced Crombec *Sylvietta whytii*. Whilst the three species of tit were observed together on one occasion, there was a stronger association between Miombo Grey Tit and Rufous-bellied Tit, with White-bellied Tit the only tit species observed on 6 out of the 7 occasions when it was seen.

Woodpeckers were very common in the foraging flocks, usually as satellite species, with 5 species recorded: Bennett's Woodpecker *Campethera bennettii* (3/20 flocks), Golden-tailed Woodpecker *Campethera abingoni* (2/20 flocks), Green-backed Woodpecker *Campethera cailliautii* (6/20 flocks), Cardinal Woodpecker *Dendropicos fuscescens* (6/20 flocks) and Bearded Woodpecker *Dendropicos namaquus* (5/20 flocks). Several species would often be present in the same flock, although no competition, acts of aggression, or kleptoparisitism were observed.

Several cuckoo species were observed, including Jacobin Cuckoo *Clamator jacobinus* and Levaillant's Cuckoo *Clamator levaillantii*, although they showed no clear affinity to foraging flocks. The one species that did was (presumed) African Cuckoo *Cuculus gularis*, although given the difficulty of separating this species from European Cuckoo *Cuculus canorus*, many birds seen were left unidentified as *Cuculus sp.* On two occasions when views allowed identity to species possible, African Cuckoos were observed on the periphery of foraging flocks, one of which attempted to steal food from a Green Wood-hoopoe. White-breasted Cuckoo-Shrike *Coracina pectoralis* was common (8/20 flocks), and on one occasion kleptoparisitism was observed, when 1 bird chased and stole food from a Fork-tailed Drongo *Dicrurus adsimilis* within a feeding party.

Three species of oriole were observed in the woodlands, and all showed some affinity to foraging flocks, usually on the periphery. Eastern Black-headed Oriole *Oriolus larvatus* (3 out of 7 records were in foraging flocks), African Golden Oriole *Oriolus auratus* (2 out of 4 records were in foraging flocks) and Eurasian Golden Oriole *Oriolus oriolus* (2 out of 2 records were in foraging flocks).

Other species that were common in foraging flocks included Ruaha (previously Arnott's) Chat *Myrmecocichla (arnottii) collaris* (6 out of 7 records in foraging flocks), Black-crowned Tchagra *Tchagra senegalus* (6 out of 6 records in foraging flocks), Black-backed Puffback *Dryoscopus cubla* (6 out of 11 records in foraging flocks), Red-headed Weaver *Anaplectes rubriceps* (6 out of 6 records in foraging flocks), Common Scimitarbill *Rhinopomastus cyanomelas* (5 out of 5 records in foraging flocks), Black Cuckoo-Shrike *Campephaga flava* (4 out of 4 records in foraging flocks) and Western Violet-backed Sunbird *Anthreptes longuemarei* (3 out of 3 records in foraging flocks).

Sedentary and often solitary species that were occasionally observed with foraging flocks included Ring-necked Dove *Streptopelia capicola*, Greater Honeyguide *Indicator indicator*, Common Bulbul *Pycnonotus barbatus*, Kurrichane Thrush *Turdus libonyanus*, Trilling Cisticola *Cisticola woosnami*, Tabora Cisticola *Cisticola angusticauda*, and Fork-tailed Drongo *Dicrurus adsimilis*. All these species were also observed alone or in monospecific family groups on several occasions.

Common species that showed no affinity to foraging flocks included Meyer's Parrot *Poicephalus meyeri* (only 1 out of 5 records with foraging flocks), Racket-tailed Roller *Coracias spatulatus* and Bare-faced Go-away Bird *Corythaixoides personatus* (both 3 records, all away from foraging flocks), Emerald-spotted Wood-Dove *Turtur chalcospilos* and (Tanzanian) Red-billed Hornbill *Tockus (erythrorhynchus) ruahae* (both only 1 out of 3 records with foraging flocks).

Given that foraging flocks were actively sought out during walking surveys, as a result of the primary objective of the trip (to record all species present), it is likely that data comparing species found associating with foraging flocks with species found away from foraging flocks will be biased. However, this bias may not be significant, given that often as much time was spent searching for these flocks (and thus away from the flocks, looking and listening for birds), as was spent with the flocks.

3.2. Mammals

Along the road transect through the Miombo woodlands of central Tanzania forty-two (42) small, medium and large mammal species were recorded. The presence of Elephant (*Loxodonta africana*), Giraffe (*Giraffa camelopardalis*), Buffalo (*Syncerus caffer*), Sable antelope (*Hippotragus niger*), Roan antelope (*Hippotragus equinus*), Greater Kudu *(Tragelaphus strepsiceros),* Leopard (*Panthera pardus*), and Spotted Hyaena (*Crocuta crocuta*) were recorded within the study area. Although visibility was limited due to the habitat, the majority of species were identified through direct observations as shown in figure 1.

Of the 42 species recorded 46% were sighted (on foot or by car), 40% were identified through tracks and signs, 12% were identified with the camera traps and only one species has been recorded through vocalization at night (tree hyrax).

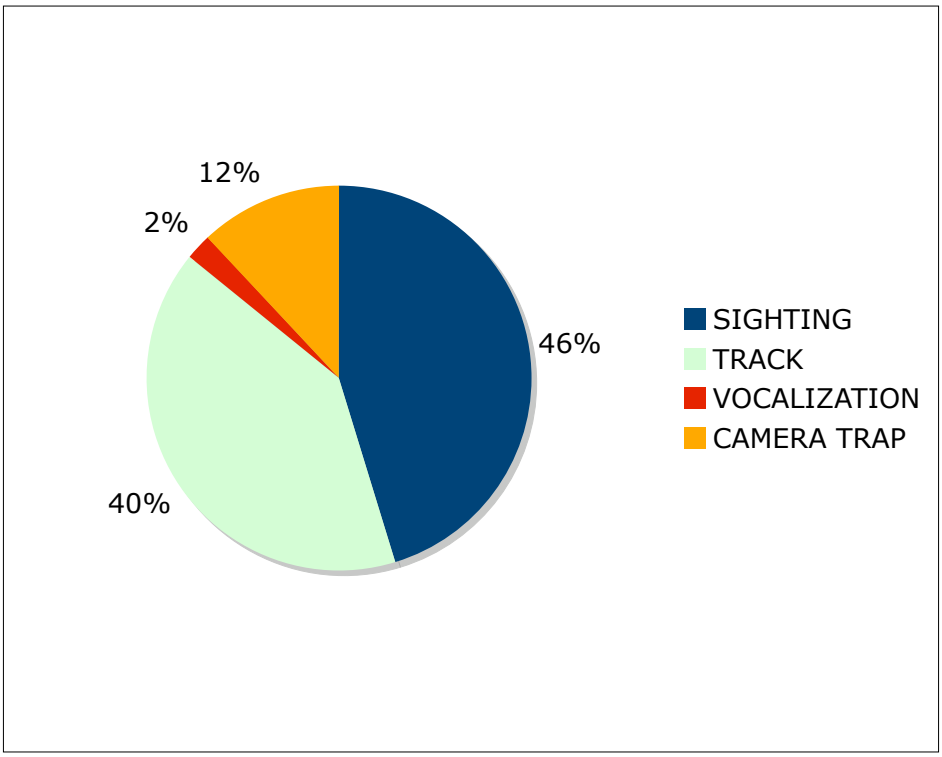


Figure 2
All large and medium sized mammal species seen and heard and signs recorded during the study are listed in Table 2 and the complete database in Appendix III.

Table 2 Results of mammal species recorded in survey area.
S= Seen; V= Vocalisation; T= Tracks seen; D= Dung seen; C= Camera Trap;

COMMON NAME	SCIENTIFIC NAME	
Porcupine	*Hystrix cristata*	T
Lesser Galago	*Galago senegalensis*	S,V
Vervet Monkey	*Allenopithecus nigroviridis*	S
Yellow Baboon	*Papio cynocephalus*	S,T,V
Side Striped Jackal	*Canis adustus*	T,C
Zorilla	*Ictonyx striatus*	T
African Civet	*Civettictis civetta*	T,D
Blotched Genet	*Genetta tigrina*	C
Common Genet	*Genetta genetta*	S,T,C
Miombo Genet	*Genetta angolensis*	C
Dwarf Mongoose	*Helogale parvula*	S
Marsh Mongoose	*Atilax paludinosus*	T
Mellers Mongoose	*Rhynchogale melleri*	T,C
Slender Mongoose	*Herpestes sanguineus*	S
White Tailed Mongose	*Ichneumia albicauda*	T,C
Spotted Hyaena	*Crocuta crocuta*	T,V,C
Striped Hyaena	*Hyaena hyaena*	T,V
Leopard	*Panthera pardus*	T,D
Savanna Elephant	*Loxodonta africana*	T,D
Bush/Rock Hyrax?	*Heterohyrax brucei/Procavia johnstoni*	S,D
Southern Tree Hyrax	*Dendrohyrax arboreus*	V
Aardvark	*Orycteropus afer*	T
Bush Pig	*Potamochoerus porcus*	T
Warthog	*Phacochoerus africanus*	T
Four toed elephant shrew	*Petrodromus tetradactylus*	S
Squirrel Ochre bush	*Paraxerus ochraceus*	S
Squirrel Smith's Bush	*Paraxerus cepapi*	S
Scrub hare	*Lepus saxatilis*	S
Buffalo	*Syncerus caffer*	T
Giraffe	*Giraffa camelopardis*	T,D
Bushbuck	*Tragelaphus scriptus*	S
Bush Duiker	*Sylvicapra grimmia*	S,T,D
Eland	*Taurotragus oryx*	T
Greater Kudu	*Tragelaphus strepsiceros*	T
Impala	*Aepyceros melampus*	S
Klipspringer	*Oreotragus oreotragus*	T
Oribi	*Ourebia ourebia*	S
Reedbuck Southern	*Redunda arundiaum*	S,T,D
Roan Antelope	*Hippotragus equinus*	S,T,D

3.2.1. Camera traps

Each photograph taken by the camera traps was considered a record excluding those which were taken during placement and removal of the cameras. No pictures of other taxonomic groups (Reptiles and Birds) were taken during the survey so all other pictures were considered mammal records.

The pictures were divided in total number of photographs taken and independent (specific individuals). Sampling effort was calculated as: number of camera traps x number of sampling days, and the sampling success was expressed as percentage: (number of independent records/ sampling effort) x 100. The sampling effort of 9 camera days, gave 14 independent records and a capture success of 77,7% (14 / 18 x 100).

Camera trap 1 was left in the field for a total of 108 hours and a total of 80 pictures were taken. Eleven different individuals visited the sites at the different locations and 7 different species were identified as shown in table 3. Only 2 animals visited the same site twice during the night: a Meller's Mongoose, which arrived at 22:52 and came back at 4:22, and a white tailed mongoose, arrived at 23:21 the first time and at 2:02 the second.

Camera trap 2 (table 3) took a total of 22 pictures in 96 hours corresponding to 3 different individuals, all different species. The species most frequently photographed were Common and Blotched Genets (3 independent records each) and both species were expected in the area.

Table 3. Camera Trap 1 – species identified and individual records

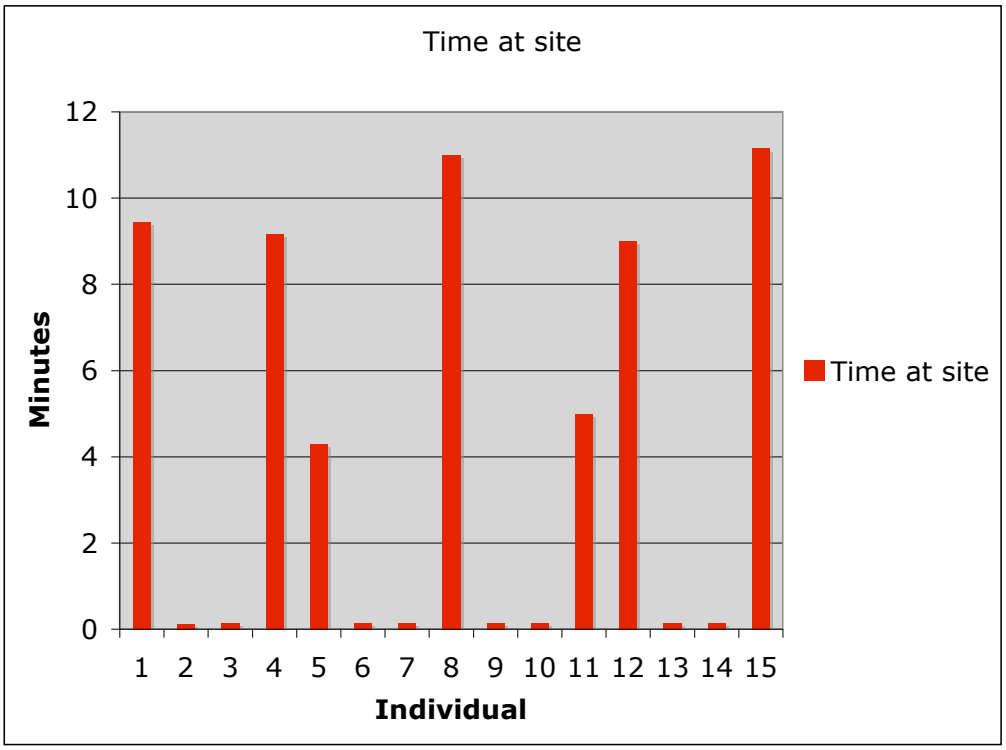
Species	Date	Arrival Time	Total Pics	Habitat
Blotched Genet	23 Jan 2011	01:20	6	Miombo/Riverine
Blotched genet	25 Jan 2011	22:10	2	Miombo
Common Genet	26 Jan 2011	2:28	6	Miombo
Side Striped Jackal	26 Jan 2011	5:33	4	Miombo
Common Genet	28 Jan 2011	5:42	2	Miombo
Common Genet	28 Jan 2011	21.30	2	Miombo
Meller's Mongoose	28 Jan 2011	22:52 / 4:22	16 / 8	Miombo
White tailed Mongoose	28 Jan 2011	5:47	2	Miombo
Spotted Hyaena	30 Jan 2011	23.18	2	Miombo
White Tailed Mongoose	31 Jan 2011	23.21 / 2:02	4 / 6	Miombo
Miombo Genet	2 Feb 2011	3:26	2	Miombo/Anthropic

Table 4. Camera Trap 2 – species identified and individual records

Species	Date	Arrival Time	Total Pics	Habitat
Side Striped Jackal	27 Gen 2011	02:31	8	Miombo
Blotched genet	28 Gen 2011	01:29	3	Miombo
White Tailed Mongoose	30 Gen 2011	03:38	6	Miombo

An average of 4 minutes were spent at the camera trap sites during a visit, with 8 seconds being the shortest and over 15 minutes the longest by a Side Striped Jackal (*Canis adustus*) (Fig 2). The camera traps were generally placed far enough to avoid taking pictures of the same individuals, however, this jackal visited both camera traps during the same night.

Figure 3. Photographs of the species identified with the camera traps are shown in Appendix 5



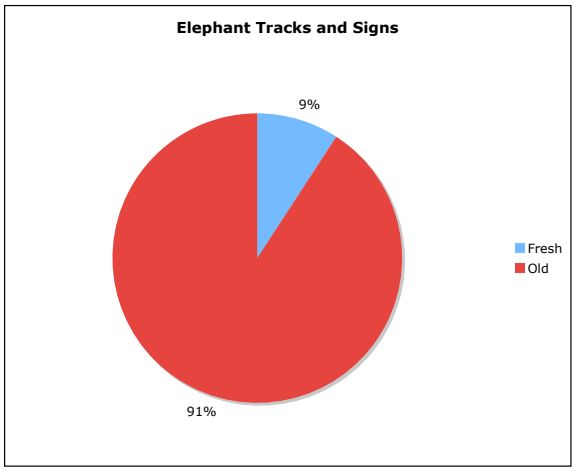
4. CONCLUSIONS AND RECOMMENDATIONS

This preliminary survey in the Miombo woodlands of central Tanzania has added considerably to what is known about the birds and mammals of Itulu and Nyaua Forest Reserves. As with all preliminary surveys, we are left with more questions than answers. This is especially the case with the distribution of the bird species outlined in section 3.1.2. Our knowledge of what should be there is based on literature and available books, both of which have considerable gaps in knowledge, lending further support to the ongoing survey work of the Ecological Initiatives and the Tanzania Bird Atlas to 'fill these knowledge gaps'. The fact that this survey is the first in this area might be indicating that these species do not occur there, rather than the survey missing the species. To confirm this a dry season survey would be the next step, which would remove the considerable bias associated with seasonality of plant associated bird species and the possible impact of breeding birds not joining, and possible actively avoiding, foraging (feeding) flocks.

The composition of foraging flocks is a particular challenge as the composition of these complex aggregations represent a high percentage of bird observations, creating observer bias. Treating the track between Madoli tisa and Ipole as a transect to be sampled at predetermined intervals, might be one method to remove bias, but again, so little is known about these random aggregations that several attempts would be needed to quantify observations.

To further support the need for a dry season survey, the mammal data indicates a marked seasonality for the larger mammal species as many old tracks and signs were found. Evidence indicates movement of elephants and other large mammals such as buffalo across all of the floodplains and zones between the Wembere catchment area, through the Itulu Forest Reserve, South of Nyahua Mbuga Forest reserve and surrounding hunting areas. Elephants are known to have distinct wet and dry ranges and the old tracks and signs found during the survey suggest these seasonal movements (Figure 4).

Figure 4. Elephant tracks and signs.



By looking at the Forest and Game Reserves within the study area and by considering the IBA (Important Bird Areas) of the Ugalla River Game Reserve which encloses the entire catchment area South East of the Reserve and South of Ipole, the elephant tracks and signs found during the survey suggest a possible connectivity between Kizigo and Ugalla River Game Reserves.

The overall scarcity of large animals in this eco-region favours the roan antelope (*Hippotragus equinus*), one of the mammals largely restricted to this habitat type, as it prefers habitats that have few competitors or carnivores (Kingdon 1997). Other ungulates identified during the survey and typical of this eco-region include sable (*Hippotragus niger)*, greater kudu *(Tragelaphus strepsiceros),* southern reedbuck (*Redunca arundium)* and buffalo (*Synerus caffer)*. However, no tracks of eland (*Taurotragus oryx)* were recorded during the survey, a species expected in the study area. Smaller carnivores, expected in these habitats, such

as the blotched and Miombo genets were recorded.

The absence of lion records is probably related to several factors. The seasonality and dispersal of prey in wet season plays a major role as well as the low prey densities in typical Miombo woodlands. While Miombo woodland in general provides important habitat for many large animals, the eco-region does not support high densities of mammals per unit area, probably due to the seasonally arid conditions and poor soil, and hence forage quality. For this reason lions have bigger ranges in order to find food. Furthermore, the survey was carried out in hunting areas and this is another limiting factor for large predators (large predators are scarce and shy).

A dry season survey should be carried out in the same area to evaluate the presence/absence of key species such as elephants and lions and verify animal movements between wet and dry seasons.

4.1. Recommendations for future study

Future studies should use the road between Madoli tisa (on the Itigi-Rungwa road) and Ipole / Sikonge (Tabora – Rungwa road) as a transect line through the catchment forest reserves of Itulu and Nyahua Mbuga. An expanded team with two vehicles would also allow for a more extensive data collection process, the study should focus on the following main objectives;

- Dry season – September / October
- Focus on recording species composition through observation for Bird Atlas database
- Conduct Timed Species Counts at predetermined sites along, or at randomised distances from, the road to establish frequency of species outside of foraging parties.
- Record species composition within foraging parties.
- Focus on all large carnivores which are amongst the most difficult species to conserve, as they tend to occur at low densities.
- Focus on the possible elephant routes between Kizigo and Ugalla River Game Reserves.
- Increase the number of camera traps

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Tanzania Mammal Atlas, http://www.tanzaniamammals.org/

Appendix I: Bird species recorded during survey period. BNo indicates Britton number following the taxonomy and nomenclature used by the Tanzania Bird Atlas

BNo	Species
12	Pink-backed Pelican
23	Little Bittern
26	Goliath heron
27	Black-headed Heron
28	Purple Heron
30	Squacco heron
32	Cattle Egret
34	Great White Egret
36	Little Egret
38	Yellow-billed Egret
50	Yellow-billed Stork
43	Open-billed Stork
42	Hamerkop
44	Abdim's Stork
45	White Stork
47	Black Stork
48	Saddle-billed Stork
49	Marabou Stork
51	Hadada Ibis
53	Glossy Ibis
54	Sacred Ibis
60	White-faced Whistling Duck
79	Spur-winged Goose
80	Knob-billed Duck
138	Yellow-billed Kite
84	Palmnut vulture
85	White-backed Vulture
90	White-headed Vulture
93	Pallid Harrier
94	Montagu's Harrier
96	Gymnogene
98	Brown Snake Eagle
100	Black-chested Snake Eagle
101	Bateleur
102	Shikra
107	Little Sparrowhawk
111	African Goshawk
114	Steppe Eagle
116	Tawny Eagle
118	Wahlberg's Eagle
120	Augur Buzzard
122	Steppe Buzzard
122	Common Buzzard
127	Booted Eagle
128	African Hawk Eagle
129	Lizard Buzzard
130	Long-crested Eagle

131	Gabar Goshawk
132	Dark Chanting Goshawk
133	Pale Chanting Goshawk
134	Martial Eagle
137	African Fish eagle
138	Black Kite
140	Honey buzzard
142	Black-shouldered Kite
147	Grey Kestrel
148	Lanner Falcon
150	Red-necked Falcon
152	African Hobby
154	Eleanora's Falcon
156	Lesser Kestral
171	Hildebrandt's Francolin
160	European Hobby
165	Quail
166	Harlequin Quail
167	Red-necked Spurfowl
170	Coqui Francolin
176	Red-winged Francolin
182	Crested Francolin
183	Shelley's Francolin
190	Helmeted Guineafowl
193	Button Quail
220	White-bellied Bustard
225	African Jacana
243	Blacksmith Plover
244	Crowned Plover
248	Wattled plover
258	Green Sandpiper
272	Little stint
294	Two-banded Courser
295	Violet-tipped Courser
306	Grey-headed Gull
317	whiskered Tern
383	Purple-crested Turaco
332	Black-faced Sandgrouse
394	Levaillant's Cuckoo
399	Red-chested Cuckoo
341	Speckled Pigeon
345	Namaqua Dove
346	Ring-necked Dove
347	Mourning Dove
350	Red-eyed Dove
351	Laughing Dove
356	Emerald-spotted Wood Dove
358	Green Pigeon
361	Fischer's Lovebird
362	Yellow-collared Lovebird
367	Brown Parrot

374	White-bellied Go-away Bird
375	Bare-faced Go-away Bird
383	Violet-crested Turaco
388	Didrick Cuckoo
389	Emerald Cuckoo
457	Mottled Spinetail
393	Black-and-white Cuckoo
395	Eurasian Cuckoo
396	Black Cuckoo
397	African Cuckoo
400	Little Swift
405	Senegal Coucal
406	White-browed Coucal
407	Barn Owl
462	Narina's Trogon
412	Spotted Eagle-Owl
414	Verreaux's Eagle Owl
417	Barred Owlet
419	Pearl-spotted Owlet
424	African Scops Owl
430	European Nightjar
436	Fiery-necked Nightjar
439	Freckled Nightjar
444	European Swift
445	Black Swift
447	White-rumped Swift
448	Horus Swift
518	Red-billed Hornbill
452	Palm Swift
454	Bohm's Spinetail
459	Speckled Mousebird
461	Blue-naped Mousebird
466	Malachite Kingfisher
472	Striped kingfisher
475	Woodland Kingfisher
478	Pygmy Kingfisher
480	Eurasian Bee-eater
481	Crested Barbet
490	Blue-cheeked Bee-eater
491	Little Bee-eater
578	Golden-tailed Woodpecker
496	Lilac-breasted Roller
497	European Roller
499	Racket-tailed Roller
500	Broad-billed Roller
502	African Hoopoe
505	Common Scimitarbill
508	Green Wood Hoopoe
515	Crowned Hornbill
517	Von der Decken's Hornbill
524	Grey Hornbill

528	Ground Hornbill
535	Red-fronted Barbet
539	Spot-flanked Barbet
546	Black-collared Barbet
549	Yellow-fronted Tinkerbird
552	Red-fronted Tinkerbird
557	d'Arnaud's Barbet
563	Greater Honeyguide
566	Lesser Honeyguide
569	Scaly-throated Honeyguide
573	Wahlberg's Honeybird
579	Bennett's Woodpecker
580	Little-spotted Woodpecker
580	Green-backed woodpecker
583	Nubian Woodpecker
585	Cardinal Woodpecker
594	Bearded Woodpecker
596	African Broadbill
605	Fischer's Sparrow-Lark
613	Fawn-coloured Lark
621	Flappet Lark
623	House Martin
624	Lesser Striped Swallow
630	Red-rumped Swallow
632	Rock Martin
634	Barn Swallow
636	Mosque Swallow
637	Wire-tailed Swallow
639	White-headed Roughwing
642	African sand martin
643	Sand Martin
644	Drongo
646	African Golden Oriole
649	Black-headed Oriole
651	European Golden Oriole
653	White-naped Raven
654	Pied Crow
661	White-bellied Tit
665	Miombo Grey Tit
666	White-winged Tit
667	Cinnamon-breasted Tit
667	Rufous-bellied Tit
668	Penduline Tit
680	Northern Pied Babbler
681	Arrow-marked Babbler
683	Black-lored Babbler
688	Black Cuckoo-Shrike
695	White-breasted Cuckoo-Shrike
710	Yellow-bellied Greenbul
716	Eastern Nicator
729	Northern Brownbul

732	Yellow-vented Bulbul
736	Brown-chested Alethe
738	Familiar Chat
744	White-browed Scrub Robin
747	Collared Palm Thrush
748	Spotted Morning Thrush
751	White-browed Robin Chat
767	Miombo Rock Thrush
775	Isabelline Wheatear
777	Northern Wheatear
779	Pied Wheatear
791	Ruaha Chat
792	Cliff Chat
798	Kurrachaine Thrush
799	Groundscraper Thrush
811	Sedge Warbler
818	Yellow-breasted Apalis
837	Grey-backed Camaroptera
854	Rattling Cisticola
857	Red-faced Cisticola
859	Tabora Cisticola
860	Winding Cisticola
866	Croaking Cisticola
873	Trilling Cisticola
878	Yellow-bellied Eremomela
880	Green-capped Eremomela
888	Olivaceous Warbler
891	Yellow-bellied Hyliota
899	Banded Parisoma
908	Willow Warbler
913	Tawny-flanked Prinia
919	Common Whitethroat
925	Red-faced Crombec
927	Grey Flycatcher
928	Pale Flycatcher
929	Silverbird
930	Semi-collared Flycatcher
935	Southern Black Flycatcher
938	Ashy Flycatcher
943	Miombo Wren Warbler
945	Spotted Flycatcher
951	Chin-spot Batis
968	Paradise Flycatcher
984	Tree Pipit
988	Yellow-throated longclaw
991	Pied Wagtail
999	Black-backed Puffback
1004	Tropical Boubou
1006	Slate-coloured Boubou
1012	Grey-headed Bush-Shrike
1019	Sulphur-breasted Bush Shrike

1020	Brubru
1022	Brown-crowned Tchagra
1025	Black-crowned Tchagra
1027	Magpie Shrike
1028	Long-tailed Fiscal Shrike
1029	Common Fiscal
1030	Red-backed Shrike
1034	Red-tailed Shrike
1041	Northern White-crowned Shrike
1043	White Helmet Shrike
1044	Grey-crested Helmet Shrike
1045	Retz's Helmet Shrike
1048	Violet-backed Starling
1051	Ashy Starling
1052	Wattled Starling
1055	Blue-eared Starling
1062	White-winged Starling
1074	Hildebrandt's Starling
1076	Superb Starling
1077	Yellow-billed Oxpecker
1078	Red-billed Oxpecker
1080	Collared Sunbird
1082	Western Violet-backed Sunbird
1084	Eastern Violet-backed Sunbird
1091	Amethyst Sunbird
1116	Beautiful Sunbird
1122	Scarlet-chested Sunbird
1128	Variable Sunbird
1133	Yellow White-eye
1135	Red-headed Weaver
1138	White-winged Widowbird
1141	Yellow Bishop
1144	Black Bishop
1148	Yellow-mantled Widowbird
1150	Southern Red- bishop
1165	Black-headed weaver
1170	Lesser Masked Weaver
1171	Golden-backed Weaver
1176	Black-necked Weaver
1180	Chestnut Weaver
1187	Vitteline Masked Weaver
1189	Holub's Golden Weaver
1193	Red-billed Quelea
1195	Red-billed Buffalo Weaver
1196	White-headed Buffalo Weaver
1197	Rufous-tailed Weaver
1201	Grey-capped Social Weaver
1204	House Sparrow
1204	Chestnut Sparrow
1206	Grey-headed Sparrow
1207	Rufous Sparrow

1208	Yellow-spotted Petronia
1210	Speckle-fronted Weaver
1215	Steel-blue Whydah
1216	Pin-tailed Whydah
1217	Broad-tailed Paradise Whydah
1218	Paradise Whydah
1219	Zebra Waxbill
1233	Crimson-rumped waxbill
1235	Peter's Twinspot
1239	African Firefinch
1241	Red-billed Firefinch
1255	Orange-winged Pytilia
1256	Green-winged Pytilia
1261	Red-cheeked Cordon-Bleu
1262	Blue-capped Cordonbleu
1263	Purple Grenadier
1266	Bronze Mannikin
1273	Golden-breasted Bunting
1290	Yellow-fronted Canary
1291	Stripe-breasted Seedeater
9052	Swahili Sparrow
9085	Ruaha Hornbill

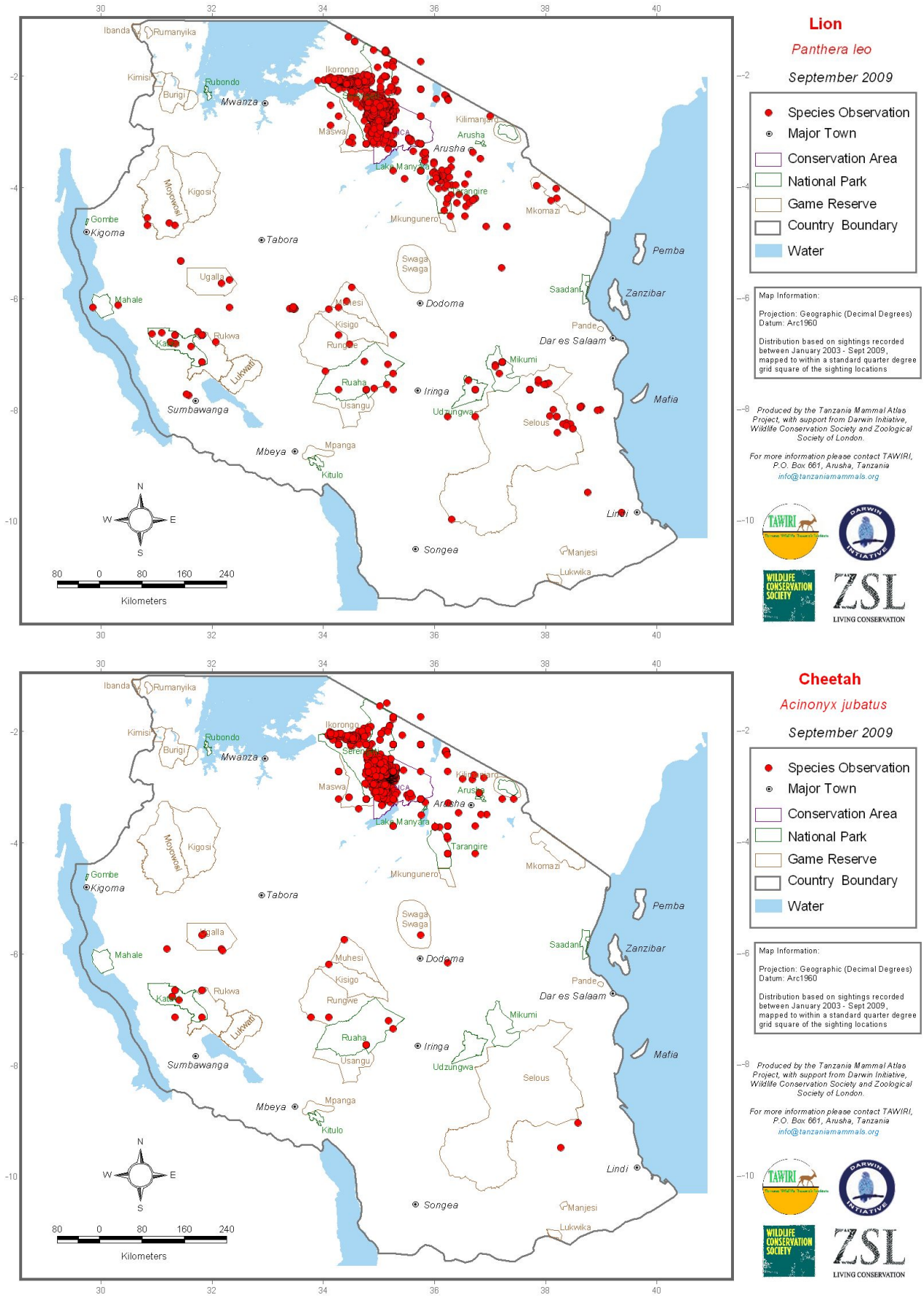
Appendix II. Species recorded on walking surveys in the Itulu Hills area, and their associations with feeding parties

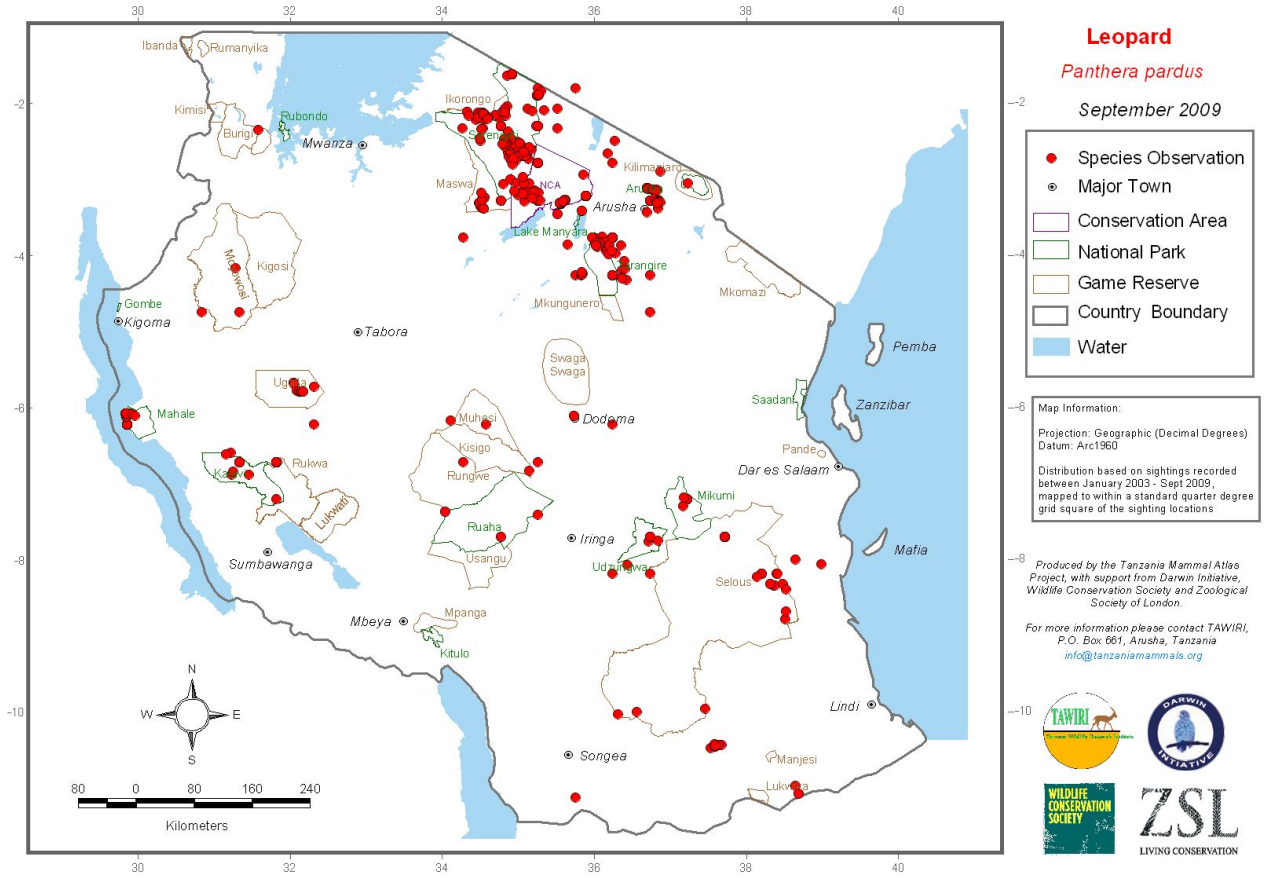
English Name (ABC Taxonomy* with additions for other common names / taxa in brackets)	Scientific Name	Records of each species	Records associating with feeding parties	Records not associating with feeding parties
Coqui Francolin	*Francolinus coqui*	2	0	2
African Green Pigeon	*Treron calvus*	1	0	1
Emerald-spotted Wood Dove	*Turtur chalcospilos*	4	1	3
Red-eyed Dove	*Streptopelia semitorquata*	2	0	2
Ring-necked Dove	*Streptopelia capicola*	10	4	6
Laughing Dove	*Streptopelia senegalensis*	1	0	1
Meyer's Parrot (Brown Parrot)	*Poicephalus meyeri*	6	1	5
Purple-crested Turaco	*Tauraco porphyreolophus*	1	0	1
Bare-faced Go-away Bird	*Corythaixoides personatus*	3	0	3
Jacobin Cuckoo (Black-and-white Cuckoo)	*Clamator jacobinus*	1	1	0
Levaillant's Cuckoo	*Clamator levaillantii*	1	1	0
African Cuckoo	*Cuculus gularis*	2	2	0
African Barred Owlet	*Glaucidium capense*	1	0	1
Woodland Kingfisher	*Halcyon senegalensis*	1	0	1
Racket-tailed Roller	*Coracias spatulatus*	3	0	3
Broad-billed Roller	*Eurystomus glaucurus*	1	0	1
Green Wood-hoopoe	*Phoeniculus purpureus*	9	9	0
Common Scimitarbill	*Rhinopomastus cyanomelas*	5	5	0
(African) Hoopoe	*Upupa epops (Africana)*	1	0	1
(Tananian) Red-billed Hornbill	*Tockus erythrorhynchus (ruahae)*	4	1	3
African Grey Hornbill	*Tockus nasutus*	1	1	0
Yellow-fronted Tinkerbird	*Pogoniulus chrysoconus*	2	2	0
Spot-flanked Barbet	*Tricholaema lachrymosa*	1	1	0
Black-collared Barbet	*Lybius torquatus*	1	0	1
Crested Barbet	*Trachyphonus vaillantii*	3	2	1
Brown-backed Honeybird	*Prodotiscus regulus*	1	1	0
Scaly-throated Honeyguide	*Indicator variegatus*	1	1	0
Greater Honeyguide	*Indicator indicator*	7	5	2
Bennett's Woodpecker	*Campethera bennettii*	3	3	0
Golden-tailed Woodpecker	*Campethera abingoni*	2	2	0
Green-backed Woodpecker (Little-spotted Woodpecker)	*Campethera cailliautii*	6	6	0
Cardinal Woodpecker	*Dendropicos fuscescens*	6	6	0
Bearded Woodpecker	*Dendropicos namaquus*	5	5	0
Black Cuckoo-Shrike	*Campephaga flava*	4	4	0
White-breasted Cuckoo-Shrike	*Coracina pectoralis*	8	8	0
Common Bulbul (Yellow-vented Bulbul)	*Pycnonotus barbatus*	6	2	4
White-browed Scrub-Robin	*Cercotrichas leucophrys*	2	0	2
Familiar Chat	*Cercomela familiaris*	1	0	1
Arnott's Chat (Ruaha Chat)	*Myrmecocichla arnottii (collaris)*	7	6	1
Miombo Rock-Thrush	*Monticola angolensis*	1	1	0

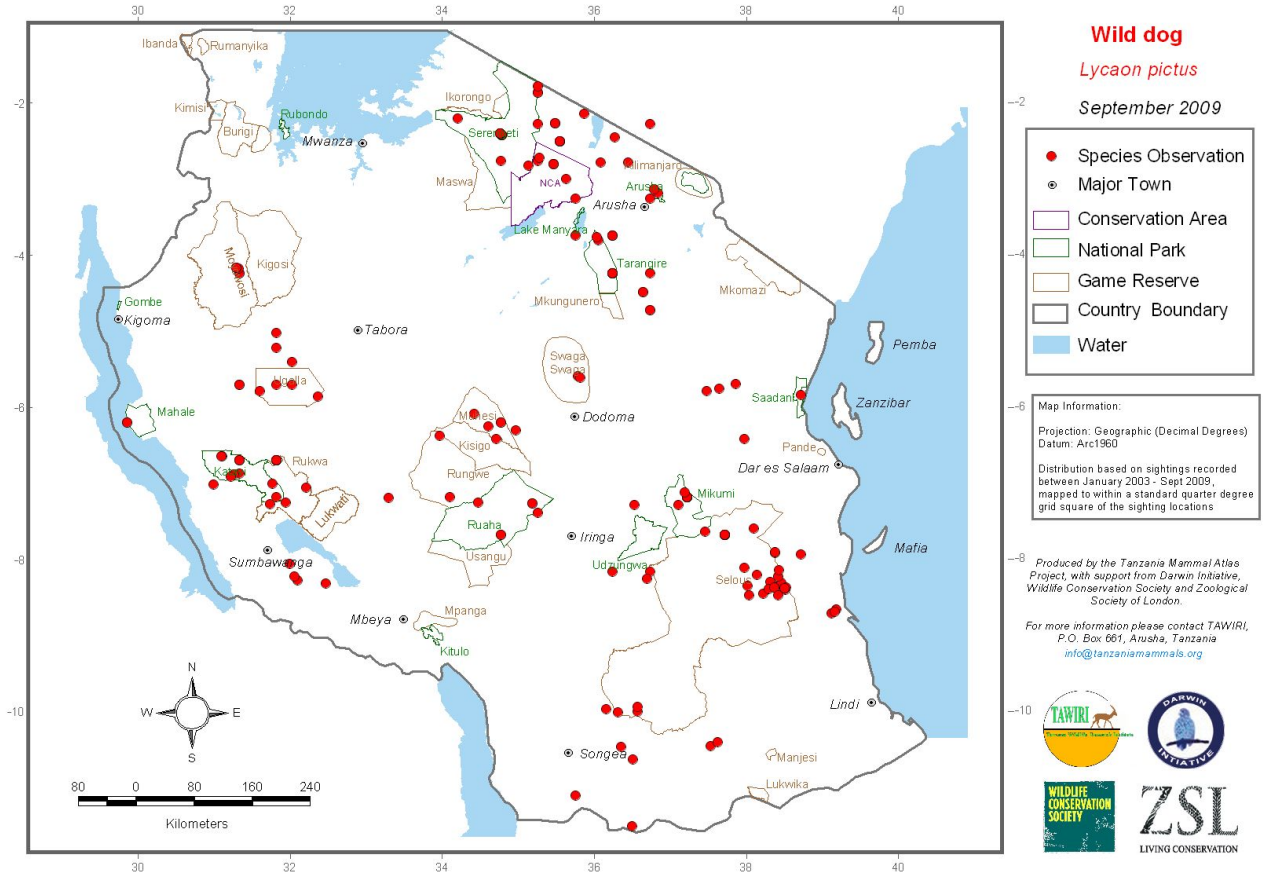
Kurrichane Thrush	*Turdus libonyanus*	9	5	4
Yellow-bellied Eremomela	*Eremomela icteropygialis*	1	1	0
Green-capped Eremomela	*Eremomela scotops*	9	9	0
Red-faced Crombec	*Sylvietta whytii*	2	2	0
Willow Warbler	*Phylloscopus trochilus*	5	5	0
Yellow-bellied Hyliota	*Hyliota flavigaster*	5	5	0
Trilling Cisticola	*Cisticola woosnami*	8	1	7
Tabora Cisticola	*Cisticola angusticauda*	3	2	1
Tawny-flanked Prinia	*Prinia subflava*	4	2	2
Green-backed Camaroptera	*Camaroptera brachyura*	2	0	2
Miombo Wren-warbler	*Calamonastes undosus*	3	1	2
Southern Black Flycatcher	*Melaenornis pammelaina*	1	1	0
Pale Flycatcher	*Bradornis pallidus*	1	1	0
Spotted Flycatcher	*Muscicapa striata*	1	0	1
Ashy Flycatcher	*Muscicapa caerulescens*	2	0	2
Semi-collared Flycatcher	*Ficedula semitorquata*	1	1	0
African Paradise-Flycatcher	*Terpsiphone viridis*	4	2	2
Chinspot Batis	*Batis molitor*	6	5	1
Arrow-marked Babbler	*Turdoides jardineii*	1	1	0
Sharpe's Pied Babbler (Black-lored Babbler)	*Turdoides sharpei*	1	0	1
Miombo (Grey) Tit	*Parus griseiventris*	2	2	0
White-bellied Tit	*Parus albiventris*	7	7	0
Rufous-bellied Tit (Cinnamon-breasted Tit)	*Parus rufiventris (pallidiventris)*	2	2	0
Grey Penduline Tit (African Penduline Tit)	*Anthoscopus caroli*	3	3	0
Western Violet-backed Sunbird	*Anthreptes longuemarei*	3	3	0
Amethyst Sunbird	*Chalcomitra amethystina*	6	5	1
Scarlet-chested Sunbird	*Chalcomitra senegalensis*	2	0	2
Collared Sunbird	*Hedydipna collaris*	1	0	1
Marico Sunbird	*Cinnyris mariquensis*	1	1	0
susp. Jameson's Firefinch	*Lagonosticta rhodopareia*	1	0	1
susp. Miombo Scrub-Robin	*Cercotrichas barbata*	1	0	1
Northern White-crowned Shrike	*Eurocephalus rueppelli*	2	2	0
Grey-headed Bush-Shrike	*Malacanotus blanchoti*	1	0	1
Brown-crowned Tchagra	*Tchagra australis*	1	0	1
Black-crowned Tchagra	*Tchagra senegalus*	6	6	0
Black-backed Puffback	*Dryoscopus cubla*	11	6	5
Slate-coloured Boubou	*Laniarius funebris*	3	1	2
Brubru	*Nilaus afer*	2	2	0
White Helmet-Shrike	*Prionops plumatus*	8	7	1
Retz's Helmet-shrike	*Prionops retzii*	2	2	0
Eastern Black-headed Oriole	*Oriolus larvatus*	7	3	4
African Golden Oriole	*Oriolus auratus*	4	2	2
Eurasian Golden Oriole	*Oriolus oriolus*	2	2	0
Fork-tailed Drongo	*Dicrurus adsimilis*	11	7	4
Babbling Starling (White-winged Starling)	*Neocichla gutturalis*	7	7	0

Red-headed Weaver	*Anaplectes rubriceps*	6	6	0
White-winged Widowbird	*Euplectes albonotatus*	1	1	0
Red-cheeked Cordon-Bleu	*Uraeginthus bengalus*	8	6	2
Orange-winged Pytilia	*Pytilia afra*	1	0	1
Golden-breasted Bunting	*Emberiza flaviventris*	4	3	1

Appendix III: Mammal Distribution Maps




Leopard
Panthera pardus
September 2009
Species Observation
Major Town
Conservation Area
National Park
Game Reserve
Country Boundary
Water
Map Information:
Projection: Geographic (Decimal Degrees)
Datum: Arc1960
Distribution based on sightings recorded between January 2003 - Sept 2009, mapped to within a standard quarter degree grid square of the sighting locations
Produced by the Tanzania Mammal Atlas Project, with support from Darwin Initiative, Wildlife Conservation Society and Zoological Society of London.
For more information please contact TAWIRI, P.O. Box 661, Arusha, Tanzania
info@tanzaniamammals.org
Ibanda
Rumanyika
Kimisi
Burigi
Rubondo
Mwanza
Ikorongo
Serengeti
Maswa
NCA
Arusha
Kilimanjaro
Lake Manyara
Tarangire
Mkungunero
Mkomazi
Kigosi
Moyowosi
Gombe
Kigoma
Tabora
Swaga Swaga
Pemba
Zanzibar
Saadani
Dodoma
Muhesi
Kisigo
Rungwe
Mahale
Rukwa
Lukwati
Ruaha
Usangu
Iringa
Mikumi
Pande
Dar es Salaam
Udzungwa
Selous
Mafia
Sumbawanga
Mbeya
Mpanga
Kitulo
Lindi
Songea
Manjesi
Lukwika
N
W
E
S
80 0 80 160 240
Kilometers
30 32 34 36 38 40
-2 -4 -6 -8 -10


Wild dog
Lycaon pictus
September 2009
Species Observation
Major Town
Conservation Area
National Park
Game Reserve
Country Boundary
Water
Map Information:
Projection: Geographic (Decimal Degrees)
Datum: Arc1960
Distribution based on sightings recorded between January 2003 - Sept 2009, mapped to within a standard quarter degree grid square of the sighting locations
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Lake Manyara
Tarangire
Mkungunero
Mkomazi
Kigosi
Moyowosi
Gombe
Kigoma
Tabora
Swaga Swaga
Pemba
Zanzibar
Saadani
Dodoma
Muhesi
Kisigo
Rungwe
Mahale
Rukwa
Lukwati
Ruaha
Usangu
Iringa
Mikumi
Pande
Dar es Salaam
Udzungwa
Selous
Mafia
Sumbawanga
Mbeya
Mpanga
Kitulo
Lindi
Songea
Manjesi
Lukwika
N
W
E
S
80 0 80 160 240
Kilometers
30 32 34 36 38 40
-2 -4 -6 -8 -10

Appendix IV – Camera Trap Locations

CAMERA TRAP 1: GPS LOCATIONS

Species	Date	Latitude	Longitude	Habitat
Blotched Genet	23 Jan 2011	05.22711	034.17813	Miombo
none	24 Jan 2011	05.55439	033.98627	Miombo
none	25 Jan 2011	06.10612	033.86837	Miombo
Side Striped Jackal Common Genet	26 Jan 2011	06.03714	033.75803	Miombo
Common Genet	28 Jan 2011/site 1	06.02779	033.65542	Miombo
Common Genet	28 Jan 2011/site 2	05.99634	033.59287	Miombo
Meller's Mongoose White Tailed Mongoose	29 Jan 2011	05.86925	033.38686	Miombo
Spotted Hyaena White Tailed Mongoose	30 Jan 2011	06.31078	033.03162	Miombo
Miombo Genet	1 Feb 2011	05.80139	033.03967	Miombo/Anthropic

CAMERA TRAP 2: GPS LOCATIONS

Species	Date	Latitude	Longitude	Habitat
none	23 Jan 2011	05.22800	034.17966	Miombo/Riverine
none	24 Jan 2011	05.55404	033.98590	Miombo
none	25 Jan 2011	06.10642	033.86910	Miombo
Side Striped Jackal	26 Jan 2011	06.03699	033.75.939	Miombo
none	28 Jan 2011/site 1	06.02978	03.65566	Miombo
none	28 Jan 2011/site 2	05.99676	033.59313	Miombo
White Tailed Mongoose	30 Jan 2011	05.86568	033.38837	Miombo
none	1 Feb 2011	05.80119	033.03817	Miombo/Anthropic

Appendix 5 – CAMERA TRAP PICTURES

Blotched Genet

Common Genet

Side Striped Jackal

Meller's Mngoose

Brown Spotted Hyaena

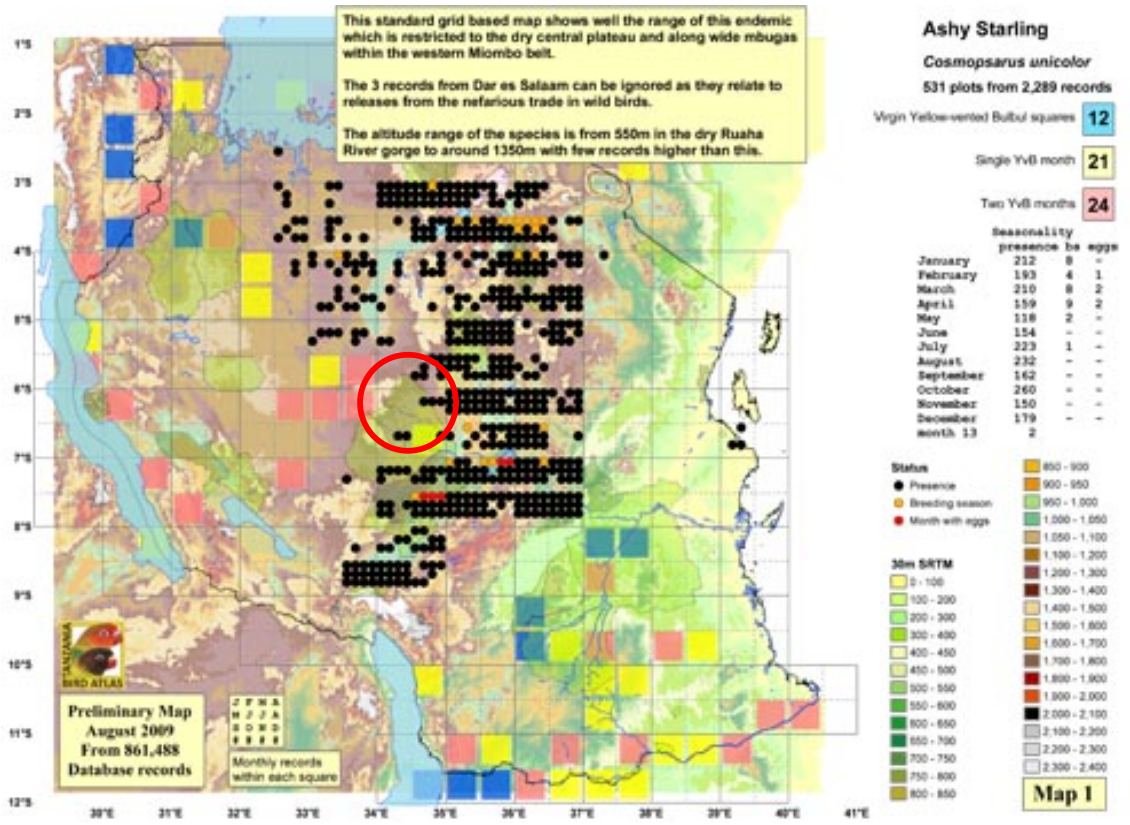
White Tailed Mongoose

Miombo Genet

Appendix VI – Sample Bird Atlas Information for selected species

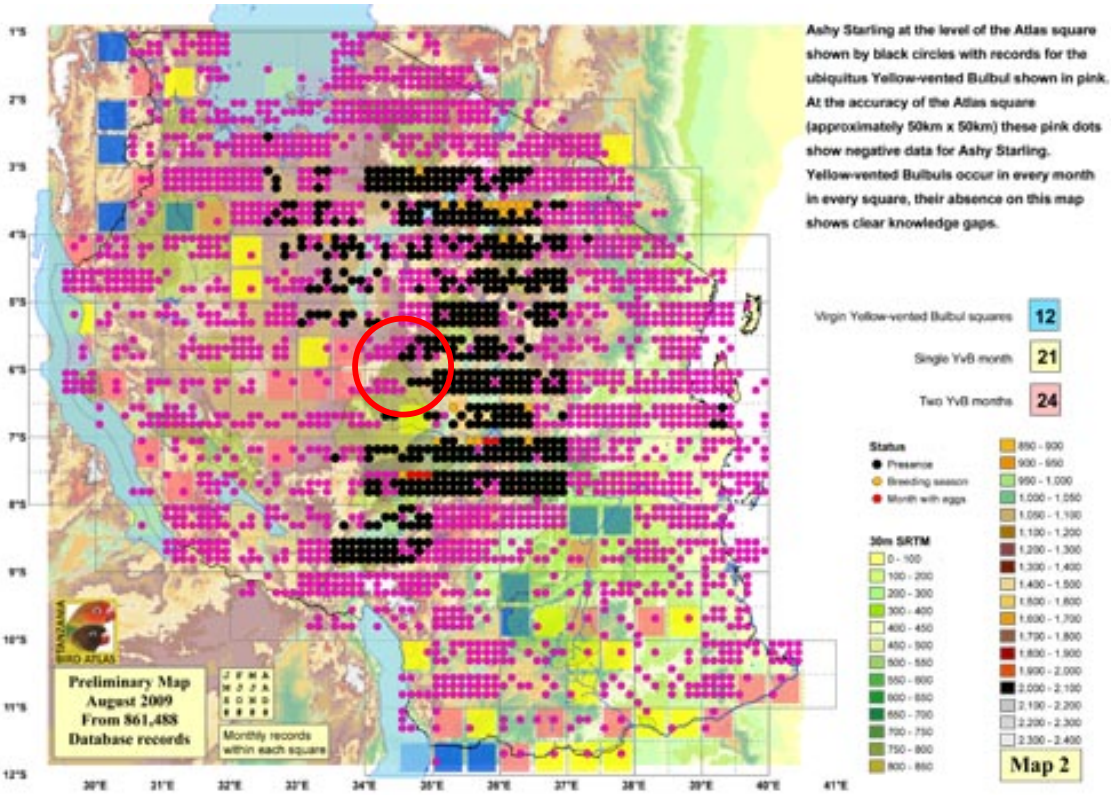
The example maps are based around the distribution of the Ashy Starling *Cosmopsarus unicolor* which is endemic to Tanzania yet often locally common and quite widespread. It is an easy bird to find and identify allowing some confidence when discussing NEGATIVE DATA.

MAP 1 : The standard grid based Atlas distribution of Ashy Starling



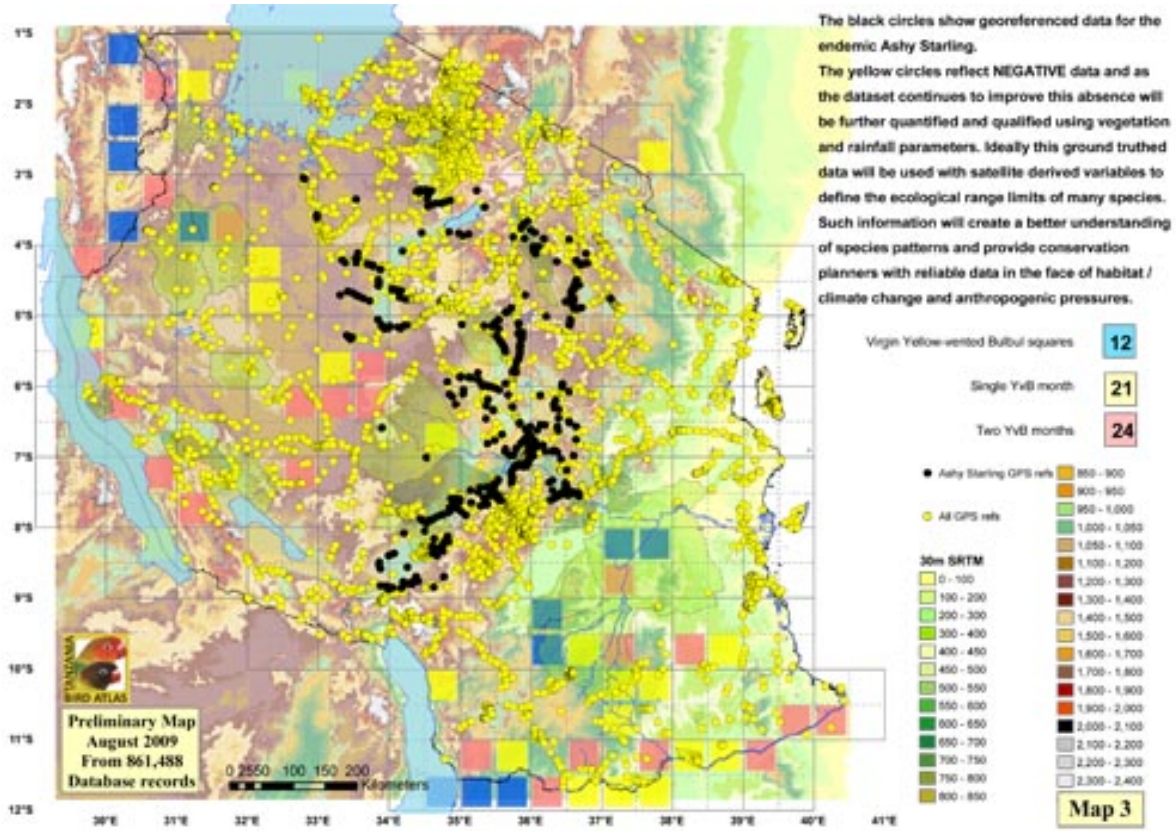
Within each atlas square the 12 dots represent the months of the year from January to December (there is also a month 13, the explanation for which must wait). Thus, at a glance, the reader can see the quality of coverage for the square. In resident species such as this starling this only shows coverage. In migrant species it is indicative of seasonality. The orange dots represent breeding season and the red dots months with eggs in the nest. Combined these show the extent of and the peak (or indeed, peaks) in the breeding season. The table shows seasonality with the total number of records per month. This map shows well the range of the species and the quality of coverage BUT THAT IS ALL IT SHOWS. This then was the basic aim of the Atlas when it was conceived in the late 1970s. However, there is far more valuable information to be gained from long term monitoring, the use of georeferenced data and the use of NEGATIVE DATA. All would agree that it is far easier to record the presence of a species than its absence especially if one is not so far away from where the species is known to occur.

MAP 2 : The standard grid based Atlas distribution of Ashy Starling and Yellow-vented Bulbul.



The Yellow-vented Bulbul *Pycnonotus barbatus* is the most widespread species in Tanzania. It occurs in every square in every month. Lack of data for this species in any month in any square is indicative of poor / no coverage. The presence of this species in any month in any square is indicative of a visit to that square in that month. When combined with presence for a well known data produces a map that suggests NEGATIVE DATA for the species one is concerned with. As the Atlas database continues to grow and eliminates all the YvB month gaps the reliability of this NEGATIVE DATA will increase.

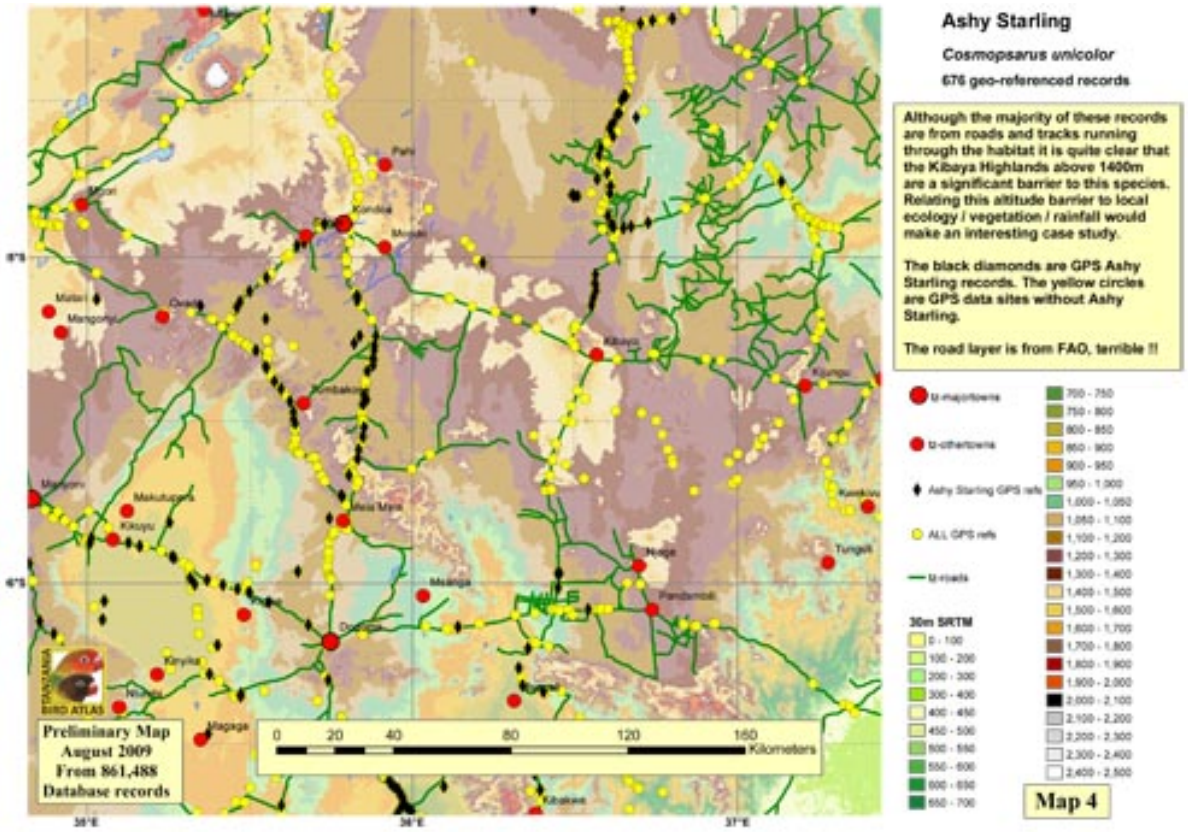
MAP 3 : Georeferenced data for ALL sightings combined with georeferenced data for Ashy Starling.



The use of geo-referenced data, all species observed within 500m of a GPS location, has revolutionised the quality of data being collected for the Atlas. Combined with altitude and vegetation profiles this data will provide accurate habitat usage within the range of the species. Understanding this area of occupancy for any species is of the utmost importance in defining status, trends and threats. Using this ground-truthed data with satellite derived variables will enable computer modelling of species habitat requirements. Essential for understanding the ecological requirements of the rarer, most threatened species.

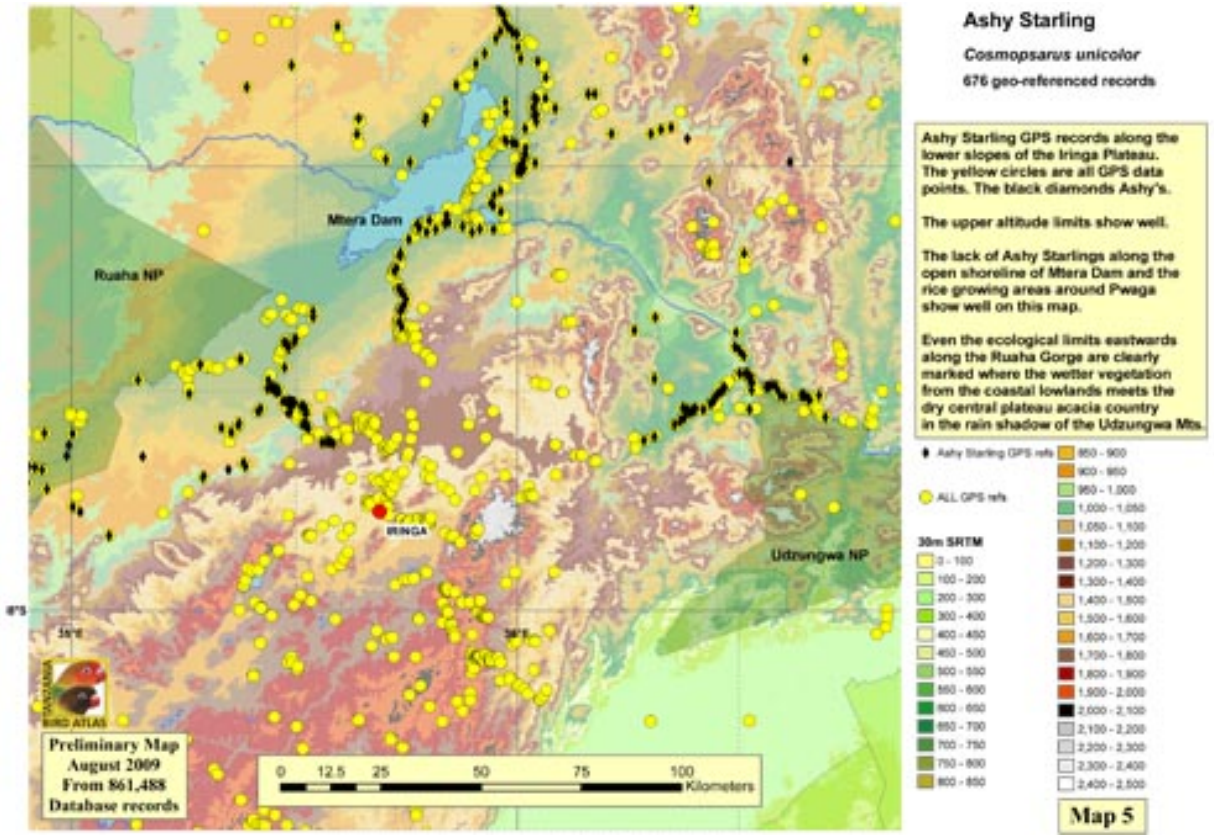
The yellow circles on this map represent all the GPS data entered in the Atlas. Some of these locations are for single records of single species (all sightings of diurnal raptors are geo-referenced) so some care and analysis is required to present these spots as NEGATIVE DATA for Ashy Starling. At this scale the spots are far larger than the actual data collection parameter of a radius of 500m and often blend together to obscure potentially important information. Fortunately ARCGIS with the latest 30m SRTM data allows the use of finer scales that reveal movement barriers for species with restricted altitudinal distributions.

MAP 4 : The Kibaya Ridge, a barrier to the movement of Ashy Starlings



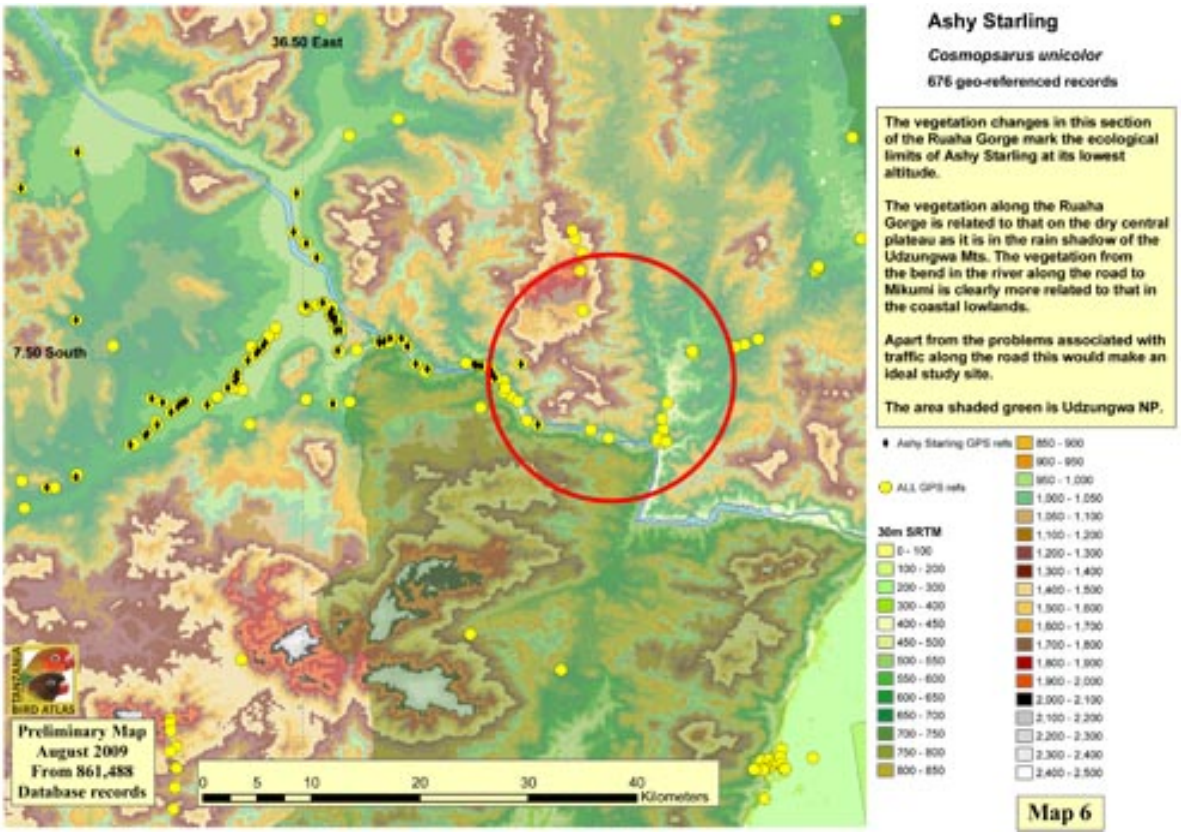
The high ground of the Crater Highlands flows south through the Mbulu Plateau towards Singida with an offshoot of hills SE through Kibaya on the very edge of the Masai Steppe. This high ground above 1400m is currently (we do not know what the situation was even a few hundred years ago let alone hundreds of thousands of years ago) a significant barrier to the movement of Ashy Starlings and effectively creates 3 isolated populations. In this finer scale map the Kibaya Ridge is seen as an effective barrier but it is possible that further fieldwork in the lower altitude reaches of the ridge will provide evidence of movement, at least seasonally, such as post breeding dispersal. It is also possible, even likely, that historically the range of this bird extended further east around the eastern base of these hills and that the isolation of the NE population is quite recent.

MAP 5 : Ashy Starling distribution at the base of the Iringa Highlands.



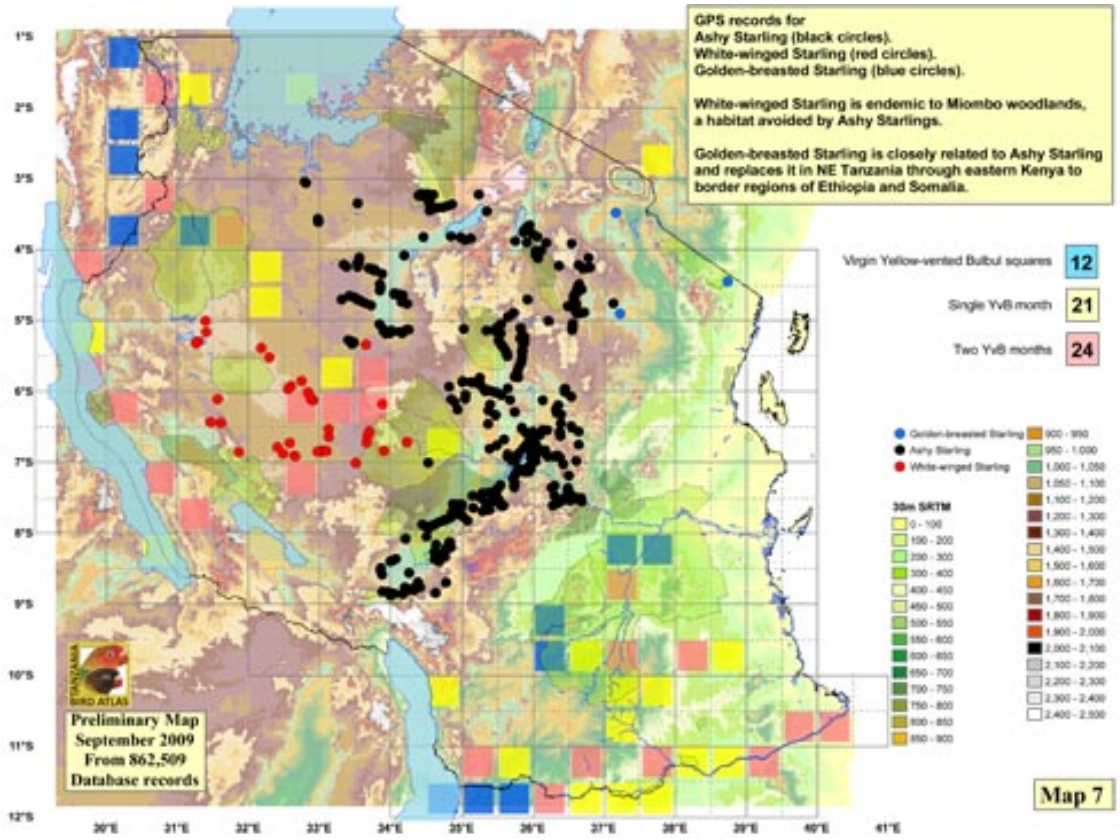
Although much of these data are related to records along roads the altitudinal limits of Ashy Starling are clearly shown. It is totally absent from the Iringa Plateau. Along the road north to Dodoma the highest record is just into the woodland on the escarpment at 1130m. Along the road west to Pawaga it occurs as high as 1345m where the drier woodland is at a higher altitude in the rain shadow of the Udzungwa Mts. At the base of the Kitonga Gorge it occurs no higher that 725m.
This map also shows it absent along the shore of Mtera Dam where at low water the open grassland covers several km2. Interestingly at this scale it is also shown absent from the rice fields near Pawaga although it occurs in the dry acacia country on the fringes of the rice.

MAP 6 : Ashy Starling distribution in the Ruaha Gorge at the eastern limits of its range.



At an even finer scale the distribution limits become even more interesting. The main road through the Ruaha Gorge drops altitude rather gradually as it proceeds eastwards before turning through the hills towards Mikumi at the point where the river turns south to flow into Kidatu Dam. Before the road reaches this junction, Ashy Starlings drop out of the avifauna. Several visits are required to create a more exact limit than shown here and to establish any seasonality to these limits. In particular more breeding records are required and closer observations of any association with vegetation types, in particular the larger trees. The most easterly record is at an altitude of only 505m, the lowest this bird is known from.

MAP 7 : The western and north-eastern ecological limits of the Ashy Starling with respect to habitat and sister species.



Within its range the Ashy Starling has no close relative that could be seen as a competitor for such resources as food and nest sites. There are only 2 members of the genus Cosmopsaurus, the other being the Golden-breasted Starling *C. regius* (although both are sometimes lumped in the larger genus Lamprotornis, Fry & Keith 2000). The latter occurs in even drier country extending southwards from border regions of Ethiopia and Somalia through lowland eastern Kenya to its southern limits in NE Tanzania. It is not a common bird in Tanzania and has been subjected to much persecution by the trade in wild birds. Its ecological niche appears confined to the north-eastern fringes of the Masai Steppe and the drier parts of the middle Pangani Valley through Mkomazi NP into Tsavo West NP. There are only 3 geo-referenced records in the Atlas database and one of these is quite recent from the Kitwei Plain where it is very close to the most easterly record of Ashy Starling, which is the only record east of 37º East. However the near presence of this potential competitor does not explain the very real eastern limits of Ashy Starling on the Masai Steppe. The southern limits are easily understood as this species occurs throughout the acacia zone on the Usangu

Flats where these abut the volcanic uplands of the Mbeya Range and the Kipengere and Poroto Mts. The western limits are also quite well understood in that the Ashy Starling does not occur in Miombo woodland. While not considered a competitor of Ashy Starling the White-winged Starling *Neocichla gutturalis* is endemic to Miombo and the geo-referenced locations shown on this map clearly indicate a range quite separate to that of Ashy Starling. While these 2 species may never actually meet they could conceivably occur together when feeding on termite alles where acacia dominated floodplain habitat fringes on Miombo woodland, especially in the catchment of the Wembere Steppe.

In summary the Bird Atlas continues to provide new insights into our understanding of the distribution of birds throughout Tanzania. The data gathered by the volunteer observers continues to provide Government, International Agencies, Scientists, Conservation managers and others with useful and sometimes vital information on the status of many species.

The Atlas website, blog and email group provide a constant source of new data and are updated on a regular basis.

CONSULTANTS

Mammal specialist - *Alessandra Soresina*

Alessandra has worked on a number of wildlife projects around the world. In Saadani Game Reserve in Southern Tanzania, she was involved in a mammal monitoring project which led to Saadani being upgraded to a National Park. In 2001 she setup the lion project in Tarangire National Park, northern Tanzania, and for over 5 years Alessandra has concentrated her efforts on lion – human interactions. In this time she has made a huge contribution to what is known about lions in and around the Tarangire ecosystem. One of her major goals was implementing the radio-tracking program in Tarangire, which has allowed conservationists and national park management to fully understand Lion movements in the Tarangire ecosystem. After setting up a snow leopard project in the Himalayas with the Università degli Studi di Siena, she is now involved in a mammal monitoring project in Mozambique which is essential to the implementation of new protected areas.

Bird Specialist - *Marc Baker*

Marc is the owner and director of Ecological Initiatives Ltd, a Tanzanian company working on supporting forestry and wildlife conservation in Tanzania. Based in Arusha, Marc has worked in conservation and ecotourism since 1998. Initially as an ornithologist for the United Nations Development Program – Global Environmental Fund cross border biodiversity project from 1998 – 2000 conducting a range of biodiversity surveys in Tanzania and Kenya. As a wildlife specialist Marc works on a wide variety of ecological issues, such as wildlife management, out of protected area tourism viability and carbon forestry for Danida (Danish Development Agency), Care International, the Wildlife Division of Tanzania and the Tanzania bird atlas.