Tanzania Forest Conservation Group
Shirika la Kuhifadhi Misitu ya Asili Tanzania

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TANZANIA FOREST CONSERVATION GROUP

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FILLING THE KNOWLEDGE GAP: SURVEYS OF POORLY KNOWN SITES AND SPECIES IN THE EASTERN ARC AND COASTAL FORESTS OF TANZANIA

METHODS MANUAL

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Executive summary

This manual documents the methods being used for the biodiversity survey project 'Filling the Knowledge Gap: Surveys of Poorly Known Sites and Species of the Eastern Arc and Coastal Forests of Tanzania.' This is a partnership project between the Tanzania Forest Conservation Group (TFCG) and the Museo Tridentino di Scienze Naturali (MTSN). The project is financed by the Critical Ecosystem Partnership Fund, a joint initiative between Conservation International, the Global Environmental Facility, World Bank, Government of Japan and MacArthur Foundation.

The surveys aim to document the biodiversity values of some of the less known sites and taxa in the Eastern Arc and Coastal Forests of Tanzania.

The surveys will be conducted between October 2005 and December 2007 and will focus on the North Pare, the Udzungwa, the Rubeho (in Dodoma Region) and Nguu Mountain forests in the Eastern Arc as well as selected coastal forests in Tanga, Lindi and Coast regions. The surveys will focus on mammals (especially primates, forest antelopes, sengis, hyraxes and carnivores), birds, reptiles and amphibians. Levels of forest disturbance will also be recorded.

In order to ensure that the surveys include a representative selection of habitat types, precise sample sites will be selected on the basis of elevation and vegetation type using a combination of 1:50,000 maps, satellite images, a review of available literature and consultation with local residents.

Primates (nocturnal and diurnal), forest antelopes, hyraxes, sengis and carnivores will be surveyed by transect walks and camera trapping. For nocturnal and crepuscular mammals (particularly galagos and hyraxes) vocalisations will be recorded for comparison with a reference sound library and Chardonneret traps will be used to live-trap galagos and palm civets for photographing and recording biometrics.

At selected sites, pitfall traps with drift fences and Sherman traps will be used to sample small mammals.

Reptiles and amphibians will be surveyed by visual encounter surveys, acoustic sampling and pitfall traps. The Visual Encounter Survey (VES) will be used to document the presence of amphibians and reptiles while pitfall traps will also contribute to assessments of species abundance.

Birds will be surveyed using a combination of mist netting and observations. All birds caught in mist nets will be measured according to standard methods and identified using field guides.

Systematic records of forest disturbance will be carried out in order to assess rates of human disturbances such as pole cutting, timber extraction, pitsaws and traps.

In each area to be visited by the survey team, interviews will be conducted with the villagers who live adjacent to the forests for the presence and abundance of animals in the forests.

The project will provide the results of these surveys to the Tanzanian National Biodiversity Database, the CEPF Outcomes Database, the relevant IUCN SSC Specialist Group and the Forestry and Beekeeping Division of the Ministry of Natural Resources and Tourism. Reports will also be available online from the TFCG website www.tfcg.org.

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Tanzania Forest Conservation Group
The Tanzania Forest Conservation Group (TFCG) is a Tanzanian non-governmental organisation that has been promoting the conservation of Tanzania's forests since 1985. TFCG's mission is to conserve and restore the biodiversity of globally important forests in Tanzania for the benefit of present and future generations. We will achieve this through capacity building, advocacy, research, community development and protected area management, in ways that are sustainable and foster participation, cooperation and partnership.

TFCG supports field based projects promoting participatory forest management, environmental education, community development, advocacy and research in the Eastern Arc and Coastal Forests. TFCG also supports a community forest conservation network that facilitates linkages between communities involved in participatory forest management. To find out more about TFCG please visit our website www.tfcg.org

TFCG is a partner in the Filling the Knowledge Gap project.

Museo Tridentino di Scienze Naturali
The Museo Tridentino di Scienze Naturali (MTSN), founded in 1922, is an Italian institution dedicated to conservation, education and research in natural sciences. The mission of the MTSN is to promote knowledge and conservation of the mountainous environment through the transfer of up-dated information to a wide audience. The MTSN promotes both its own research activity and the connections with national and international universities and research centers.

MTSN has been conducting research in the Eastern Arc Mountains of Tanzania since 1998. MTSN also supports an community conservation project in the Udzungwa Mountains.

MTSN is a partner in the Filling the Knowledge Gap project.

Critical Ecosystem Partnership Fund
The Critical Ecosystem Partnership Fund (CEPF) is a joint initiative of Conservation International, the Global Environment Facility, the Government of Japan, the John D. and Catherine T. MacArthur Foundation and the World Bank. Conservation International administers the fund. CEPF provides strategic assistance to nongovernmental organizations, community groups and other civil society partners to help safeguard Earth's biodiversity hotspots. A fundamental goal is to ensure civil society is engaged in biodiversity conservation. The partnership invests in biodiversity hotspots, Earth's biologically richest and most threatened areas. CEPF focuses on hotspots in the developing world and strategically targets priority areas in the hotspots for maximum impact.

The Critical Ecosystem Partnership Fund is currently investing US$ 7 million in the Eastern Arc and Coastal Forests of Kenya and Tanzania.

CEPF is financing the Filling the Knowledge Gap project.

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1) Introduction

By Nike Doggart

1.1 Background to the project

The project 'Filling the Knowledge Gap: Surveys of Poorly Known Species and Sites in the Eastern Arc and Coastal Forests of Tanzania', is a partnership between the Tanzania Forest Conservation Group (TFCG) and the Natural History Museum of Trento (MTSN), Italy. The project is financed by the Critical Ecosystem Partnership Fund (CEPF). The project focuses on increasing the knowledge of the vertebrate biodiversity of the Tanzanian Eastern Arc Mountains with a particular focus on four isolated montane forest sites (the North Pare, Udzungwa, Rubeho and Nguu Mountains) as well as selected coastal forests in Tanga, Coast and Lindi regions. The taxonomic focus of the project is on vertebrates, particularly primates, hyraxes, sengis, carnivores, forest antelopes, birds, amphibians, and reptiles. The project is being implemented by a team of specialists from TFCG and MTSN with guidance from eight project advisors.

1.2 Report structure

This manual outlines the methods being used used by the TFCG and MTSN survey teams. The report is arranged by taxa with separate chapters for diurnal primates, forest antelopes and carnivores; nocturnal / crepuscular primates; sengis; rodents and shrews; reptiles and amphibians; and birds. There are also chapters on disturbance surveys, data management and indigenous knowledge. The report is designed as a reference manual for those working on the project in the field as well as a means of sharing information about the project with other researchers working in the Eastern Arc and Coastal Forests.

1.3 Methods selection

The methods that the project team are using have been selected on the basis of a number of considerations. The project has aimed to use methods that are considered to be 'best practice' and that will generate data that will be of greatest relevance to IUCN SSC Specialist groups; to the Ministry of Natural Resources and Tourism's Forestry and Beekeeping Division or other relevant protected area authority; and to regional biodiversity monitoring initiatives such as the monitoring scheme led by BirdLife International with finance from CEPF. As such many of the methods aim to be comparable with other surveys in the area such as those led by Frontier-Tanzania, by the Conservation and Management of the Eastern Arc Mountain Forests and by the Chicago Field Museum.

1.4 Survey sites

Between October 2005 and December 2007, the survey team will visit the North Pare, Udzungwa, Rubeho and Nguu Mountains and selected Coastal Forest sites. These sites were selected on the basis of gaps in available data for the focus taxa. According to current knowledge, of the 97 vertebrate species endemic to the Eastern Arc, there are five Eastern Arc endemic species in the North Pare Mountains; 14 in the Rubeho Mountains and 31 in the Udzungwas (Doggart et al. 2005). The surveys aim to confirm the continued presence of these species as well as documenting the presence of other Eastern Arc endemic species, not previously known from these areas.

The North Pare Mountains, which are found in Mwanga District, Kilimanjaro region, contain three Forest Reserves (Kindoroko, Minja and Mramba). The elevation of the North Pare Mountains ranges from 500 - 2113 m a.s.l. The team will visit each of the gazetted forest reserves.

The Rubeho Mountains are found in Kilosa District, Morogoro Region and in Mpwapwa District, Dodoma region. The Rubeho mountains include five Forest Reserves of which two are in Kilosa District (Pala-Ulanga, Ukwiva) which total more than 66,316 ha and three are in Mpwapwa District (Mafwomero, Mang'alisa, Wota) which total 9,249 ha. Kiboriani Forest Reserve is also in Mpwapwa District and includes 56,000 ha of woodland with Eastern Arc forest and grassland habitats at higher altitudes. The surveys will visit Mang'alisa and Mafwomero Forest Reserves in Mpwapwa District. CEPF is also financing Frontier-Tanzania to undertake biodiversity surveys in the Rubeho Mountains of Kilosa District.

The Udzungwa Mountains are the largest of the Eastern Arc Mountain blocks. The study will focus on the southern forests within Mufindi District. Although relatively well studied the Udzungwa Mountains have been included because new taxa continue to be discovered in this area and because the Udzungwa forests in Mufindi District are less well-known. The survey team will visit Kigogo, Kidegemsitu, Udzungwa Scarp, S.W Matundu, Lulanda and Ikaning'ombe Forest Reserves.

The survey team will also conduct targeted surveys for selected taxa in the Nguu Mountains (Nguru North, Kilindi and Derema Forest Reserves) and the Eastern Udzungwas (Udzungwa Mountains National Park, Magombera Forest and the Udzungwa Scarp and West Kilombero Scarp Forest Reserves). Primates, forest antelopes, sengis, hyrax, reptiles and amphibians are of particular interest in these areas.

The Coastal Forests of Eastern Africa are discontinuous from the Kenya–Somali border to the Tanzania–Mozambique border. Most of these forests are at elevations between 0 - 500 m a.s.l but may extend to a maximum of 1100 m a.s.l depending on ecological conditions (Burgess *et al*. 2000).

In Tanzania, there are 66 forest patches covering an area of 700 sq. km (Burgess *et al*. 2000). Notwithstanding the small area covered by these forests, they retain high numbers of endemic animal species: five birds, three mammals, 24 reptiles, and five amphibians. Priority forests to be visited by the survey team include: Rondo, Chitoa, Litipo, Ruawa and Ndimba Forest Reserves in Lindi Region; Msumbugwe, Kilulu Hill and Genda Genda Forest Reserves in Tanga Region and Ngumburuni and Namakutwa in Coast Region.

2) Project purpose

The purpose of the 'Filling the Knowledge Gap' project, as outlined in the project document agreed with CEPF, is that:

'Protected area authorities, conservation organisations and other stakeholders within the Eastern Arc and Coastal Forests are planning and implementing conservation activities using current, relevant and accurate information on the status of selected sites and species'.

The project has three outputs:

- ❖ Vertebrate biodiversity and habitat condition is documented for selected forests in the North Pare, Udzungwa and Rubeho Mountains.

- ❖ Field data on the status of sengi, galago, duiker, hyrax and selected amphibian and reptile species gathered and contributing to redlist re-assessments by relevant IUCN-SSC specialist groups and hotspot monitoring processes.

- ❖ The capacity of civil society organisations and protected area authorities to conserve and monitor the unique species and forests of the Eastern Arc and Coastal Forests is enhanced.

The projects overall objectives are

- To conduct field surveys of the vertebrate fauna and habitat condition for selected forests in the North Pare, Udzungwa and Rubeho (Dodoma-side) Mountains.
- To address key gaps in our knowledge of the distribution and conservation status of diurnal primates, duikers, galagos, sengis (elephant-shrews), tree hyraxes, selected amphibians (bufonids and microhylids) and reptiles across the Eastern Arc and Coastal Forests of Tanzania.
- To provide data on the distribution and relative abundance of duikers, galagos, diurnal primates, sengis, tree hyraxes, selected amphibians (bufonids and microhylids) and reptiles to the relevant IUCN-SSC Specialist Groups.
- To clarify the phylogeny of two key Eastern Arc amphibian taxa: bufonids and microhylids through genetic analyses.
- To share survey data with the BirdLife-led hotspot monitoring process, the Forestry and Beekeeping Division (including CMEAMF) and the CEPF Outcomes database.
- To document indigenous knowledge on diurnal primates, duikers, galagos, sengis and tree hyrax.
- To train protected area authority staff in monitoring and survey techniques.
- To train members of local communities in monitoring techniques.

For each taxa there are more specific objectives relating to the research priorities identified during the development of the project. These are outlined under the relevant sections of this report.

3) Methods for surveying diurnal primates, forest antelopes and carnivores

By Francesco Rovero

3.1 Background and research priorities

Seven species of diurnal primate, five species of forest antelope and an unknown number of species of carnivores (26 species confirmed for the Udzungwa Mountains) are found in the Eastern Arc Mountains. Among the primates, three species are Udzungwa-endemic (Sanje mangabey *Cercocebus sanjei* and Udzungwa red colobus *Procolobus gordonorum*) or near endemic (Highland mangabey *Rungwecebus kipunji*). Among the forest antelopes, Abbott's duiker *Cephalophus spadix* is endemic to a few forest blocks in Tanzania that are found mainly in the Eastern Arc Mountains. Among the carnivores, the Lowe's servaline genet *Genetta servalina lowei* was known to occur in the Udzungwa Mountains only but has recently been found in the Nguru and Uluguru Mountains (Rovero *et al.,* 2006). The Jackson's mongoose *Bdeogale jacksoni* has been recorded in the Udzungwa Mountains (De Luca and Mpunga 2005) which is the first record ever in Tanzania.

The main objective of the surveys is to assess presence, relative abundance, distribution and conservation status of these species in the target forest blocks. This data can then be used for assessing the threatened status of these species by the relevant IUCN SSC specialist groups; in guiding protected area authorities to make appropriate management decisions and for monitoring the region's forests.

Additionally, visits to Coastal forests will be of interest for other species, notably the Natal duiker *Cephalophus natalensis* and Ader's duiker *Cephalophus adersi*.

Some of the key, specific questions on the distribution of target species are the following:

- Investigate the presence of *Cephalophus spadix* in the least known forest blocks (Pare, Rubehos, least known Udzungwa forests);
- Investigate the presence of *Genetta servalina lowei* outside its known range in the Udzungwa, Uluguru and Nguru Mountains;
- Assess the distribution of *Colobus angolensis* and *Colobus guereza* that potentially meet along the Pare/Kilimanjaro gap;
- Assess the distribution of *Colobus angolensis* subsp. *palliatus* and subsp. *sharpei* in areas where their distributions potentially meet, such as the Mufindi district portions of the Udzungwa Mountains;
- Assess the distribution of *Cephalophus natalensis* and *Cephalophus harveyi* in areas where their range appear to meet (e.g. East of Udzungwa Mountains);
- Investigate the presence of *Rungwecebus kipunji* in unexplored forests of the Udzungwa Mountains;
- Assess the abundance of *Procolobus gordonorum* in the least known forests of the Udzungwa Mountains.

3.2 Literature review

Relevant records and publications on the area and target species should be reviewed. Of particular interest are records of Abbott's duiker, Lowe's servaline genet and the above mentioned species.

3.3 Site selection

Sites are selected using 1:50,000 scale Tanzania Government maps, satellite images, a review of the literature and interviews with local residents. Depending on forest size and elevation range, a variable number of survey sites at different altitudes are selected *a priori* e.g. in the Udzungwa mts. there should be a low (300 - 500 m a.s.l.), medium (600 - 1000 m a.s.l.) and high altitude site (1200 - 1800 m a.s.l.) that usually relates to fairly distinct vegetation communities (respectively: 1. deciduous/semi-deciduous and lowland forest, 2. submontane, mainly evergreen forest, 3. montane forest). Subsequently, reconnaissance walks in the area pre-selected help to select each particular survey site. Survey sites range from 4-9 sq. km depending on the nature of the terrain and accessibility. Surveys for diurnal

primates, forest antelopes and carnivores are carried out in the Udzungwa, North Pare, Rubeho and other selected sites in the Eastern Arc and coastal forests.

3.4 Interviews with villagers

A representative group of forest users (hunters, firewood collectors, etc.) should be interviewed for presence and abundance of medium to large mammals and sites of higher abundance. Field guides and photographs of key species are used to facilitate identification. A preliminary list can then be compiled. This complements the indigenous knowledge research outlined in section 0.

3.5 Transect walks

Transects, or "directional walks" are used to count primates, diurnal antelopes and mammal dung and tracks. These are conducted by the principal researcher and one research assistant. Using a compass and GPS, some 3 - 4 walks of 2 - 3 km each (depending on vegetation density and terrain morphology) are done each day starting at about 7-7.30 am. Walks follow existing paths where possible and follow straight lines as much as the terrain and vegetation allow. Data is recorded in notebooks and is then transcribed onto a data-sheet (Appendix 2) after each transect walk.

The start and the end time and GPS position of each walk is recorded, together with straight distance walked. Average speed is about 1 km/h. This allows for the calculation of a gross encounter rate (number of primate groups/individual antelopes/signs per km walked and per sampling time) that in turn gives a proxy of relative abundance.

For each sighting, data is recorded on:

- the time of encounter,
- species,
- number of individuals,
- group size estimation,
- demographic structure whenever possible (for primates), and
- habitat and locality notes (see Table 1).

As this is not a systematic line-transect study, factors such as width of the transect and density of vegetation are not taken into account. Consistency in the personnel carrying out the work should accommodate for biases due to observer's experience, ensuring that data can be compared between sites. For comparison of data taken by different projects, it is recommended that training of data collectors by experienced biologists is done first. Long-term line-transect primate census data from the Udzungwa Mountains, however, show that inter-observer bias are usually limited and do not significantly affect the comparability of the data. For additional information on line transect censusing please refer to Rovero *et al.* (2006) for primates and to Rovero and Marshall (2004) for forest antelopes.

3.6 Camera-trapping

Non-digital Deercam DC300, heat-in-motion camera-traps are used with 200-400 ISO color prints (36 exposures). The number of cameras used depends on the area of the study site, but may vary between 8 - 20. Camera-trapping site selection is done by inspecting the forest floor for wildlife trails and other signs. Within the survey area (of 4 - 9 sq. km, see section 3.4) cameras are deployed in pairs whereby two cameras are set at a relatively close distance (max 100 - 200 m) from each other and different pairs are spread at about 1 km apart. This design allows the team to sample relatively different sites within each area (by elevation, habitat type, vegetation pattern, morphology) while decreasing the chance - by using camera pairs - that sampling fails at a particular site because of possible damage to one camera. Camera-trapping sites are baited with duiker dung and a cat lure scent (commercially available in the US) that attracts carnivores. A form is used to record all camera-trapping stations (Appendix 3).

Minimum delay between photographs is set at 1 minute and cameras are left to run continuously for at least 30 days. Monitoring of camera-trapping (progressive number of pictures, status of batteries, technical problems, etc.) is recorded using a standard form (Appendix 4). Photographs are analysed by capture time and species. Multiple photographs of the same species taken within the same hour are

considered as only one “independent event”, to compromise between scoring the same individual multiple times and missing individuals.

Camera-trapping rate per species (or group of species) is computed as the number of independent events divided by trapping days. Trapping-days are computed as the number of 24-h periods from deployment until the film is full or the camera is retrieved. This provides a reliable proxy of relative abundance, and, for forest antelopes, it correlates linearly to densities obtained through line-transect walks (F. Rovero unpubl. data). Data recording (identification of species photographed and event scoring) is done on a standard form (Appendix 5).

3.7 Description of gross habitat type and habitat disturbance

Gross categories of habitat, based on vegetation type (see Table 1 for categories) and forest age (e.g. regenerating, secondary vegetation, mature, old growth), are used to classify the forest that is being surveyed. Thus, each portion of about 1 km section of directional walks is categorized according to habitat type. Moreover, all signs of habitat disturbance by people along these walks is recorded: poles cut, trees cut, snares or other traps, trails, pitsawing, settlements, hunter camps, farms, etc. As per animal sightings, an index of human disturbance per km can then be computed. Similar information is collected during the disturbance transects (see Section 10) however the purpose of collecting data on disturbance along the primate / duiker transects is to enable direct comparisons to be made between the status of the duiker and primate populations and the forest condition.

3.8 Data analysis

The information collected can be summarized as follows:

- Species list considering confirmed species (sighted or camera-trapped) and probable species (based on tracks, non-confirmed sightings, village information), inclusive of notes on the IUCN status, taxonomy, habitat type, altitude range, index of abundance.
- Additional report on key species: data on group size and demographic structure for the primates, behavioral notes, morphological description, habitat preferred, forest areas where is mainly found.
- Report on forest status and human disturbance.
- Overall discussion on species found in relation to those expected and in relation to the literature review.

Table 1. Standard locality, habitat, topography, vegetation structure and water association categories.

FOREST RESERVE	Name of Forest Reserve
RECORDERS	Initials or name of people recording the data.
LONGITUDE	Write the degrees, minutes and seconds.
LATITUDE	Write the degrees, minutes and seconds.
ALTITUDE (m)	Altitude in metres.
DAY	Write in numbers.
MONTH	Write in numbers.
YEAR	Write in numbers.
SLOPE (deg)	Slope in degrees.
ASPECT	General aspect of the site. Aspect measures direction down the slope.
TOPOGRAPHY	Check only one which describes the overall site
GENTLE LOWER SLOPE	Slope of $<30^{o}$ at the lower third of a hill. This is a macro-habitat note.
STEEP LOWER SLOPE	Slope of $>30^{o}$ at the lower third of a hill. This is a macro-habitat note.
GENTLE MID-SLOPE	Slope of $<30^{o}$ at the middle third of a hill. This is a macro-habitat note.
STEEP MID-SLOPE	Slope of $>30^{o}$ at the middle third of a hill. This is a macro-habitat note.
GENTLE UPPER SLOPE	Slope of $<30^{o}$ at the upper third of a hill. This is a macro-habitat note.
STEEP UPPER SLOPE	Slope of $>30^{o}$ at the upper third of a hill. This is a macro-habitat note.
RIDGE/HILL TOP/PEAK	Narrow area at the top of a mountain. This is a macro-habitat note.
UPLAND PLATEAU	Level area at altitude away from valley floor. This is a macro-habitat note.
VALLEY FLOOR	Low-lying area between two ridges. This is a macro-habitat note.
LOWLAND PLAIN	This is a macro-habitat note.
GULLY	Channel cut by water. This is a macro-habitat note.
OTHER	Use sparingly.
VEGETATION TYPE	Check only one in the following section.
LOWLAND FOREST	Relatively continuous stand of trees at least 10m tall, with interlocking canopy, less than 850m a.s.l..
SUBMONTANE FOREST	Relatively continuous stand of trees at least 10m tall, with interlocking canopy, 850m or higher a.s.l..
MONTANE FOREST	Relatively continuous stand of trees at least 10m tall with interlocking

	canopy, above 1200m a.s.l..
SWAMP FOREST	Relatively continuous stand of trees at least 10m tall, with interlocking canopy in an area that has a high water table or on land permanently water-logged.
COLONIZING FOREST	Broken canopy cover with many young trees. This was usually a previously disturbed area.
RIVERINE FOREST	Relatively continuous stand of trees at least 10m tall with interlocking canopy found in patches along banks of rivers, streams or lakes.
PLANTATION FOREST	Planted tree species.
(OPEN) WOODLAND	An open stand of trees at least 8m tall with a canopy cover of 40% or more. Usually grassy understorey.
SCRUB/THICKET/BUSH	An open or closed stand of shrubs or bushes up to 7m in height with a canopy cover of 40% or more.
BAMBOO	Dominated by bamboo grasses.
GRASSLAND	Land covered with grasses and other herbs with or without woody plants not covering more than 10% of the ground cover.
HERB. MARSH/SWAMP	Areas permanently waterlogged with lower canopy cover.
FERNS DOMINATED	Areas where ferns were the most common plant. Usually this vegetation type occurs at higher altitudes.
FALLOW/PREV. DISTURBED	Areas formerly cultivated but now regenerating.
CULTIVATION	Areas where the dominant plant species were domesticated.
ROCK/BARREN	Areas with little or no vegetative cover.
OTHER	Specify vegetation type. Use sparingly.
TREE CANOPY	Estimate the extent that the foliage blocks out the sky.
GROUND LAYER	Estimate the extent that the grass and herb layer covers the ground.
SHRUB LAYER	Estimate the extent that the lower canopy blocks out the sky
CANOPY HEIGHT	Estimate the average height of the upper canopy excluding emergents.
WATER regardless of size.	Check only one of the following.
ASSOCIATION RIVER	Generally taken as a watercourse with a name
STREAM	Usually an unnamed watercourse.
POND/LAKE	A non-stagnant pool of water
MARSH/SWAMP	A relatively stagnant pool of water.
DRY RIVER BED	A seasonal water course.
OTHER	Use sparingly.

4) Methods for surveying nocturnal primates

by Andrew Perkin

4.1 Background and research priorities

There are seven species of galago in the Eastern Arc Mountains and Coastal Forests that have been described, a further two taxa require additional information in order to determine their taxonomic status. This is based on detailed surveys conducted in the East Usambara, Uluguru, Udzungwa, Rondo plateau, Pugu / Kazimzumbwi and Rufiji forests. Less is known about the ranges of these species in other parts of the Eastern Arc and Coastal forests. In particular, information is required to answer the following biogeographical and taxonomic questions:

- Is *G. orinus* present in the N. Pares, S. Pares, Nguu, South Nguru, Ukaguru, Mahenge, Western Udzungwa and Malundwe?
- How different are the populations of *G. orinus* within the different mountain blocks in terms of their vocalizations?
- Is the Taita galago present in the North Pare?
- Is *G. rondoensis* present in Noto, Chitoa, Pindiro, Msumbugwe and Genda Genda forests?
- How far south does the range of *G. cocos* extend for example is it present in Kilulu Hill forest in Tanga region?
- Is *G. zanzibaricus* present in lowland Mahenge, Malundwe, N. Pare, S. Nguru, Nguu, Ukaguru, Msumbugwe, Genda Genda and Kilulu Hill forests?
- Are the populations of 'O. sp. Nov.' from Mwera sufficiently different from other Otolemur to merit full species status?
- How widespread are the populations of *G. granti* in the western Udzungwas and is there any overlap in the ranges of *G. granti* with either *G. orinus* or *G. zanzibaricus*?
- Are *O. garnett*ii and *O. crassicaudatus* present in N. Pares, S. Pares, Nguu, South Nguru, Ukaguru, Mahenge, Western Udzungwa and Malundwe?

4.2 Objectives

- To document the distribution of *G. orinus*, *G. rondoensis*, *G. cocos*, *G. zanzibaricus*, *G. granti*, *O. garnettii* and *O. crassicaudatus* in the Eastern Arc and Coastal Forests.
- To improve our understanding of the taxonomy of Eastern Arc and Coastal Forest galago species.

The data collected by the surveys will also be used for assessing the threatened status of these species by the relevant IUCN SSC specialist groups; in guiding protected area authorities to make appropriate management decisions and for monitoring the region's forests.

4.3 Site selection

Through the TFCG - MTSN project, these methods are being used in the North Pare, Southern Udzungwa, Rubeho, Nguu and Malundwe Mountains and selected coastal forests including Msumbugwe, Kilulu Hill, GendaGenda, Noto, Chitoa and Pindiro Forest Reserves. Through the BREAM project, led by Frontier-Tanzania, additional information is being collected for the Ukaguru and Mahenge forests.

Sample sites are selected using 1:50.000 scale Tanzania Government maps, satellite images and publications. The number of sites will depend on forest size and elevation range.

4.4 Interviews with villagers

A representative group of forest users (hunters, firewood collectors, etc.) are interviewed for presence and abundance of nocturnal / crepuscular primates and sites of higher abundance. Field guides, recordings and photographs of key species are used to facilitate identification and discussion. Results of these interviews are recorded on the relevant data sheet (see Appendix 21). This work is undertaken by the Principal Researcher and / or by the TFCG Research Officer at the same time as the interviews outlined in Section 11.

4.5 Nocturnal census walks

4.5.1 Overview

The aim of the nocturnal census walks is to record the presence of galago species. During the nocturnal census walks, vocalisations are recorded and visual observations described. Recording galago vocalisations, particularly the 'species specific advertising call', provides a reliable way of recognising galago species in the field and is an important field survey tool, especially where it is difficult to trap individuals (Zimmermann, 1994; Bearder et al, 1995; Bearder, 1999; Ambrose and Perkin, 2002;). A reference database of galago vocalizations is held at Oxford Brookes University, UK, as well as the tape recording database of the principal researcher, Andrew Perkin, with which recordings are compared. By recording observations systematically, relative encounter rates and densities can be estimated. It should be noted that with the constraints and difficulties of detection galagos at night, estimating population densities can be subject to high degrees of error. Applying 'Distance' methods has proved to be difficult for nocturnal work mainly due to over counting where galagos can 'overtake' a recorder result in them being double-counted.

4.5.2 Procedure

Night walks are conducted along pre-existing paths to reduce noise and disturbance. In the event that no paths are found, straight line transects should be prepared in advance. The transect lines should be marked using boundary tape. Cutting is kept to the minimum required to make the transect line visible and passable at night.

At night, once spotted with the aid of a torch, galago species can be distinguished by their size and pelage. Particular attention is paid to the face mask, overall body pelage, and the tail. A Petzl zoom head-torch (sometimes using a red filter which does not disturb the galagos as much as white light) is used to spot animals, a 4 D cell Maglite torch is used to better illuminate animals for detailed observations, and 8 x 42 magnification binoculars are used to detect and observe the galagos. Visual descriptions based on field notes and photographs are compared with published descriptions of galago species including Lawrence and Washburn, 1936, Honess, 1996; Honess and Bearder, 1996, Kingdon, 1997; Groves, 2001; Lumsden and Masters, 2002. Unpublished data collected by the author is also used.

Night walks start just before dusk between 18:45 and 22:00, then in the mornings from 05:00 – sunrise. During the night, data is also taken advantageously around camp. At least 5 hours per night of night walks should be conducted. Walks are conducted slowly at 0.5 km/hr pausing to observe any galagos and other target species when animals are seen and to record vocalisations. Start and finish times are noted as well as time taken to record and/or observe animals (see Appendix 8). The distance of each walk is measured to give an estimate of animal encounter / km by recording way points on a GPS. Where GPS coverage is too weak to provide a reliable signal the distance travelled is recorded using a tape measure.

During the nocturnal census walks, galago vocalisations are tape-recorded and used for species identification. An analogue Marantz PMD-222 audiocassette recorder using Type II cassettes and a Sennheiser K6-ME66 directional, shotgun microphone are used to record vocalizations.

At the start of each night walk, the recorder states the location, time, date, their name, weather conditions, moon phase and a description of the dominant vegetation type on the tape. As many vocalisations are recorded as possible even of those that seem distant. Long sequences of vocalisations should also be recorded. At the end of each vocalisation recording, the recorder states the time and the species (to the best of his / her ability) and any interesting behavioural notes. At the end of each walk, the recorder states the time the survey is completed.

In a notebook, the recorder notes the location, time, date, their name, weather conditions, moon phase and a description of the dominant vegetation type (see Table 1 for details of standard vegetation types). For each animal encounter (this should include sightings of animals that are not calling as well as those calling) and vocalisation record, the recorder notes the time, species, call type and any interesting behavioural observations or additional information to describe the encounter. In these notes the

recorder should include information on: the substrate used by the animal (angle and diameter of the branch), feeding observations (where possible note the exact type of food), presence of young, whether the call is replied to; if the animal is alarm calling, what the cause for the alarm is; estimated height above the ground; leaping distance and notes on any other interesting behaviour. Notes can then be transcribed to a data sheet (see Appendix 8)

4.6 Analysis of vocalizations

4.6.1 Overview

Vocalization recordings are imported and digitised onto a computer. The most recent update of Avisoft-Sonapro (R. Spect, Berlin) software is used to generate sonograms, and spectrograms that graphically illustrate sound patterns. These can then be used to make qualitative comparisons and descriptions or quantitative measurements can be taken. Calls are comprised of phrases that can have units. Galagos can utter many combinations of phrases in one calling episode (Bearder *et al*, 1995). Measurements include phrase duration, number of units, unit duration, fundamental frequency, and highest frequency and the amount and frequency of harmonics.

4.6.2 Procedure

Recorded vocalisations are imported into the computer in various ways depending on whether the recording source is analogue (eg tape recorders) or digital (eg minidisk, DAT or solid sate memory recorders). Programmes such as Avisoft Sonapro (www.avisoft-saslab.com) and Raven (from Cornell University sound laboratories, USA) are popular for analysis of nature sounds. This project uses Avisoft Sonapro.

Recordings from analogue recorders require a phono line usually with a 3.5 mm jack. One end is plugged into the tape recorder 'line out' socket and the other onto the line-in socket of the computer. Recordings from some DAT recorders can also be inputted in this way. If you are using a laptop which usually does not have a line in socket then input into the microphone socket, however this can lead to sound distortion so a digitiser such as a 'USN Audio Interface' device is recommended. One such model is the EDIROL UA-1A (See www.edirol.com). Once connected, the Avisoft programme is opened and the record function activated at the same time as you activate the tape recorder.

Recordings from a digital recorder are fed into the computer via the USB or if using Flash memory cards a PCMCA adapter can be used which is useful for laptop computers. Sound files that are imported should ideally be uncompressed '.wav' files which can be read by the Avisoft Sonapro software. Other file formats include:

Avisoft-DOS (*.DAT) File format of the old DOS-based Avisoft-SONAGRAPH.
NeXT/SUN (*.AU; *.SND) Standard sound file format on UNIX workstations.
Apple AIFF (*.AIF; *.SND) Standard sound file format on Apple-Macintosh.

For more information on sound importing to Avisoft and other aspects of using the programme there is a clear help section at the website www.avisoft-saslab.com.

Once the recordings are ready to be imported 'Sound card settings' and the 'Spectrogram parameters' need to be set. In the 'Sound card settings' (in the file menu) menu set the 'number of bits' to 16, click stereo if recordings were in stereo, and set the 'Sample frequency'. The ideal sample frequency is that level which is double the highest frequency of the recording. For example if the highest frequency recorded is 8000 Hz then set the sampling frequency to 16,000 Hz. Thus this figure will vary according to the recording. Many galago calls reach >10,000 Hz but tree hyrax calls only reach approximately 5000 Hz. The 'Spectrogram parameters' also need to be set to maximise the frequency resolution of the spectograms created, for most uses the following settings are appropriate: FFT-length = 512, Frame size (%) = 50, Window = 'Hamming', overlap = 50).

Once calls are imported satisfactorily then individual calls and even parts of calls can be cropped and prepared for sound analysis and as graphic files. Once power spectrograms (volts vs. time) and sonogram's (frequency vs. time) are generated numerical parameters can be measured using the

cursors and measuring tools of Avisoft. Various measurements can be taken but the following are typical measurements used from the statistical analysis and description of galago calls: number of calls measured, call duration, number of units per phrase, unit length, phrase interval, unit interval, fundamental frequency and frequency range. The fundamental frequency is the lowest harmonic of each unit, where this is modulated a mean can be taken between the highest and lowest harmonic (kHz) (Figure 1 & 2). The types of parameter chosen greatly depend on the type of call being measured but should be consistent when conducting comparative analysis of analogous calls e.g. one populations' advertising call with another.

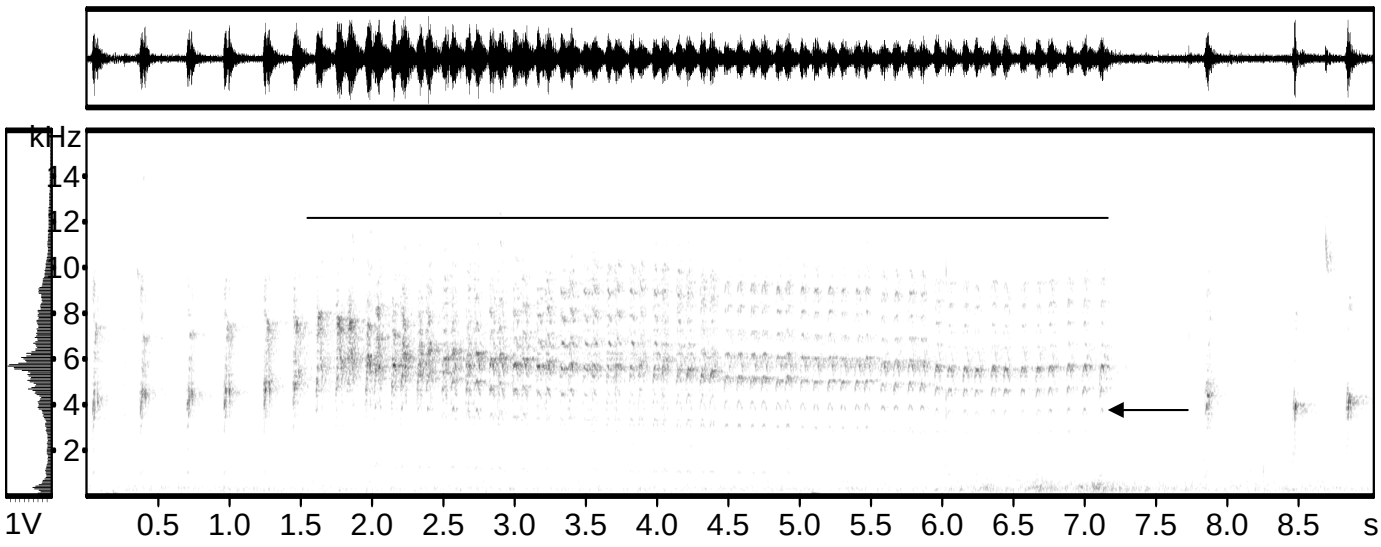

Figure 1. An example of the alarm call 'yaps and rapid descending twitters' of *Galagoides orinus* from the Uluguru Mountains.

The power spectrogram is the top graphic, the sonogram the main graphic and the left graphic is the frequency spectrum. This is an alarm call that can go one for more than ½ hour comprising of two components, 'yaps' (units illustrated outside the line) then interspersed with rapid 'descending twitters' (indicated by the line). Thus defining this (and alarm calls in general) as a discrete call is often problematic. Measuring the various call components can also be complex. The fundamental frequency of the last unit in the 'descending twitters' would be measured at the point indicated by the arrow.

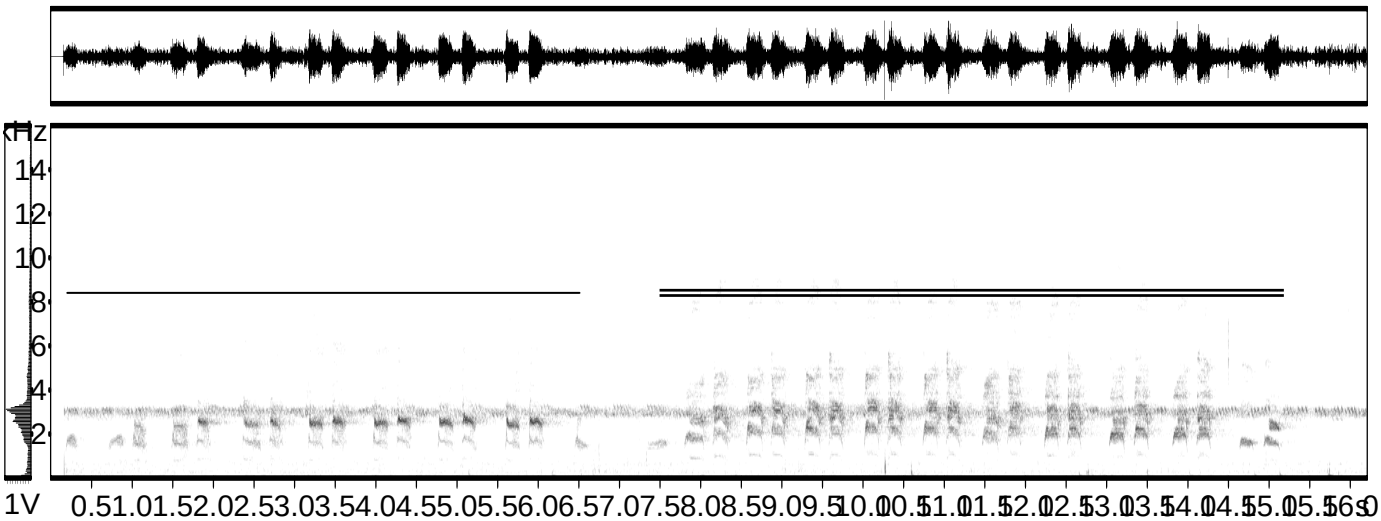

Figure 2. An example of the 'repetitive call' of G. orinus.

This is the advertising call of this species. In this example the first call (denoted by the single line) is replied to by the second call (denoted by the double line). Advertising calls are easier to measure as they are usually short (0.5 – 10 sec), discrete calls. The solid line represents background insect noise which is a common feature of nocturnal sound recordings. These can be erased graphically in Avisoft

but not electronically to eliminate the insect sound. Harmonics (appearing as the parallel lines within each call unit) are generally present in advertising calls and much less so in alarm calls.

4.7 Live Trapping

4.7.1 Overview

From a live-trapped animal, detailed biometric information and tissue samples can be collected for comparative morphology studies and taxonomic work. Galagos are trapped with Chardonneret traps (Charles-Dominique and Bearder, 1977). There are certain characteristic features which have been used for differentiating species. When studying galagos in the field or live trapped, these include weight, pelage, tail colour and form, penile morphology, relative proportions of the face mask such as width and length of nose stripe, ear size and nail morphology.

4.7.2 Procedure

Galagos are trapped with Chardonneret traps (Charles-Dominique, 1977). Traps are baited with a combination of fruits and locally fermented palm wine or 'mnazi'. The traps are placed between 1 m – 5 m above the ground where practical in areas where galagos have been observed. Traps are securely wedged into the vegetation and where necessary secured using rubber strips, wire or forest vines. The traps are set each evening between 17:00 and 17:30 and are checked every 2 hours until midnight or up to 2 am and then closed. Unless workers are prepared to check traps every two hours then it is practical to close at around 2 am by which time galagos have already fed and trapping success decreases significantly. Researchers need to be aware that small carnivores, especially Genets (Viverridae) will attack galagos in the trap and even dislodge traps if not tied. In the event that an animal has been caught the trap should immediately be taken down with the galago inside. Place a cover e.g. coat over the trap for transportation to the processing site. The trap should then be placed inside a tent or other quiet and secure place to minimise disturbance to the trapped animal. In the morning the animal is carefully removed from the trap to be weighed, photographed and measured.

Measurements taken include:

- Sex
- Colour notes:
- head with special attention to the chin, ear tips, width and length of the nose stripe,
- Back
- Belly
- Forelegs
- Hind limbs
- Tail with special attention to the from and colour of the tail tip

- Weight
- Head-body length
- Ear length
- Tail length
- Penis length
- Penile morphology – presence, size and distribution of spines

Photographs are taken of the overall animal, head, hands, tail, tail tip, feet and back

These are recorded on the trapping sheet (Appendix 9).

A tissue sample is collected from the left ear of each animal trap. The sample is taken using a 2 mm biopsy punch and is stored in a labelled vial of ethanol. Each vial is labelled with the following information: specimen number, date, collector, forest, longitude, latitude, elevation and species. The specimen number is particularly important as this enables the field data sheets to be linked to the tissue sample. Assign a unique field number to this vial that is also assigned to the data in a field notebook or data sheet. Using a graphite ("lead") pencil write this field number at least twice on a small piece of clean waterproof paper and insert it into the same vial as the tissue.

The animal is then returned to the trap to be released after nightfall in the same place that it was caught. When releasing the animal, open the door of the trap and wait for the animal to climb out by itself. Ensure that no predators are in the vicinity of the trap when releasing the animal. It is important that animals are not released during the day time when they are particularly vulnerable to predation.

Galagos can and do bite if given the opportunity. It is therefore important that these animals are handled with care. Thick gloves should be worn at all times when handling the animals. Two people are needed, one to handle the galago and one to measure and scribe. With the smaller galagos it is best to hold them with their neck between your first and second fingers. Larger galagos should be held with two hands.

Other taxa, particularly African palm civets may also enter these traps. In such cases, animals will be photographed and weighed while still in the trap and released. No attempt should be made to handle palm civets or genets without anaesthetic and trained personnel.

4.8 Camera trapping

4.8.1 Overview

Camera trapping can provide information on the presence of galago species and their behaviour. Camera trapping methods are outlined in Section 3.6. When applying these methods to galagos, the main difference is that the traps should be set arboreally.

4.8.2 Procedure

Non-digital camera traps (Deercam DC300 heat-in-motion camera-traps) are used with 200-400 ISO color prints (36 exposures). For galagos, camera traps are set in trees where animals have been seen to return regularly to a feeding point e.g. a gum licking site. Attempts to bait galagos to feeding sites can be made. For more details see Section 3.6.

5) Methods for surveying sengis

This section is based on sengi research priorities and protocols provided by Galen Rathbun.

5.1 Background and research priorities

Three forest-dwelling sengis occur in Tanzania: *Rhynchocyon petersi*, *R. cirnei*, and *Petrodromus tetradactylus*. Both species of *Rhynchocyon* are of special concern because of the destruction of their forest habitats (Nicoll and Rathbun, 1990). *Petrodromus* is also found in woodlands throughout much of central and eastern Africa and thus it is of less conservation concern. Therefore, the project will focus on the two species of *Rhynchocyon*.

Based on the recent assembly and analysis of distribution information by Rathbun and Butynski (http://www.calacademy.org/research/bmammals/eshrews/distribution.html), there are several issues with regard to the identification and distribution of *Rhynchocyon* in Tanzania that are basic to the development of conservation plans. See the following web site for details: (http://www.calacademy.org/research/bmammals/eshrews/current_topics.html).

Eastern Arc Forests: It is known that *R. petersi* occurs in the Eastern Arc forests from north to south as far as the northern Udzungwa Mts. and *R. cirnei* occurs from the south as far as the northern Udzungwa Mts. It is not clear where these two species come together – there is evidence that there may be an undescribed form of *R. cirnei* in the West Kilombero forests. Of particular interest in understanding the distribution of *Rhynchocyon* are the following forests in the north-eastern Udzungwa Mts: Luhombero, Ndundulu, Nyumbanitu, Ukami, Lyondo, Iwonde, Nyanganje, Magombero and Mwanihana. Similarly, there is evidence that *R. cirnei* and *R. petersi* may occur in the Nguru Mountains. Also, the presence or absence of *Rhynchocyon* in the isolated forests on the Mahenge and Malundwe mountains needs to be established. The TFCG / MTSN survey will focus on the Udzungwa Mountains and Coastal forests to complement sengi data being collected by Frontier-Tanzania in the Mahenge and Nguru forests.

Coastal Forests: There is also some question surrounding the distribution of *Rhynchocyon* in the coastal forests in Lindi District and further south into Mozambique. Specifically, does the Rufiji River indeed separate *R. petersi* to the north and *R. cirnei* to the south along the coast. Also, it is unclear how far inland along riparian forests of this region *Rhynchocyon* occurs. See Section 1.4 for a list of coastal forests to be surveyed.

5.2 Objectives

1. To determine which species of *Rhynchocyon* occur in the Udzungwa Mountains and along the Coastal Forests of Tanzania.
2. To determine the general forest condition in those forests where surveys are completed for *Rhynchocyon*.
3. To collect and curate fresh tissue from each taxon or form of *Rhynchocyon* from as many sites as possible for subsequent analyses to elucidate the taxonomy and phylogeography of the different forms that occur in Tanzania.

The data collected by the surveys will also be used for assessing the threatened status of these species by the IUCN SSC Afrotheria specialist group. These assessments will guide local and national authorities to make appropriate management decisions and will be used for monitoring forest biodiversity.

5.3 Literature review

A review of available information, records, and publications will be undertaken. The primary resource in this review will be the searchable bibliography on sengis (http://www.calacademy.org/research/bmammals/eshrews/biblio/index.html).

5.4 Site selection

The forests that will be surveyed will be selected on the basis of the research priorities identified above and to focus on forests that are not being visited by other survey teams financed by CEPF. Within these

forests, sample sites will be selected using 1:50,000 scale Tanzania Government maps, satellite images and local knowledge. Where possible, a variety of forest habitats will be sampled within each forest.

5.5 Diurnal transect surveys

5.5.1 Overview

This method aims to record the presence of *Rhynchocyon* species in selected forests. Although cryptic, *Rhynchocyon* can be heard in a forest, and very occasionally seen. During diurnal transect surveys, all observations of *Rhynchocyon* are recorded. Data on the location, habitat, behaviour and appearance of the animal and the reliability of the identification is recorded on standard data sheets (Appendix 2).

Rhynchocyon are most frequently detected by their sounds, especially when the forest floor is dry. Typical sounds include tail slapping, stotting and half-bounding on forest floor leaf litter.

Appendix 6 includes descriptions and photographs for use during the field surveys. These are a more reliable guide than standard field guides and should be used by the survey team. On those occasions when they are seen, the poor lighting in their habitat and their antelope-like behaviours mean that particular care needs to be taken in identifying to species.

This method is not systematic and no reliable abundance estimates can be made using this method.

5.5.2 Procedure

A team of two or three observers walk along a transect or path and record all observations of sengis. Data on the date, time, location (forest reserve, longitude / latitude, elevation, slope and aspect) and habitat (see Table 1 for details) are recorded on the sengi observation data sheets (or into a notebook for later entry onto a datasheet as preferred by the individual observers). Additional notes are made on the appearance of the animal or the kind of sound that it was making (see above). Notes on the appearance include a description of its colour and size (Appendix 2). Each observation is categorised as heard, seen and / or identified. Transects vary in length depending on the terrain and time available. GPS readings for the start and end points of each transect are recorded in a notebook or on the standard forms (Appendix 2). GPS readings are also recorded for each sengi observation.

5.6 Live trapping

5.6.1 Overview

This method provides the most reliable means of identifying *Rhynchocyon*. It involves capturing sengis in nets strung along forest paths. Captured animals can be carefully examined and photographed and a tissue sample collected for later analyses. In the event that the animal does not match the pictures and descriptions provided in Appendix 6 and the researcher suspects that it may be an undescribed taxon, the animal may be taken as a specimen.

5.6.2 Procedure

This method involves setting nets across forest paths or transects; checking the nets regularly and when an animal is caught recording key biometric data and collecting a tissue sample.

Nets should be fishing nets made of multi-filament nylon (twine = 210D/Z/6) with a 9 cm stretched mesh and coloured brown, grey or green (not light colours). They should be at least 26 mesh deep and approximately 50 metres long. Monofilament should not be used, as it may cut the sengis.

Nets are prepared by stringing a multifilament line along the top and bottom of each, so that they can be hung. The line should be about double or triple the diameter of the net twine. Each end of this line is tied to a larger-diameter loop so that the end can easily be identified and can be attached to a bush twig or a low tree limb.

The nets are strung vertically along the forest floor so that about 1/4 or 1/3 of the net is loose on the floor of the forest, and the rest forms a loose vertical panel about 1 m in height. The net is suspended by the top line from bushes, branches and small sapling stakes pushed into the ground. Generally, the net should be strung along existing paths through the forest, or along quickly cleared paths, so that it does

not become badly entangled on vegetation when a sengi is captured. Nets strung along territory boundaries work best.

The nets should be checked at least every two hours during the daylight and are not set during the night. When caught in a net, sengis are vulnerable to predators and to damaging themselves, it is therefore extremely important that they are checked at least every two hours.

Nets are left in an area for several days, but are lifted or collapsed so sengis and birds can not be caught while they are not being monitored. If collapsed onto the forest floor, care is taken that they are completely flat so that they will not continue to "fish." Nets are easily stored in small, wide-mouthed, cloth bags.

When an animal is caught, it should be held with one hand around its neck while the other hand is used to hold the animal by the rear thighs / legs. Particular care should be taken with their legs which are long and thin and can break if handled incorrectly. Although sengis do not bite or chew they can inflict painful scratches with their hind legs. If someone is scratched, you should apply antiseptic cream immediately as they can easily become infected. While being handled, sengis tend to become docile and then burst into a fit of thrashing and can easily be lost if one is not prepared.

For each animal trapped, a data sheet should be completed (see Appendix 8). Data on location, habitat type and biometrics should be recorded. Boxes should be ticked to indicate whether tissues and photos are taken. Each captured animal should be allocated a 'specimen' number (even where no specimen is taken) using the format Forest Reserve Code (see Appendix 1) / Animal number e.g. the third animal caught in Kindoroko would be labelled as KI/3.

Every animal caught is photographed using a digital camera. In photographing hand-held animals, particular attention is paid to getting good and clear images of the colouration and patterning of the back, rump, and sides; the coloration of the forehead; and the coloration of the tail. Notes should be made in a field note book to record the date / location / 'specimen' number and film / picture number for every picture taken.

For every animal caught, fresh tissue is obtained by cutting off the tail tip (1 cm). Use clean (new) vials that do not leak. Use 95% ETOH (ethyl alcohol). Use this alcohol to clean the forceps, scissors or scalpel, and tail tip before cutting. Be sure that the vial or container is clean and that it will hold at least 20 ml of ETOH so that the tissue is well preserved. Assign a unique field number to this vial that is also assigned to the data in a field notebook or data sheet. Using a graphite ("lead") pencil write this field number at least twice on a small piece of clean waterproof paper and insert it into the same vial as the tissue.

On the outside of the vial attach a label with the following information written in pencil:
TFCG/MTSN, Date, Forest Reserve, Longitude / latitude, field number, region, country.

At the next available opportunity, the tissue and a COPY of the field data should then be stored in a refrigerator. The specimens can then be sent for analysis following instructions from Galen Rathbun (grathbun@calacademy.org).

5.7 Camera trapping

See Section 3.6 for details. Giant forest sengis usually occur at relatively low densities, making it unlikely that enough photographs can be obtained for any meaningful population analysis. However, even a single capture can be used to determine presence, and if the image is good enough perhaps even used to determine the species of *Rhynchocyon*.

5.8 Sengi nest counts on transects

5.8.1 Overview

All *Rhynchocyon* taxa create leaf nests on the forest floor, which cover a small depression in the soil, and are about 50 cm in diameter (see Appendix 7 for photographs of sengi leaf nests). FitzGibbon and Rathbun (1994) found that individual *R. chrysopygus* use on average six nests at any one time and that

there is a straight line positive correlation between nest abundance and the abundance of *R. chrysopygus*. Based on this finding, relative abundance of sengis can be determined using counts of their nests along transects.

5.8.2 Procedure

Straight, narrow transect lines, just wide enough to walk along, are cut through the area to be sampled, and the perpendicular distance from the transect line to the centre of each nest sighted is recorded, to the nearest 0.5 m. Only nests within 3 m either side of the transect line are counted i.e. a fixed sample width of 6 m. The transect lines are 400 m in length (where possible). At least four transects are walked in each habitat type. All transects are checked twice, once by a local tracker who marks all the nests he sees, and again by the principal researcher, ensuring that virtually all visible nests are sighted. Nests vary in their state of repair and are categorised as 'in use' (IU) or 'not in use' (NIU). Nests that are no longer in use are distinctive in that their 'roofs' fall in so that a depression is obvious in the middle of the leaf mound.

6) Methods for surveying rodents and shrews

By Andrew Perkin

6.1 Background and research priorities

Less research has been carried out in the Rubeho, North Pare and Mufindi forests on rodents and shrews than in many other Eastern Arc Mountains. The surveys aim to document the presence of rodent and shrew species in these mountains with a particular focus on Eastern Arc endemic and near-endemic species.

A recent review of the distribution of Eastern Arc mammals recorded no endemic or near endemic shrew or rodent species to be present in the North Pare mountains and only *Beamys hindei* to be present in the Rubeho Mountains (Burgess et al. in p. In the Udzungwa Mountains, *Beamys hindei*, *Crocidura desperata*, *Congosorex phillipsorum*, *Crocidura monax*, *Crocidura telfordi*, *Myosorex kihaulei* and *Paraxerus vexillarius* (Burgess et al. In Press) have all been recorded from the central and / or eastern forests, although little is known about their presence in the Mufindi forests. The surveys will visit these less well known forest to assess whether these species are present.

Similar research is being carried out by the Chicago Field Museum at other sites in the Eastern Arc Mountains. The two teams will collaborate closely and specimens will be sent to the Field Museum for taxonomic verification.

6.2 Objectives

- To document the presence of Eastern Arc endemic and near endemic rodent and shrew species in the North Pare, Rubeho and Mufindi forests.
- To document the species richness of selected forests in the North Pare, Rubeho and Mufindi Forests.

The data collected by the surveys will also be used for assessing the threatened status of these species by the relevant IUCN SSC specialist groups; in guiding protected area authorities to make appropriate management decisions and for monitoring the region's forests.

6.3 Site selection

This is done using 1:50,000 scale Tanzania Government maps, satellite images and a review of the literature. Sampling sites should be located in forest. The methods outlined below are used for surveys in the North Pare, Southern Udzungwa and Rubeho mountain forests only.

6.4 Bucket pitfall traps with drift fencing

6.4.1 Overview

This method is used to sample diurnal, crepuscular and nocturnal ground-dwelling rodents and shrews It is particularly effective for catching shrews. The traps work by channelling animals that are crossing the forest floor along the drift fencing until they fall into a bucket. Although larger animals can escape, shrews, some rodents, frogs, snakes and invertebrates are trapped in the bucket.

Trapping sites are located with a preference for areas of forest known to have lower levels of disturbance and close to water sources. There should be at least one sampling site in each forest with a minimum of 1 site per 1000 ha of forest. Where multiple sites are being surveyed within a forest reserve, these should be distributed in such a way as to sample forest from the maximum possible altitudinal range. A secondary consideration is to sample from sites with different aspects.

Bucket pitfall arrays are left for five nights at each trap site.

6.4.2 Procedure

Three 50 m linear transects are created at each survey site. Each transect has eleven 10 litre plastic buckets sunk into the ground with their rims flush to ground level. Buckets contain small holes to allow rainwater to drain from them and each bucket is positioned 5 m apart. A line of vertical plastic sheeting (approximately 0.5 m high, and no less than 0.3 m) runs along the bucket line crossing the centre of

each bucket to form a 'drift fence'. The plastic fencing is supported by stakes tied to the plastic sheeting using sisal string. Small holes are pierced into the plastic using a twig (not a knife to prevent tearing) through which the string can be threaded. A 10 - 15 cm lip of plastic sheeting is left flat on the ground onto which soil and leaf litter is placed to prevent any gap in the drift fence at ground level. The lip is oriented so that it is facing up the slope. Two slits are made in the 'lip' above each bucket to avoid animals using the 'lip' as a bridge over the bucket. When setting out the bucket pitfalls, the habitat details are recorded on a standard form (Appendix 17) for each bucket pitfall so that consistent details are recorded on individual specimen forms. Habitat details refer to the general habitat of the area in which the bucket pitfall is located.

Each line is placed no more than 50 m apart but is sited in such a way as to encompass a range of micro-habitats. Traps are checked early each morning and each evening.

All shrews should be taken as specimens as it is not possible to provide reliable identification in the field. Two samples of each rodent taxa that can be confidently identified by the lead researcher to be a distinct taxon should be collected per mountain range. Other individuals can be marked and released. The animals should be marked by clipping a small area above the left hind foot and should be released close to the trap where they were caught.

6.5 Sherman traps

6.5.1 Overview

This method is used to sample crepuscular and nocturnal ground-dwelling rodents and shrews It is particularly effective for catching rodents. The method uses folding, Sherman traps. The traps are live traps. Animals that enter the trap trigger the door to close. The animals can then be carefully taken out of the trap to record their biometrics before being released or collected as specimens.

6.5.2 Procedure

Small rodents and terrestrial insectivores are sampled using 45 medium Sherman traps (23 cm x 8 cm x 9 cm) and five large Sherman traps (38 cm x 12 cm x 10 cm) baited with toasted coconut and peanut butter. Traps are placed in three micro-habitat types in each sample area to gain a representative sample of the different micro-habitats.

Traps are set in two groups of 17 and one group of 16 (with at least one large trap in each group) in different micro-habitat types and set at least 2 m apart in clusters of two or three. Numbered tags are tied to vegetation at eye height above each trap to ensure that the traps can be relocated. Traps should be wedged into tree roots or between stakes to prevent a trapped animal from endangering itself by 'rolling' the trap. Traps are located in areas likely to be frequented by rodents such as in dense tangles of vegetation; at the base of fruiting trees and close to rodent holes. At least three and no more than ten traps per trap site are located along low level branches. These can be secured by wedging the trap between branches and / or using vines or rubber strips. All large Sherman traps are set on the ground. When setting out the traps, the habitat details are recorded on a standard form (Appendix 19) for each trap so that consistent details are recorded on individual specimen forms. Habitat details refer to the general habitat of the area in which the trap is located.

Traps are baited each evening (16.00 hr or later) for five nights and checked early the following morning (08.00 hr or earlier). Traps are closed during the day. It is important to ensure that all traps are checked and closed each morning so that no animal is left inside a trap during the day. When checking the traps, the status of each trap is recorded on a standard form to record whether the trap had caught an animal or was touched, snapped, not working or the bait was missing (Appendix 16). This data is then summarised on a separate form (Appendix 18) to provide overall trapping rates for each site.

Voucher specimens will be retained as outlined above; these specimens will be subsequently sent to taxonomic authorities for positive identification. Where specimens are to be sent outside of the country, this must be with the approval of the University of Dar es Salaam and with the appropriate CITES exemption certificate issued by the Wildlife Division.

Where it is necessary to take a specimen, animals are euthanised using chloroform.

Small mammal specimens are fixed and preserved in ethyl alcohol. For injection and fixing, ethyl alcohol is used undiluted. For storage of amphibians 70% alcohol is used.

All specimens are labeled with a standard KMH field label or MTSN label attached to the rear, left limb or around the centre of the body for snakes, caecilians and limbless skinks. For each specimen relevant information is recorded on a standardised data sheet (Appendix 11) while summary information is recorded on a summary sheet (Appendix 15).

For each trap site the sampling intensity, trapping rate per taxon and trap site location is recorded on a standard form (Appendix 14).

Specimens are deposited and stored in the Zooology and Wildlife Conservation Department at the University of Dar es Salaam, Tanzania or at the Field Museum of Natural History, Chicago, USA.

6.6 Data entry

Summary information about the sampling location, trapping rate and sampling intensity are recorded on the Trap Site summary form (Appendix 14). Data for each animal captured will be recorded on standardised sheets (Appendix 11) regarding the identification, sex, breeding status and biometrics of each animal captured, as well as habitat notes. The notes below aim to assist recorders in completing the forms. Additional guidance is provided in Table 1.

FOREST RESERVE	Name of forest reserve.
COORDINATES	Longitude and latitude where the animal was collected / sighted.
KMH NUMBER	For specimens this refers to the museum 'KMH' number that should be attached to the left, hind leg. Where no specimen is collected, write '0'.
COLLECTOR	Initials of the person completing the form. Full names of the full survey team should be recorded in the survey report.
DAY / MONTH / YEAR	Date in the format 01 / 01 / 2006
TAXON ID	Common name for the animal e.g. rodent or shrew
GENUS	Tentative field identification to be indicated in pencil. This should be written in pen when verification has been provided by the taxonomist.
SPECIES	Tentative field identification to be indicated in pencil. This should be written in pen when verification has been provided by the taxonomist.
SUBSPECIES	Tentative field identification to be indicated in pencil. This should be written in pen when verification has been provided by the taxonomist.
CAPTURE METHOD	This should indicate whether the animal was captured in a Sherman trap, bucket pitfall or other means. The trap site and trap number should be listed.
BAIT USED	Where relevant indicate the bait used to capture the animal.
DETERMINER	The name of the taxonomist who provides the final identification.
DET. DATE	Date in dd/mm/yyyy for the correspondence in which the final identification is documented.
MICROHABITAT	Check one only
METERS ABOVE GROUND	The height above ground level that the animal was collected / sighted.
ASSOCIATED PLANT SPECIES	If trapped / observed in a tree or other vegetation, indicate the tree species.
WATER ASSOCIATION DISTANCE	Distance to water in metres.
SEX	Tick one box.
AGE	Tick one box
TISSUE SAMPLE TAKEN	If tissue sample has been taken, tick this box
BIOMETRICS	Measured in millimetres and grams.
HEAD+BODY (mm)	From tip of nose to base of tail when body and head extended.
TAIL (mm)	From base of tail to end of tail. If tail damaged, do not measure but make a note of this on the form.
EAR (mm)	Base of ear to tip of ear. Measured from inside the ear.
HIND FOOT (mm)	Back of heel to longest toe tip not including claw.
WEIGHT (g)	Measure in grams before any processing has begun.

OTHER	Other notes.
FEMALE PREGNANT	Note if possible on back of sheet number of foetuses and their size.
FEMALE LACTATING	Note if nipples are enlarged.
COLOUR NOTES	Note of pelage colours.

7) Methods for surveying hyrax

By Andrew Perkin

7.1 Background and research priorities

One species of tree hyrax, *Dendrohyrax validus,* occurs in the Eastern Arc Mountain and Coastal forests (EACF) of Tanzania. Various surveys have revealed that the distribution of this species is patchy within its known range (Burgess and Clarke 2000, Kingdon and Howell 1993). Other species that may occur in the EACF are the rock hyrax *Provocaria* which only occur in the northern ranges such as the Pare Mts and the bush hyrax *Heterohyrax* which occurs throughout the range of EACF but in bushed and rocky areas not in forest.

Dendrohyrax validus like other *Dendrohyrax* species are highly vocal. This is linked to their need to maintain territories and social cohesion whilst leading a largely solitary and arboreal lifestyle. Preliminary vocalisation studies indicate widely differing vocal repertoires between populations (Roberts, 2001). It is thought that this may be related to taxonomic differences given the long periods of isolation of the region as a whole and of individual populations. Vocalisation studies at the very least can indicate the presence of tree hyrax in an area. Monitoring levels of vocalisations may also give an indication of hunting pressure. One study in the Udzungwa Mountains (Topp-Jørgensen and Pedersen 2001) has indicated that vocalisation levels decrease with hunting pressure. Whether this is a behavioural response or due to a reduction in numbers of individuals is not certain.

Objectives

- To document the distribution of hyrax in the EACF.
- To improve our understanding of the taxonomy of Eastern Arc and Coastal Forest hyrax species.

7.2 Site selection

The forests that the research team will visit, will be selected on the basis of the research priorities identified above and to focus on forests that are not being visited by other survey teams financed by CEPF. Within these forests, sample sites will be selected using 1:50,000 scale Tanzania Government maps, satellite images and local knowledge. Where possible, a variety of forest habitats will be sampled within each forest.

7.3 Nocturnal census walks

Nocturnal census walks are conducted as per the galago census walks (see Section 4.5).

7.4 Analysis of vocalisations

The vocalisations of hyrax species can be analysed following the same procedures used to analyse galago vocalisations (see Section 4.6). A library of hyrax vocalisation recordings is held at the Nocturnal Primate Research Group, Oxford Brookes University.

7.5 Village interviews

Since hyrax are known to be vocal, their dens are not hard to locate and they are a favoured animal for hunting. Local hunters are therefore a good source of information on this species group. Procedures to gain this information form part of the indigenous knowledge component of this project (see Section 11).

7.6 Collection of skins and skulls

Where possible skins, dung pellets and skulls are collected. Each skin or skull is allocated a KMH number and a mammal data sheet is completed providing information on the locality from which it was collected (Appendix 11).

8) Methods for surveying reptiles and amphibians

By Michele Menegon

8.1 Background and research priorities

There are at least 53 endemic and 46 near-endemic species of amphibian and reptile that have been recorded in the Eastern Arc Mountains. A further 29 species of amphibian and reptile are known to be endemic to the East African Coastal Forests. This represents approximately 55% of the Eastern Arc endemic and 62% of the Eastern Arc near endemic vertebrate fauna. As such, understanding the herpetofauna is an important part of documenting the biodiversity of this region.

Every year new findings are increasing the number of described species from the region and many areas are still poorly collected. During the early 20th Century, Barbour and Loveridge conducted extensive surveys in Tanzania resulting in the discovery of many of the species now known to be endemic to the area. More recently surveys conducted by MTSN, Frontier-Tanzania, the British Museum of Natural History, the University of Dar es Salaam and TFCG in the South Nguru, Rubeho, Uluguru and Udzungwa Mountains have resulted in the discovery of at least three species of reptile and nine amphibian species which are new to science and it seems likely that additional species will continue to be discovered.

Some of these discoveries have been facilitated by the use of phylogenetic analysis. In other cases, preliminary analysis of differences in the vocalisations of some Eastern Arc amphibians such as *Leptopelis barbouri* and *Hyperolius puncticulatus,* indicate that these 'species' may consist of a complex of different species.

Some genera such as the bufonid genus *Nectophrynoides* and the microhylid genera *Probreviceps*, *Callulina* and *Hoplophryne* are endemic or near endemic of the Eastern Arc Mountains. Due to their high forest dependency, their current distribution and phylogenetic relationships may shed useful insights on the historical biogeography of the Eastern Arc Mountains.

Data on the distribution of Eastern Arc and Coastal Forest species indicate that many have restricted distributions and narrow ecological niches. In many cases this combination of factors has meant that these species are particularly vulnerable to habitat loss and disturbance. Accurate information on the distribution and conservation status of these species is critical for effective conservation action.

Survey intensity across the Eastern Arc and Coastal forests has been uneven. The current project will visit sites which have not yet been intensively surveyed for their herpetofauna including the North Pare, Mufindi, Rubeho, Nguu and Ukaguru forests.

8.2 Objectives

In addition to conducting an inventory of the herpetofauna of the forests of the Mufindi, North Pare and Rubeho Mountains some of the specific objectives relating to the region's herpetofauna that the survey aims to address are:

- To assess the number of species of forest associated amphibian and reptile that have ranges that extend into the North Pare, Mufindi, Rubeho, Nguu and Ukaguru Mountains
- To document the altitudinal ranges and geographical distributions of forest associated amphibian and reptile species in the Eastern Arc and Coastal Forests;
- To define the phyletic relationship of species within the genera *Nectophrynoides, Callulina, Probreviceps* and *Hoplophryne* through morphological, molecular and bioacoustical analysis;
- To improve our understanding of the biogeography of the Eastern Arc Mountains, particularly in terms of the relationship between forests north and south of the Makambako gap.

The data collected by the surveys will also be used for assessing the threatened status of these species by the relevant IUCN SSC specialist groups; in guiding protected area authorities to make appropriate management decisions and for monitoring the region's forests.

8.3 Site selection

The Eastern Arc herpetofauna shows distinctive biogeographical patterns (Poynton, 2000), whereby species assemblages change rapidly over small increases in altitudes. In order to get a good representative sample of species in a mountain area, it is therefore necessary to sample at different altitudes.

Preliminary site selection will be done using 1:50,000 scale Tanzania Government maps, satellite images, discussions with other researchers and publications. Using these sources site selection will be based on factors including elevation, forest patch extension, vegetation type, site morphology and presence of streams. An "in situ" survey will be necessary to select a precise sampling area.

In addition, the project will sample species occurring along the forest edge and in adjacent agricultural land as well as in montane grassland. This will help to clarify the ecological requirements of the species that are sampled.

8.4 Habitat Characterisation

At each sample site the habitat is described according to the parameters outlined in Table 1. Where possible this should be complemented by more detailed information about dominant tree and shrub species and topographical features (e.g. presence of rocky outcrops, streams, steepness of the terrain, etc). Furthermore based on GPS data collected during the surveys, satellite imagery can allow the distribution of species to be correlated with a number of abiotic factors, e.g. precipitation. The site description data are recorded on standard field data sheets (Appendix 12 and Appendix 13).

8.5 Sampling techniques

Amphibians and reptiles are generally relatively easy to sample. Frogs usually occur at high densities in forest habitats or congregate around ponds and along streams. However, some lizards and most snake species are more secretive and therefore harder to find. To produce accurate inventories of the amphibian and reptile fauna it is necessary to undertake a variety of survey methods which will sample all niches. For example, digging is essential to sample subterranean amphibian and reptiles, including burrowing frogs, caecilians, amphisbaenians, snakes and lizards – all of which might well occur in the area. In the case of this study, we employ four main methods: (1) Visual encounter surveys – with timed digging; (2) Pitfall Trapping; (3) Acoustic sampling and (4) Opportunistic captures.

Table 2. Summary of survey methods for Amphibians and Reptiles

Taxa	Survey type	Details
Amphibians and Reptiles	Visual Encounter Surveys - Transects (water associated and non water associated species)	Night search: 150 m transect length x 3 hours (19:00 - 22:00) - randomly placed within 1 homogeneous microhabitat
Amphibians and Reptiles	Visual Encounter Surveys – Quadrats	100 m^2 x 1/2hr x 4 microhabitats (randomly placed within a variety of microhabitats)
Amphibians and Reptiles	Timed digging during day search	½ hour per session, in soft soil at the base of large trees or underneath large logs
Amphibians and Reptiles	Visual Encounter Surveys - Opportunistic walks	½ hr per microhabitat x 2 to 4 microhabitats
Amphibians	Acoustic sampling - calls recording	During night search and opportunistic walks.
Snakes, Caecilians and Chameleons	Samples from local inhabitants.	

Amphibians and Reptiles (Additional - same lines used for small mammals)	Bucket pitfall traps	11 buckets in 3 x 50 m lines

8.6 Visual Encounter Survey

8.6.1 Overview

Visual Encounter Surveys (VES) are used to document the presence of amphibians and reptiles, and can provide both quantitative and qualitative data on amphibian species richness. Visual encounter survey methods were formalized by Campbell and Christman (1982) and Corn and Bury (1990). Visual encounter surveys are based on a number of assumptions: 1) equal observability among species and among individuals, 2) no between-sampling visit effects e.g. there is an equal likelihood of being observed for each species for each sampling visit, 3) individuals are recorded only once per survey, and 4) no observer related effects.

There are three standard sampling designs for visual encounter surveys: opportunistic or randomized walk, transects, or a quadrat design (see Crump and Scott 1994 for details). Visual encounter surveys can determine species richness; be applied in long term monitoring projects; provide information for compilation of a species list; and provide data used to estimate proportion of area surveyed that is occupied by target species. Data collected yields quantitative and qualitative information on species.

8.6.2 Procedure

Four types of visual encounter survey are conducted at each sample site. For each method, the recorder notes the number and species of animals collected relative to the amount of survey time that has elapsed. These results are recorded in a note book.

i) Transect VES

To detect the presence of tree frogs, tree toads, arboreal snakes, geckoes and chameleons, the project herpetologist slowly follows a 150 m transect for three hours between 19:00 – 22:00 across a pre-selected area of homogeneous habitat, usually along a stream. The recorder notes the number and species of animals collected relative to the amount of survey time that has elapsed.

ii) Quadrat VES

To detect the presence of fossorial microhylids, leaf litter toads, leaf litter skinks and caecilians, the project herpetologist will conduct a detailed survey of the leaf litter within four 100 m^2 quadrats. This involves turning over the leaf litter using a stick throughout the quadrat and capturing any animals that are disturbed. Each quadrat will be surveyed for 30 minutes. Quadrats are selected in areas with large, old trees with a lot of leaf litter that has accumulated around the roots. .

iii) Opportunistic VES

To detect the presence of diurnal amphibians and reptiles, the project herpetologist walks for 30 minutes during the day through a uniform area of habitat and opportunistically records any amphibians or reptiles encountered. This is repeated in between two and four microhabitats at each sampling site.

iv) Timed digging

To detect the presence of fossorial skinks, caecilians and amphisbaenians, timed digging is carried out for 30 minutes in the humus layer of the soil at the base of large trees or underneath large logs. Depth of digging does not exceed 30 cm. A spade or hoe is used for digging. This is generally conducted in the same area as the quadrat and opportunistic surveys.

In the event that, during other activities, the researcher comes across areas which appear to have potential, opportunistic digging is also conducted.

8.7 Bucket pitfall traps with drift fencing

8.7.1 Overview

Although widely used and recommended, especially in long-term field studies within temperate regions, pit fall traps and drift fences have proved to be the least effective method in forest habitats (Donnelly *et*

al. 2001). However this method can be useful to determine species richness of epigeic organisms or active surface forms. Capture success may vary greatly between species, for example, frogs that are strong jumpers are difficult to trap (e.g. *Strongylopus*). Therefore only a specific subset of the amphibian and reptile assemblage is likely to be captured in such a way

8.7.2 Procedure

The procedure for setting up the bucket pit falls and drift fencing is outlined in Section 6.4.

8.8 Acoustic sampling

8.8.1 Overview

In the majority of frog species, males use distinctive species-specific calls to advertise their position to potential mates and rivals during breeding periods. These species-specific vocalisations can be used to determine the presence of species. Calls should be recorded for reference purposes.

8.8.2 Procedure

Frog calls are recorded using an audiocassette, DAT or minidisc recorder and a directional microphone. Recordings are digitised and stored as records of species presence. Sound analysis is conducted using the software 'Raven' (Cornell Bioacustic Workstation), a package developed for Macintosh computers. The programme generates spectrograms indicating frequency versus time, and amplitude (represented by shades of grey), Fast Fourier Transform (FFT) spectra (amplitude/ pressure in arbitrary units versus frequency), and oscillograms (amplitude versus time). The Raven measurement tool is used to give precise measurements of call features. Measurements include call duration, number of units, unit duration, fundamental frequency, and highest frequency and the frequency of visible harmonics. The advertisement calls are described together with numerical data about the temporal and spectral features of the calls. These are then compared with a reference collection of calls held by the author.

8.9 Sampling cryptic assemblages

8.9.1 Overview

Snakes are difficult species to detect. This is because they are often well-camouflaged and can easily elude capture once detected. Therefore a complete list of snake species can be difficult to obtain. Snakes are often encountered during walks or can be observed during the night while "sleeping" on tree branches. In any case the number of species collected or encountered during a survey will be far from a complete list and help from local inhabitants can provide important supplementary information. Since local inhabitants are often working at the forest edge and they are willing to kill snakes found in fields, making an agreement with them in order to obtain those specimens can greatly increase the number of snake species recorded for the area. Species obtained in this way are not included in analyses of abundance or species richness estimates but can provide useful information when compiling the species lists for areas.

8.10 Preservation of amphibian and reptile specimens

Methods for the preservation of collected specimens are as follows:

- **Euthanizing**. Specimens are euthanized in a way that leaves them undamaged and relaxed.
- **Preservative injection**. Liquid preservative is introduced into the body cavity, limbs and tail, by hypodermic injection to ensure a proper preservation.
- **Fixing.** While the specimens are relaxed, they are arranged in trays so that they harden in the proper position.
- **Labeling.** Each specimen is accompanied by an MTSN label, attached directly. Data regarding the specimen is entered in a standard data sheet.
- **Storage.** After specimens have been fixed in the proper position, they are stored in liquid preservative and deposited in an institutional herpetological collection

8.10.1 Euthanizing

Reptiles are killed with chloroform. The animal is put into a ziplock bag with cotton wool soaked in chloroform.

Amphibians are euthanized using a solution of 0.08% MS222.

8.10.2 Preserving Solutions and specimens managing

Reptile specimens are fixed and preserved in ethyl alcohol. For injection and fixing, ethyl alcohol is used undiluted. For storage of reptiles 70% alcohol is used. Once killed, in order to allow taxonomical analysis on sexual organs, hemipenis of chameleons and some snakes are fully everted by means of an injection of 90% alcohol at the base of the tail.

Amphibian specimens are fixed and preserved in 70% alcohol.

8.10.3 Tissues sampling

Once the specimens have been properly fixed in ethanol, tissue samples are taken. This material is used to carry out DNA analyses.

From each specimen, tissue is taken from liver or skeletal muscle where possible. The tissue samples are cut and placed in a vial with 95% ethanol. If tissues are sampled form freshly killed specimens, the tissue samples should not exceed 2 mm to ensure penetration of ethanol. Vials are then placed in a plastic bag and labeled with the specimen code, species and collector. Additional information is recorded on the data sheet with the same specimen code.

8.10.4 Labels and Records

A digital photograph of each specimen is taken while the animal is alive in order to document coloration pattern. All specimens are labeled with a standard KMH field label or MTSN label attached to the rear, left limb or around the centre of the body for snakes, caecilians and limbless skinks. For each specimen relevant information is recorded on a specific standardised data sheet (Appendices 12 and 13).

8.10.5 Storage

Specimens are deposited and stored in the herpetological collection of the Museo Tridentino di Scienze Naturali, Trento, Italy or in the collection of the University of Dar es Salaam, Tanzania.

9) Methods for surveying birds

By Nike Doggart

9.1 Overview and research priorities

There are a total of 20 bird species endemic to the Eastern Arc Mountains, 5 endemic to the East African Coastal Forests and six species endemic to the Eastern Arc and Coastal Forests. Recent research in the Eastern Arc Mountains has documented the presence of three new bird species including two species of forest partridge (Dinesen et al 1994, Bowie and Fjeldsa 2005) and a new species of akalat (Beresford 2004).

As in much of the world, the birds of the Eastern Arc Mountains are amongst the best studied taxa. There has been long term monitoring of the birds in the East and West Usambaras (Newmark 2006). Researchers from the Zoological Museum of the University of Copenhagen have worked in the Udzungwa, Uluguru, South Nguru and Rubeho Mountains. Neil and Liz Baker from the Tanzania Bird Atlas have worked in the Pare, Usambara and Udzungwa Mountains as well as in several of the Coastal forests (Baker and Baker 2001). The Tanzania Bird Atlas shows records for most months from almost all of the coastal forest and Eastern Arc mapping squares (www.tanzaniabirdatlast.com). There are several field guides for the area including Zimmerman *et al.* (1997), Stevenson and Fanshawe (2002) and Britton (1980).

Birds have been included in the current survey in order to provide a better overview of the biodiversity of the Rubeho, North Pare and Udzungwa (Mufindi) forests. Where possible we have drawn on the results of previous surveys.

In addition to summarising previous records, the current surveys will use two methods to record bird species: mist netting and observations. Given that the focus of these surveys is on recording species presence, methods to assess abundance have not been included.

9.2 Objectives

- To provide an inventory of bird species found in selected forest reserves in the North Pare, Rubeho and Udzungwa Mountains (Mufindi District).

The data collected by the surveys will also be used for assessing the threatened status of these species by the IUCN SSC Bird specialist groups; in guiding protected area authorities to make appropriate management decisions and for monitoring the region's forests.

9.3 Site selection

This will be done by using 1:50,000 scale Tanzania Government maps, satellite images and a review of the literature. The methods outlined below will be applied in the North Pares, Rubehos and Southern Udzungwas (Mufindi District).

Each forest reserve will be surveyed using a stratified sampling strategy. Reserves will be classified according to forest type and altitude. Sampling points will be located in such a way as to cover a range of altitudes and forest types. The number of mist netting sites per reserve will depend on the area and altitudinal range of the reserve with a minimum of one site per 1000 ha of forest. Sampling will be conducted in forests and montane grasslands only.

9.4 Mist netting

9.4.1 Overview

Mist netting is the most effective means of recording more cryptic understorey birds. Mist netting should only be conducted by individuals who are properly trained. The method involves stringing fine nets through the forest understorey. When birds fly into the net, they drop into one of the mesh pockets and become entangled. They can then be carefully removed, identified and measured.

9.4.2 Procedure

Mist nets should be set in undisturbed forest away from the forest edge. Where multiple sites are to be sampled in a given forest, sites should be selected on the basis of altitude and forest type. Mist nets are often most productive near streams so this should also be taken into consideration when selecting a site.

Having selected an area to be sampled, the nets should be set along existing paths or along cut net rides approximately 1 m wide. Where it is necessary to cut net rides, care should be taken to minimise the impact on the natural vegetation while ensuring that the net ride is sufficiently clear to avoid understorey vegetation or rocks getting caught in the nets.

Each net should be suspended between two poles. Where possible the nets should form a continuous run with no breaks between the nets.

Nets will be checked at least every 20 minutes and more frequently around dawn and dusk. At each sampling site, a maximum of 120 metres of net will be set. Nets will be moved every 3 - 4 days at the point when the recorder is no longer capturing new species in the net. For each site, locality and habitat data will be recorded following the categories outlined in Table 1.

In addition data will be recorded on:

- dates when netting starts and stops at each sample site,
- length of nets opened on each day,
- times when nets are opened and closed.

Mist nets will be opened in the mornings and late afternoons. All birds caught in the mist nets will be extracted, identified and measured. For each bird caught, the species, sex, weight, wing length and status of the moult in the primary wing feathers will be recorded on standard sheets.

Birds will be identified in the field by an experienced bird watcher using a combination of three guides Zimmerman et al. (1997), Stevenson and Fanshawe (2002) and Britton (1980). Where there is uncertainty regarding identifications digital photographs will be taken.

9.5 Observations

9.5.1 Overview

Observations will be made throughout the day and night on the basis of sightings and from calls. This work will be undertaken by a team with experience of bird watching in the Eastern Arc Mountains. Observations will be made during walks or at any other time e.g. around camp or while conducting mammal and herpetofauna surveys.

At night members of the bird survey team will walk along paths and drive along roads to record nightjars, owls and other nocturnal birds. The calls of nocturnal birds will also be tape recorded (see 4.5).

9.5.2 Procedure

At the start of a walk, the recorder will make a note of the altitude, habitat type and geographical position. All bird species heard or seen during the walk will be recorded in a notebook. If during the walk, the recorder enters a significantly different vegetation type or climbs / descends more than 100 m, a new site description should be made so that the altitude and vegetation type in which a bird species is recorded, is clear. The focus of the surveys is on forest and montane grassland although forest edge species are also surveyed.

10) Disturbance transects

By Nike Doggart

10.1 Background and research priorities

This method is based on the disturbance transect methods developed by Frontier Tanzania (Frontier-Tanzania 2001) and applied in the East Usambara, Udzungwa, Uluguru and Mahenge Mountains in the Eastern Arc. The method outlined below differs from the method used by Frontier-Tanzania in terms of the sampling strategy. While Frontier-Tanzania developed a systematic grid sampling strategy, we have used a stratified sampling strategy. The priority is to assess levels of disturbance in the North Pare, Rubeho (Dodoma-side) and Udzungwa (Mufindi) forests. Disturbance transects have already been carried out in some of these forests by the Conservation and Management of the Eastern Arc Mountain Forests Project (FBD 2005) during 2004 however the sampling intensity used during these surveys was low. The current project will use a higher sampling intensity more evenly distributed across the reserves.

10.2 Objectives

- To assess the intensity and distribution of human disturbance within a forest.
- To record the types of human disturbance affecting a forest.

10.3 Disturbance transects

10.3.1 Overview

Levels of disturbance are measured along transects distributed through the forest based on a stratified sampling strategy. The levels of pole cutting, timber extraction, trapping, encroachment and other human disturbances are assessed. For the purposes of this survey, poles are defined as all trees with straight stems at least 2 m in length and with a diameter at breast height (dbh) of 5 -15 cm. Timber trees are defined as all trees with straight stems at least 3 m in length and exceeding 15 cm dbh.

The level of disturbance is assessed in terms of the number of incidences of pole cutting, timber cutting, traps and other disturbances in a 10 m strip (5 m either side of the transect line) along a 1 km transect. The disturbance transect is sub-divided into 50 m sections and data is recorded separately for each section. A description of each transect section is recorded in terms of topography, vegetation cover (canopy, shrub and ground layers) and altitude. This data is recorded at the start of each section.

The longitude, latitude and altitude of the start and end points of each disturbance transect are carefully measured using a GPS and recorded.

A stratified sampling strategy is adopted. Thus the forest reserve is categorised in terms of habitat types using the habitat categories outlined in Table 1. The sampling intensity shall be not less than 0.1% equivalent to 1 transect per 1000 ha with a minimum of one transect per habitat type and two per reserve. The transects should be distributed evenly across the reserve and should incorporate both ‘edge’ areas and ‘internal’ areas i.e. areas close to the forest edge and areas towards the ‘centre’ of the forest. To calculate the distance between transects it is necessary first to calculate the number of transects needed to meet the sampling intensity outlined above. Having calculated the total number of transects required per habitat type and given the area of the habitat the distance between transects can be calculated as:

$d = a/n$

Where d = distance between transects (m); a = habitat area (ha) and n = number of transects.

All transects within a single reserve should adopt the same bearing. This may be East – West or North – South depending on the shape of the reserve. The bearing should be selected so as to maximise the number of transects which can be followed for a full 1 km. This is most relevant for small reserves. For larger reserves where this is not an important consideration, a North – South bearing should be adopted.

The team also record other disturbance events observed during the survey including descriptions of the kind of activity and the location of the 'event'. This provides a more comprehensive overview of disturbance occurring within the forest.

10.3.2 Procedure

A team of at least three people are required: one guide, one observer and one recorder. The altitude and coordinates for the starting point are recorded using a GPS. Using a compass and GPS, the team follow a constant bearing for 1 km. The bearing may be East – West or North –South. The team use a 50 m rope to measure out 50 m sections along the 1 km transect. Records are taken separately for each 50 m section.

All disturbances and all live or naturally dead poles and trees within 5 m either side of the transect line are recorded. Where there is uncertainty regarding the diameter of a tree or pole, a dbh tape is used to determine the diameter of the tree. Data are recorded in note books to be transcribed onto data sheets. In case of rain, it is preferable to use a pencil for recording the data.

Each transect should be 1000 m long however in situations where this is not possible, the exact length of the transect is recorded.

Fallen tree trunks or branches are not counted, only stumps. This reduces possible duplicate counts by ensuring that the trunk and branches are not counted as separate 'events'.

Records of other human disturbance seen along each 50 m section of the transect are made including the number of traps, pitsaws, cultivated areas or burnt areas. For each of these disturbance types detailed notes are made on the nature of the disturbance. For example this might include information on the kind of trap; the type of crop being cultivated; the area being cultivated or the extent of a burnt area.

10.4 Data entry

For each transect, the disturbance will be recorded on the data sheet titled DISTURBANCE SURVEY SUMMARY (see Appendix 20). The locality data are the same as those indicated in Table 1.

FOREST RESERVE	Name of forest reserve.
DATE:	Date of completing transect
TRANSECT NUMBER:	Transect number using the two letter code for the Forest Reserve followed by the transect number. Forest reserve codes are given in Appendix 1.
RECORDERS:	Initials of recorders. Full names of all recorders should be recorded in the survey report.
STARTING POINT (LONG / LAT)	Write the longitude and latitude of the transect start point. One transect is recorded on one sheet.
END POINT (LONG/LAT)	Write the longitude and latitude of the transect end point. One transect is recorded on one sheet.
DIRECTION:	The bearing of the transect recorded as N, E, S or W.
SECTION DISTURBANCE CATEGORY	Write the disturbance categories in this section using the initials indicated at the top of the sheet.
NO. OF LIVE SAPLINGS	Record the number of standing, live saplings. Saplings are defined as 5 - 15 cm dbh and a straight trunk of at least 2m in length.
NO. OF NATURALLY DEAD SAPLINGS	Record the number of dead saplings, either standing or fallen. Saplings are defined as 5 - 15cm and a straight trunk of at least 2m in length.
NO. OF CUT SAPLINGS OLD/FRESH	Record the number of cut live saplings. Saplings are defined as 5 - 15 cm dbh. To be considered as cut, the panga mark must be visible. Old is defined as anything other than clean, white marks which are classified as fresh.
NO. OF LIVE TREES	Record the number of standing, live saplings. Saplings are defined as >15 dbh and a straight trunk of at least 3m in length.
NO. OF NATURALLY DEAD TREES	Record the number of standing, live saplings. Saplings are defined as >15 dbh and a straight trunk of at least 3m in length.
NO. OF CUT TREES	Record the number of standing, live saplings. Saplings are defined

OLD/FRESH	as >15 dbh. To be considered as cut, the panga or saw mark must be visible. Old is defined as anything other than clean, white marks which are classified as fresh.

Data will be stored on an Access database in two tables. The first table will store information about the location of transects, and the date when they were completed. The second table will store the detailed results of the disturbance surveys.

11) Methods for recording indigenous knowledge

By Nike Doggart and Charles Leonard

11.1 Background and research priorities

There is a wealth of indigenous knowledge about the biodiversity of the Eastern Arc Mountain and Coastal Forests. Some of this has been documented, particularly for plant species. Less effort has gone into documenting indigenous knowledge about the region's fauna. Understanding the traditional uses and perceptions of different animal species can be useful for conservation planning. For more cryptic species, observations by hunters and others familiar with these animals can also provide valuable insights into their ecology.

In documenting indigenous knowledge, recognition of intellectual property rights is a primary consideration and the identity of informants needs to be scrupulously recorded.

Given the project's focus on primates, duikers, hyrax and sengis, these will be the priority taxa for this work. Key areas of information will include understanding whether these animals are hunted and if so how; whether they have cultural values associated with them; local names; behavioural and ecological observations and perceptions of changes in their abundance.

Within communities, knowledge of the forest will vary between social groups. It is therefore important to document knowledge from women, men, youth and elders. Hunters and herbalists are often the most knowledgeable because they tend to visit the forest regularly so particular effort will be made to interview them.

11.2 Objectives

To document indigenous knowledge about diurnal primates, duikers, galagos, sengis and tree hyrax.

11.3 Literature review

A review of available literature will be undertaken.

11.4 Site selection

This work will be conducted in all sites visited by the members of the survey team.

11.5 Semi-structured interviews

11.5.1 Overview

Semi-structured interviews are conducted with a fairly open framework which allows for focused, conversational, two-way communication. They can be used both to give and receive information (FAO 1990).

Unlike the questionnaire framework, where detailed questions are formulated ahead of time, semi structured interviewing starts with more general questions or topics.

Not all questions are designed and phrased ahead of time. The majority of questions are created during the interview, allowing both the interviewer and the person being interviewed the flexibility to probe for details or discuss issues.

Semi-structured interviewing is guided only in the sense that some form of interview guide provides a framework for the interview.

The interviews will cover the following species:

Harvey's duiker (all forests)
Abbott's duiker (Eastern Arc forests only)

Ader's duiker (coastal forests only)
Blue duiker (all forests)
Bush buck (all forests)
Black and rufous elephant shrew (all forests)
Chequered elephant shrew (all forests)
Golden rumped elephant shrew (coastal forests only)
Dwarf galago (all forests)
Greater galago (all forests)
Black and white colobus monkeys (all forests)
Red colobus (Eastern Arc forests only)
Sykes monkeys (all forests)
Mangabey (Udzungwa only)
Tree hyrax (all forests)
Rock hyrax (all forests)
Snakes
Chameleons
Frogs
Lizards, geckoes, skinks

5.1.2 Procedure

At the start of the interview, the facilitator explains that the purpose of the interview is to understand better the relationship between people in the local area and the animals which the research team is interested in.

An interview may be conducted with between one and three people of the same gender and age group. The interview should not exceed two hours in length.

The interviewer indicates the interview code on the data sheet. This includes a two-letter code for the nearest forest reserve plus a number e.g. the first interview in Kindoroko has the code KI 1 (see Appendix I for a list of forest reserve codes).

The facilitator records the name, gender, tribe, profession, age group, length of residency in the area; sources of livelihood and whether their property is adjacent to the forest for each person being interviewed.

The facilitator then starts asking questions about each species. This process is begun by showing photos and pictures from Kingdon in order to ensure that the interviewer and interviewee are talking about the same species. Discussions then focus around the following areas:

Uses

- Do people eat the animals?
- Do they use their skins for anything. If so what?
- Are they used for any medicinal practices?
- Do people sell the meat? If so, to whom and for how much?
- Do people sell the skins? If so, to whom and for how much?
- Do people sell the live animals?
- How are the animals trapped or hunted?
- By whom are the animals trapped or hunted (women / men?; tribal groups?)
- Does the animal cause any problems to people?

Local names

What are the local names for the animals (specify for each species in Swahili and the local language)

Local traditions or stories

- Do you know of any stories about the animals?
- Do the animals occur in any local traditions?

Abundance

How frequently do you see this animal? And where?

Have they noticed a change in the abundance of these animals? If so are they increasing or decreasing and over what time period?

Behavioural or ecological observations

what do they eat;
what eats them;
what do their vocalisations sound like;
when do they breed;
do they stay with their young;

Any other anecdotes about the animals

The process is then repeated for each of the target species.

During the interview a few notes are made. Immediately after the interview, the facilitator should make detailed notes on the discussion using the forms.

Care should be taken to avoid leading questions; to listen closely; to avoid repeating questions that have already been answered; to probe where necessary; to avoid asking vague or insensitive questions.

12) Data Management

12.1 Data storage

Hard copies of all data sheets will be stored by the Tanzania Forest Conservation Group. Original copies will be held by the lead researchers. Separate files will be kept for mammals, birds and herpetofauna, each file being arranged by location.

Specimen data will be stored on a Microsoft access database. The TFCG Research Officer is responsible for entering the field data to be verified by the relevant lead researcher.

In keeping with the field data sheets, data fields will include:
Forest Reserve
District
Region
Longitude
Latitude
Field specimen number
Altitude
Vegetation type
Aspect
Slope
Topography
Distance to water
% Canopy, shrub and herb cover
Canopy height
Biometrics

12.2 Data sharing

The project will provide the results of these surveys to the Tanzanian National Biodiversity Database, the CEPF Outcomes Database, the relevant IUCN SSC Specialist Group and the Forestry and Beekeeping Division of the Ministry of Natural Resources and Tourism.

Technical reports summarising the findings of the surveys will be prepared for each mountain block visited and will be circulated to relevant stakeholders as well as being made available on the internet at www.tfcg.org. In addition reports will be prepared for each of the focal taxa: galagos, diurnal primates, duikers, sengis and selected amphibians (bufonids,and microhylids).

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Appendix 1. Forest reserve codes

FR Code	Forest Reserve
CH	Chitoa
GE	Genda Genda
IK	Ikaningombe
KA	Kamwella I and II
KD	Kidgemsitu
KG	Kigogo
KI	Kindoroko
KL	Kilulu Hill
KT	Kitwite
KV	Kiverenge
LI	Litipo
LU	Lulanda
MA	Matundu
ME	Mufindi Scarp East
MF	Mafwomero
MI	Minja
MK	Mkonge
MM	Mrima Hill
MN	Mang'alisa
MR	Mramba
MS	Msumbugwe
MW	Mufindi Scarp West
NA	Namakutwa
NG	Ngumburuni
RO	Rondo
RU	Ruawa
US	Udzungwa Scarp
WK	West Kilombero Scarp

Appendix 2. Rapid transect walk data recording sheet – large mammals and sengis

Forest…… 1st observer……2nd obs……
UTM start……UTM end……Dist.(km)……

Main bearing (deg)…….. Alt. range…….. ……Date……..Start time……End time……..
% clouds cover……..

Gross habitat: lowland forest □ submontane forest □ montane forest □ swamp □ regenerating forest □ riverine □ plantation □ woodland □ bamboo □

Other habitat……..Canopy cover (for forest habitats): closed canopy □ regenerating □ shrubby □ open □

Floor cover: shrub/thickets > 2m height □ < 2m □seedlings □ grass □ leaf litter □rock □ Cover density dense □ moderately dense □ open □

Any further relevant description…….

Time	UTM/dist. from start (if possible)	Species	Seen /Heard	Num. Ind.	Observer Distance	Bearing (deg)	Hab Notes and Miscellaneous

Appendix 3. Camera-Trap Form 1: monitoring of cameras

#	Cam. type*	Site/GPS	Date-time	Placed/checked/removed – prog. photos taken	Notes	Observer

* CamTrakker, DC 300, TrailMaster, Vision Scouting, etc

Appendix 4. Camera-Trap Form 2: camera station description

Forest site…….. Site number…….

Forest study area…….. Data collector……..

Camera type……Camera number……UTM coordinates……..

Nearest cameras and approx distance……

Altitude (m a.s.l.)……. Slope (deg.)……Dist to nearest village……..

Placed (date/time)……..Removed (date/time)……

Sampling effort (days /hours)……

Placed on: large trail (elephant trail) □ small trail (duiker trail) □Other……

Bait used: …… Any signs/dungs already in site……

Gross habitat: lowland forest □ submontane forest □ montane forest □ swamp □ regenerating forest □ riverine □ plantation □ woodland □ bamboo □ grassland □ cultivation □

Other habitat……..

Canopy cover (for forest habitats): closed canopy □ regenerating □ shrubby □ open □
Floor cover: shrub/thickets > 2m height □ < 2m □seedlings □ grass □ leaf litter □rock □
Cover density dense □ moderately dense □ open □

Dominant tree species…….

Dominant understorey species…….

Any further relevant description (e.g. more details on microhabitat)……

……

Appendix 5. Camera-Trap form 3: data recording sheet

Site number (refer to Form 2)		Total trap hours	
Camera num and type		Total trap days	
UTM Easting (7 digit integer)		Total number of pics of wildlife	
UTM Northing (7 digit integer)		Number of pics of known mammals	
Latitude (deg-min-seconds)		Number of pics of known birds	
Longitude (deg-min-seconds)		Number of pics of known other	
Start date and time		Number of unknown pics	
Stop date (day/month/year)		Film negative number	
Stop time (or time when film used up)		Data collector	
Comments (broken, batteries died, etc.)			

#	dd-mm, time	Genus species	#	dd-mm, time	Genus species

Appendix 6. Sengi photographs

Pictures of sengi occurring in the Eastern Arc and Coastal Forests of Tanzania and Kenya

Golden-rumped sengi
Rhynchocyon chrysopygus
Anteater-like nose is used to search for prey
Photo: Galen Rathbun

Golden-rumped sengi
Rhynchocyon chrysopygus
Weight = 550 g.
Gedi Ruins, Kenya
Photo: Galen Rathbun

Black and Rufous Sengi
Rhynchocyon petersi
Weight = 520 g
Captive from Tanzania at the Philadelphia Zoo, July 2002
Photo: Heidi Hellmuth, Philadelphia Zoo

Black and Rufous Sengi
Rhynchocyon petersi
Captive mother and young foraging, July 2002
Photo: Heidi Hellmuth, Philadelphia Zoo

Black and Rufous Sengi
Rhynchocyon petersi
Captive mother and young, July 2002
Photo: Heidi Hellmuth, Philadelphia Zoo

Checkered Sengi
Rhynchocyon cirnei
Weight = 500 g
Camera trap image from Matundu Forest, northern Udzungwa Mountains, Tanzania.
Photo: Francesco Rovero

Checkered Sengi
Rhynchocyon cirnei
Camera trap image (Udzungwa Mountains, Tanzania), possibly of a female in estrus followed by male.
Photo: Francesco Rovero

Four-toed sengi
Petrodromus tetradactylus
Weight = 200g
Coastal forest, Kenya
Photo: Galen Rathbun

Appendix 7. Photos of sengi leaf nests

Visual Spoor

A partially constructed nest on the forest floor, showing the oval bowl excavated in the soil with exposed rootlets.

Freshly constructed nests are relatively easy to spot because of the exposed soil surrounding the dome of leaves.

Weathered nests (arrow) are only distinguished from the surrounding leaf litter by a slight mound of leaves. With time, even the dome blends into the surrounding leaf litter and the nest essentially becomes undetectable.

Obstructing vegetation (poles) and dappled lighting on the forest floor make it difficult to a spot nest (arrow) on the forest floor.

Old unused nests can be identified by the collapse of the leaf dome in the centre (arrow), the result of decomposing leaves dr

Appendix 8. Sample galago, hyrax and other nocturnal animal data collection sheet.

It is intended that these fields are adapted and entered into field note books.

Galago, hyrax and other nocturnal animal transect data collection sheet				
Recorder name:			Date:	
Forest Reserve:			Micro site / position:	
GPS coordinates and altitude at start of survey:			GPS coordinates and altitude at end of survey:	
Moon Phase:			Weather conditions:	
Survey type (static or transect):			Survey duration:	
TIME / COUNTER NUMBER	SPECIES	CALL	SUBSTRATE Ht (m)/angle (^{o})/ dia (cm)/dist (m)	NOTES:
	START OF SURVEY			

NOTES

Most cells are self explanatory but additional notes on data type and entry are indicated below.

SURVEY
A survey can be static where observers chose a site and wait for calls to be heard e.g. at a galago nest site at dawn, or as transect surveys on paths, roads and cut transect lines.

TIME:

- Note time of start of survey and counter (cn) number on tape recorder.
- Note end of survey and counter number (cn) on tape recorder.
- If survey is linear note turn around point and any breaks taken.
- Note survey duration.
- Note time of each calling and sighting event and the counter number if the call is recorded.
- Cn = Counter Number of the tape recorder to help tie in recording with written notes.
- Note start and end time of vocalization in the case of long calls i.e. those longer that approx 1 min which mainly applies to galago alarm calls.
- When two or more animals are seen at the same time they can be bracketed together.

IMPORTANT : ALWAYS set the counter dial to zero at the beginning of each side.

SPECIES:

- Name species seen or heard to the best of observers ability.

CALL:

- All calls will be recorded where possible (some happen too fast to record). After the call is recorded, the observer should make vocal notes on the species, time, call name etc (see methods manual for more detailed methods on vocalization recording). In the data sheet note the call name if known. Use abbreviations e.g. IC = incremental call, where helpful but note what they stand for. If the call is not known, give a brief descriptive name e.g. 'descending screech'. Then describe the call more fully in the notes column using sketch sonograms where necessary..
- (u) number of units in the call: Number call units (u) should be noted
- Rec = Vocalization was recorded.

SUBSTRATE:

Note the:

- Ht (m) – Height off the ground of the animal seen. If the animal is only heard, provide an estimate.
- Angle (^{o}) – Estimated angle of the substrate used by an arboreal animal i.e. branch or trunk to nearest 5 degrees.
- Dia (cm) - Diameter estimate of stem to nearest cm
- Dist (m) – Estimate distance of animal or call form observer.

NOTES:

- This section is used to note down behavioural observations of the animal being observed and any other relevant information. Behavioural details can include: categories of locomotion, foraging, feeding, reproductive, interactive, defensive and predatory behaviour as well as scent marking and activity patterns.
- Descriptive notes of the vocalization can be expanded upon here.
- Descriptions of animals seen, noting size and colour of dorsum, flanks ventrum, tail, face mask and ears.
- Interval of at least 5 min should be left between samples of behaviour to ensure records were independent.

Appendix 9. Galago trapping data sheet

Part 1 - Galago Trapping Data Sheet

NAME OF COLLECTOR:	
SITE:	
GPS cords:	
DATE AND TIME OF CAPTURE:	
SPECIES:	
HABITAT:	
REF/SPECIMEN NO:	

Measurements

Weight (gms)	
Total length (mm)	
Tail (mm)	
Hind foot (mm)	
Ear (mm)	
Testes greatest width (mm)	
Testes greatest length (mm)	
Penis length (mm)	
Penis width at base/mid point/tip (mm)	

Notes:

Dentition	
Face mask	
Ear colour	
Dorsum	
Ventrum	
Tail	
Nail shape	

Ecto-parasites – presence/absence		Specimen no:	
DNA sample – where taken from		Specimen no:	
Scars/distinguishing marks:			

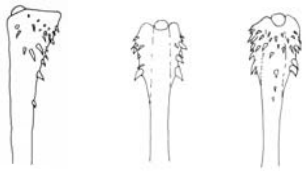
Part 2 - Galago Trapping Data Sheet

Reproductive Notes

Sex:	
Pregnancy	
Nipples - lactating etc	
Testes - present	
Penis - shape/presence & distribution of spines. (Illustration/sketch at end.)	

Penis morphology.

Draw the lateral, dorsal and ventral profiles as indicated in the example of the Rondo galago below:



Hand pad morphology

Draw the hand and foot pad as indicated in the example of Demidoff's galago below:

Part 2: Habitat notes for galago trap sites.

SPECIES:	
F.R. CODE:	
LONGITUDE / LATITUDE:	
NAME:	
DATE:	
MOONPHASE:	
WEATHER:	
ALTITUDE (m):	

TOPOGRAPHY:

SLOPE (deg):		GENTLE MID-SLOPE		RIDGE/HILL TOP/PEAK		PLAIN	
ASPECT:		STEEP MID-SLOPE		UPLAND PLATEAU		GULLY	
GENTLE LOWER SLOPE		GENTLE UPPER SLOPE		VALLEY FLOOR			
STEEP LOWER SLOPE		STEEP UPPER SLOPE		LOWLAND			

VEGETATION TYPE:

LOWLAND FOREST		SCRUB/THICKET/BUSH	
SUBMONTANE FOREST		BAMBOO	
MONTANE FOREST		(OPEN) WOODLAND	
SWAMP FOREST		HERB. MARSH / SWAMP	
COLONISING FOREST		FERNS DOMINATED	
RIVERINE FOREST		FALLOW/PREV.DISTURBED	
PLANTATION FOREST		CULTIVATION	

VEGETATION COVER:

TREE CANOPY:		<10%, 10-50% >50%	
GROUND LAYER:		<10%, 10-50% >50%	
SHRUB LAYER:		<10%, 10-50% >50%	

FOREST EDGE/GAP?		**CANOPY HEIGHT:**	
FOREST EDGE		<10m	
FOREST GAP		10-20m	
BOTH		20-30m	
NEITHER		>30m	

Other notes

Appendix 10. Sengi Data Sheet

Filling the Knowledge Gap
Forest Reserve:

SENGIS

TFCG / MTSN

FOREST RESERVE
RECORDER(S):
KMH NO: (sighting number FR/# if not collected)
COLLECTED
DAY: MONTH: YEAR:
ID, if not collected: Certain: Probable: Uncertain:
TIME OF CAPTURE OR OBSERVATION:

TAXON ID:
GENUS:
SPECIES:
SUBSPECIES:
OBSERVATION / CAPTURE METHOD:
DETERMINER
DET.DATE

ALTITUDE (m):
SLOPE (deg):
ASPECT:
LONGITUDE:
LATITUDE:

TOPOGRAPHY:

GENTLE LOWER SLOPE
STEEP LOWER SLOPE
GENTLE MID-SLOPE
STEEP MID-SLOPE
GENTLE UPPER SLOPE
STEEP UPPER SLOPE
RIDGE/HILL TOP/PEAK
UPLAND PLATEAU
VALLEY FLOOR
LOWLAND PLAIN
GULLY
OTHER

VEGETATION TYPE:

LOWLAND FOREST
SUBMONTANE FOREST
MONTANE FOREST
SWAMP FOREST
COLONISING FOREST
RIVERINE FOREST
PLANTATION FOREST
(OPEN) WOODLAND
OTHER
SCRUB/THICKET/BUSH
BAMBOO
GRASSLAND
HERB. MARSH / SWAMP
FERNS DOMINATED
FALLOW/PREV.DISTURBED
CULTIVATION
ROCK/BARREN

VEGETATION COVER:

	<10%	10-50%	>50%
TREE CANOPY:			
GROUND LAYER:			
SHRUB LAYER:			

FOREST EDGE/GAP?

FOREST EDGE
FOREST GAP
BOTH
NEITHER

CANOPY HEIGHT:

<10m
10-20m
20-30m
>30m

MICROHABITAT:

TREE BARK
TREE BASE
BRANCH
STONE
OTHER
LEAF
GRASS
LEAF LITTER
LOG
WATER
BAREGROUND
PATH
BURNT LAND

WATER ASSOCIATION

RIVER
STREAM
POND/LAKE
MARSH/SWAMP
DRY RIVER BED
NONE/UNKNOWN
OTHER

METRES ABOVE GROUND:
ASSOCIATED PLANT SP.:
WATER ASSOCIATION DISTANCE (m):

SEX: M
F
UNKNOWN

AGE:
INFANT
JUVENILE
SUBADULT
ADULT
OLD
UNKNOWN

BIOMETRICS:

HEAD & BODY (mm)
TAIL (mm)
EAR (mm)
(HIND) FOOT (mm)
WEIGHT (g)
OTHER

FEMALE PREGNANT:
FEMALE LACTATING:
TISSUE SAMPLE TAKEN:
PHOTOGRAPHS TAKEN:

COLOUR NOTES:

BELLY:
BACK:
HEAD:
LEG:
TAIL:

Notes on reverse: distinguishing descriptive, behavioural, geographic and other notes

Appendix 11. Mammal data sheet

Filling the Knowledge Gap
Forest Reserve:

MAMMALS (NOT BATS)

TFCG / MTSN

FOREST RESERVE
PLOT ID: ("0" if outside the F.R.)
KMH NO: (sighting number FR/# if not collected)
COLLECTOR:
DAY: MONTH: YEAR:
ID, if not collected: Certain: Probable: Uncertain:
TIME OF CAPTURE (where possible):

TAXON ID:
GENUS:
SPECIES:
SUBSPECIES:
CAPTURE METHOD:
DETERMINER
DET.DATE

ALTITUDE (m):
SLOPE (deg):
ASPECT:
LONGITUDE:
LATITUDE:

TOPOGRAPHY:

GENTLE LOWER SLOPE		GENTLE UPPER SLOPE		VALLEY FLOOR	
STEEP LOWER SLOPE		STEEP UPPER SLOPE		LOWLAND PLAIN	
GENTLE MID-SLOPE		RIDGE/HILL TOP/PEAK		GULLY	
STEEP MID-SLOPE		UPLAND PLATEAU		OTHER	

VEGETATION TYPE:

LOWLAND FOREST		SCRUB/THICKET/BUSH	
SUBMONTANE FOREST		BAMBOO	
MONTANE FOREST		GRASSLAND	
SWAMP FOREST		HERB. MARSH / SWAMP	
COLONISING FOREST		FERNS DOMINATED	
RIVERINE FOREST		FALLOW/PREV.DISTURBED	
PLANTATION FOREST		CULTIVATION	
(OPEN) WOODLAND		ROCK/BARREN	

OTHER

VEGETATION COVER:

	<10%	10-50%	>50%
TREE CANOPY:			
GROUND LAYER:			
SHRUB LAYER:			

FOREST EDGE/GAP?

FOREST EDGE	
FOREST GAP	
BOTH	
NEITHER	

CANOPY HEIGHT:

<10m	
10-20m	
20-30m	
>30m	

MICROHABITAT:

TREE BARK		LEAF		WATER	
TREE BASE		GRASS		BAREGROUND	
BRANCH		LEAF LITTER		PATH	
STONE		LOG		BURNT LAND	

OTHER

WATER ASSOCIATION

RIVER		DRY RIVER BED	
STREAM		NONE/UNKNOWN	
POND/LAKE		OTHER	
MARSH/SWAMP			

METRES ABOVE GROUND:
ASSOCIATED PLANT SP.:
WATER ASSOCIATION DISTANCE (m):

SEX: M
F
UNKNOWN

AGE:
INFANT
JUVENILE
SUBADULT
ADULT
OLD
UNKNOWN

BIOMETRICS:

HEAD & BODY (mm)	
TAIL (mm)	
EAR (mm)	
(HIND) FOOT (mm)	
WEIGHT (g)	
OTHER	

FEMALE PREGNANT:
FEMALE LACTATING:

TISSUE SAMPLE TAKEN:

COLOUR NOTES:

BELLY:
BACK:
HEAD:
LEG:
TAIL:

Notes on reverse: distinguishing descriptive, geographic and any other

Appendix 12. Amphibian data sheet

Filling the Knowledge Gap

AMPHIBIANS

TFCG / MTSN

FOREST RESERVE:
PLOT ID: ("0" if outside F.R.)
KMH NO: ("0" if not collected)
COLLECTOR:
DAY: MONTH: YEAR:
ID, if not collected: Certain: Probable: Uncertain:
TIME OF CAPTURE (where possible):

TAXON ID:
GENUS:
SPECIES:
SUBSPECIES:
CAPTURE METHOD:
DETERMINER
DET.DATE

ALTITUDE (m):
SLOPE (deg):
ASPECT:
LONGITUDE:
LATITUDE:

TOPOGRAPHY:

GENTLE LOWER SLOPE
STEEP LOWER SLOPE
GENTLE MID-SLOPE
STEEP MID-SLOPE
GENTLE UPPER SLOPE
STEEP UPPER SLOPE
RIDGE/HILL TOP/PEAK
UPLAND PLATEAU
VALLEY FLOOR
LOWLAND PLAIN
GULLY
OTHER

VEGETATION TYPE:

LOWLAND FOREST
SUBMONTANE FOREST
MONTANE FOREST
SWAMP FOREST
COLONISING FOREST
RIVERINE FORESTS
PLANTATION FOREST
(OPEN) WOODLAND
OTHER
SCRUB/THICKET/BUSH
BAMBOO
GRASSLAND
HERB. MARSH / SWAMP
FERNS DOMINATED
FALLOW/PREV.DISTURBED
CULTIVATION
ROCK/BARREN

VEGETATION COVER:

	<10%	10-50%	>50%
TREE CANOPY:			
GROUND LAYER:			
SHRUB LAYER:			

FOREST EDGE/GAP?

FOREST EDGE
FOREST GAP
BOTH
NEITHER

CANOPY HEIGHT:

<10m
10-20m
20-30m
>30m

MICROHABITAT:

TREE BARK
TREE BASE
BRANCH
STONE
OTHER
LEAF
GRASS
LEAF LITTER
LOG
WATER
BARE GROUND
PATH
BURNT LAND

WATER ASSOCIATION

RIVER
STREAM
POND/LAKE
MARSH/SWAMP
DRY RIVER BED
NONE/UNKNOWN
OTHER

METRES ABOVE GROUND:
ASSOCIATED PLANT SP.:
WATER ASSOCIATION DISTANCE (m):

SEX: M / F / UNKNOWN

AGE: INFANT / JUVENILE / SUBADULT / ADULT / OLD / UNKNOWN

BIOMETRICS

SNOUT-VENT (mm)
TAIL (mm)
WEIGHT (g)

EYES:

ROUND
VERTICAL
HORIZONTAL
RHOMBOID
OTHER

IRIS COLOUR:

GOLD
SILVER
RED
OTHER

OTHER

COLOUR NOTES:

BELLY
BACK
HEAD
LEG
TAIL

FEMALE EGGS:
NO. OF EGGS:
TISSUE SAMPLE TAKEN:
PHOTOGRAPHS TAKEN:

Notes on reverse: distinguish descriptive, geographic and other notes

Appendix 13. Reptile data sheet

Filling the Knowledge Gap — TFCG/MTSN

REPTILES

F.R. CODE: | TAXON ID:
PLOT ID: ("0" if outside F.R.) | GENUS:
KMH NO: ("0" if not collected) | SPECIES:
COLLECTOR: | SUBSPECIES:
DAY: MONTH: YEAR: | CAPTURE METHOD:
ID, if not collected: Certain: Probable: Uncertain: | DETERMINER
TIME OF CAPTURE (where possible): | DET.DATE

ALTITUDE (m):
SLOPE (deg):
ASPECT:

TOPOGRAPHY:

GENTLE LOWER SLOPE ☐ | GENTLE UPPER SLOPE ☐ | VALLEY FLOOR ☐
STEEP LOWER SLOPE ☐ | STEEP UPPER SLOPE ☐ | LOWLAND PLAIN ☐
GENTLE MID-SLOPE ☐ | RIDGE/HILL TOP/PEAK ☐ | GULLY ☐
STEEP MID-SLOPE ☐ | UPLAND PLATEAU ☐ | OTHER

VEGETATION TYPE:

LOWLAND FOREST ☐ | SCRUB/THICKET/BUSH ☐
SUBMONTANE FOREST ☐ | BAMBOO ☐
MONTANE FOREST ☐ | GRASSLAND ☐
SWAMP FOREST ☐ | HERB. MARSH / SWAMP ☐
COLONISING FOREST ☐ | FERNS DOMINATED ☐
RIVERINE FORESTS ☐ | FALLOW/PREV.DISTURBED ☐
PLANTATION FOREST ☐ | CULTIVATION ☐
(OPEN) WOODLAND ☐ | ROCK/BARREN ☐
OTHER

VEGETATION COVER:

	<10%	10-50%	>50%
TREE CANOPY:	☐	☐	☐
GROUND LAYER:	☐	☐	☐
SHRUB LAYER:	☐	☐	☐

FOREST EDGE/GAP?

FOREST EDGE ☐
FOREST GAP ☐
BOTH ☐
NEITHER ☐

CANOPY HEIGHT:

<10m ☐
10-20m ☐
20-30m ☐
>30m ☐

MICROHABITAT:

TREE BARK ☐ | LEAF ☐ | WATER ☐
TREE BASE ☐ | GRASS ☐ | BAREGROUND ☐
BRANCH ☐ | LEAF LITTER ☐ | PATH ☐
STONE ☐ | LOG ☐ | BURNT LAND ☐
OTHER

WATER ASSOCIATION

RIVER ☐ | DRY RIVER BED ☐
STREAM ☐ | NONE/UNKNOWN ☐
POND/LAKE ☐ | OTHER
MARSH/SWAMP ☐

METRES ABOVE GROUND:
ASSOCIATED PLANT SP.:
WATER ASSOCIATION DISTANCE (m):

SEX:

M ☐
F ☐
UNKNOWN ☐

AGE:

INFANT ☐
JUVENILE ☐
SUBADULT ☐
ADULT ☐
OLD ☐
UNKNOWN ☐

TISSUE SAMPLE TAKEN: ☐

BIOMETRICS:

SNOUT-VENT (mm)
TAIL (mm)
WEIGHT (g)
OTHER

EYE: PUPIL SHAPE

ROUND ☐
VERTICAL ☐
HORIZONTAL ☐
OTHER

FEMALE EGGS:
NO. OF EGGS:

COLOUR NOTES:

BELLY
BACK
HEAD
LEG
TAIL

Notes on reverse: distinguish descriptive, geographic and other notes

Appendix 14. Trap site summary sheet

TRAPSITE SUMMARY

Forest Reserve:	**Dates:**
Trapsite:	**Transect:**
	Altitude (masl):
Longitude:	**Habitat:**
Latitude:	**Water assocn.:**
	Water distance (m):

Total number of sherman trap nights (traps x nights):			
Total number of pitfall trap nights (traps x nights):			

Taxon	Family	Genus	Species	No. of captures (recpatures)	Specimen no.	Trapping Method

Appendix 15. Shrew and rodent biometric data summary sheet

Trap night	Date	Trap no.	KMH no.	New / Recapture	Genus	Species	Sex	Age	Breeding	Wt (g)	HB (mm)	T (mm)	E (mm)	HF (mm)	T: Hairs at tip(Y/N)	HF: dark / pink-white	Pelage Notes: Dorsal, Ventral & tail colour

Abbreviations to use for the Sherman Trapping Data Sheet.		
Subject	**Abbreviation**	**Explanation**
Trapping	N	New individual (i.e.) no mark code
	R	Recapture
Sex	M	Male
	F	Female
	U	Unknown
Age	A	Adult
	SA	Sub adult
	J	Juvenile
Breeding	L (3)	Lactating (number of nipples)
	P (3)	Pregnant (number of nipples)
	TA	Testes abdominal
	TL	Testes large
Tail	Y	Yes Hairs at tip of tail
	N	No hairs at tip of tail
Hind foot	D	dark areas to toes of hind foot
	PW	pink - white toes of hind foot
Pelage	D	Dorsal (Back)
	V	Ventral (Belly)
	r	roots of fur
	t	tips of fur

Abbreviations currently on Sherman Trapping Data Sheet		
Subject	**Abbreviation**	**Explanation**
Biometrics	Wt (g)	Weight
	HB (mm)	Head Body (nose tip to anus)
	T (mm)	Tail (anus to tail tip)
	E (mm)	Ear (base to tip- usually the diagonal)
	HF (mm)	Hind foot (ankle to skin on nail) (NOT Nail)

FOR EACH TRAPSITE WE NEED TO TAKE ONE MALE AND ONE FEMALE OF EACH SPECIES.
ALSO, TAKE ANYTHING YOU ARE NOT SURE ABOUT.
PAY PARTICULAR ATTENTION TO THE LENGTH, SCALING AND HAIRS ON TAILS.

Appendix 16. Sherman trap summary sheet

Date: **Trap night:** **Date:** **Trap night:**

Trap no.	R	BM	U	S (BM or BP)	NW	Trap no.	R	BM	U	S (BM or BP)	NW
1						1					
2						2					
3						3					
4						4					
5						5					
6						6					
7						7					
8						8					
9						9					
10						10					
11						11					
12						12					
13						13					
14						14					
15						15					
16						16					
17						17					
18						18					
19						19					
20						20					
21						21					
22						22					
23						23					
24						24					
25						25					
26						26					
27						27					
28						28					
29						29					
30						30					
31						31					
32						32					
33						33					
34						34					
35						35					
36						36					
37						37					
38						38					
39						39					
40						40					
41						41					
42						42					
43						43					
44						44					
45						45					
46						46					
47						47					

48					
49					
50					
Total					

48					
49					
50					
Total					

R : rodent BM: bait missing U: untouched S: sprung (bait missing or bait present)
NW: not working

Appendix 17. Bucket pitfall habitat description sheet.

Line	Bucket no.	Habitat	Microhabitat	Slope	Aspect	Altitude (m)	Associated Water	Distance from water	Canopy height (m)	Tree cover (%)	Ground layer (%)	Shrub layer (%)
1	1											
	2											
	3											
	4											
	5											
	6											
	7											
	8											
	9											
	10											
	11											

Line	Bucket no.	Habitat	Microhabitat	Slope	Aspect	Altitude (m)	Associated Water	Distance from water	Canopy height (m)	Tree cover (%)	Ground layer (%)	Shrub layer (%)
2	1											
	2											
	3											
	4											
	5											
	6											
	7											
	8											
	9											
	10											
	11											

Line	Bucket no.	Habitat	Microhabitat	Slope	Aspect	Altitude (m)	Associated Water	Distance from water	Canopy height (m)	Tree cover (%)	Ground layer (%)	Shrub layer (%)
3	1											
	2											
	3											
	4											
	5											
	6											
	7											
	8											
	9											
	10											
	11											

Appendix 18. Summary sheet for trap status.

Zoo site:

Date	Day	R	U	BM	S/BM	S/BP	NW	Total
	1							
	2							
	3							
	4							
	5							
Total								

Zoo site:

Date	Day	R	U	BM	S/BM	S/BP	NW	Total
	1							
	2							
	3							
	4							
	5							
Total								

Zoo site:

Date	Day	R	U	BM	S/BM	S/BP	NW	Total
	1							
	2							
	3							
	4							
	5							
Total								

Zoo site:

Date	Day	R	U	BM	S/BM	S/BP	NW	Total
	1							
	2							
	3							
	4							
	5							
Total								

R = Rodent U = Untouched BM = Bait missing S = Snapped
BP = Bait present NW = Not working

Appendix 19. Summary form for Sherman trap habitat details

Trap no.	Habitat	Topography	Microhabitat	Slope	Aspect	Altitude (m)	Associated Water	Distance from water	Canopy height (m)	Tree cover (%)	Ground layer (%)	Shrub layer (%)
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
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45												
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47												
48												
49												
50												

Key to abbreviations to be used on Sherman trap habitat details summary form

Subject	Abbreviation	Explantion	
Habitat	LF	Lowland Forest	
	RF	Riverine Forest	
	SMF	Submontane Forest	
	MF	Montane Forest	
	G	Grassland	
	PC	Previously Cultivated	
Microhabitat	LL	Leaf Litter	
	TB	Tree Base	
	DW	Dead Wood	
	S	Shrubs/tangle	
Aspect	N	North	Be as accurate as possible i.e. Use NW, NE etc where applicable
	S	South	
	E	East	
	W	West	
Associated Water	S	Stream	
	R	River	River = water course that is named
	N	None	
	P	Pond	
	M / S	Marsh / Swamp	
Vegetation Cover	<10%	less than 10 %	Use this scale for tree cover, shrub layer & ground layer
	10-50%	10 to 50 %	
	>50%	more than 50%	

Appendix 20. Disturbance Summary Form

Filling the knowledge gap

TFCG / MTSN

DISTURBANCE SURVEY SUMMARY

FOREST RESERVE: _____ DATE: _____

TRANSECT NO: _____ STARTING POINT (LONG / LAT) _____

RECORDERS: _____ END POINT (LONG / LAT) _____

DISTURBANCE CATEGORY:

PITSAWING	P	TIMBER, PLANKS, POLES	W
FIRE DAMAGE	F	CHARCAOL BURNING	B
CULTIVATION	C	TRAPS, PITFALLS, ETC	T
SETTLEMENT	S	ANIMAL REMAINS	A
CAMP(SITE)	K	GUNFIRE	G
MINING (SITE)	M	OTHER	O
PATH	R		

DIRECTION: _____

START TIME: _____

END TIME: _____

DATE (D/M/Y)	SECTION (m)	SECTION DIST.CAT.	NO. OF LIVE POLES	NO. OF NAT. DEAD POLES	NO. OF CUT POLES		NO. OF LIVE TIMBERS	NO. OF NAT. DEAD TIMBERS	NO. OF CUT TIMBERS	
					OLD	FRESH			OLD	FRESH
	0-50									
	50-100									
	100-150									
	150-200									
	200-250									
	250-300									
	300-350									
	350-400									
	400-450									
	400-450									
	450-500									
	500-550									
	550-600									
	600-650									
	650-700									
	700-750									
	750-800									
	800-850									
	850-900									
	900-950									
	950-1000									

	SECTION	TOPOGRAPHY	CANOPY COVER	SHRUB LAYER	GROUND LAYER	ALT (m)	NOTES
	0-50						
	50-100						
	100-150						
	150-200						
	200-250						
	250-300						
	300-350						
	350-400						
	400-450						
	450-500						
	500-550						
	550-600						
	600-650						
	650-700						
	700-750						
	750-800						
	800-850						
	850-900						
	900-950						
	950-1000						

Appendix 21. Indigenous Knowledge Data Sheet

NAME OF INTERVIEWER		**INTERVIEW CODE**	
DATE OF INTERVIEW	DAY	MONTH	YEAR
NEAREST FOREST RESERVE			
MOUNTAIN BLOCK			

NAME OF INTERVIEWEE	**GENDER**	**AGE GROUP**	**TRIBE**	**VILLAGE**
	M ☐ F ☐	<20 ☐ 20 - 40 ☐ 40+ ☐		
LENGTH OF RESIDENCY IN THE AREA?	☐ WHOLE LIFE		OTHER SPECIFY	
PROFESSION / MAIN ECONOMIC ACTIVITIES				
HIGHEST LEVEL OF EDUCATION ATTAINED				

INTERVIEWEE 2	**GENDER**	**AGE GROUP**	**TRIBE**	**VILLAGE**
	M ☐ F ☐	<20 ☐ 20 - 40 ☐ 40+ ☐		
LENGTH OF RESIDENCY IN THE AREA?	☐ WHOLE LIFE		OTHER SPECIFY	
PROFESSION / MAIN ECONOMIC ACTIVITIES				
HIGHEST LEVEL OF EDUCATION ATTAINED				

INTERVIEWEE 3	**GENDER**	**AGE GROUP**	**TRIBE**	**VILLAGE**
	M ☐ F ☐	<20 ☐ 20 - 40 ☐ 40+ ☐		
LENGTH OF RESIDENCY IN THE AREA?	☐ WHOLE LIFE		OTHER SPECIFY	
PROFESSION / MAIN				

ECONOMIC ACTIVITIES

HIGHEST LEVEL OF EDUCATION ATTAINED

ARE THERE ANY SACRED FORESTS IN THIS AREA? ☐ YES ☐ NO

IF YES, WHICH FOREST(S)?

CAN YOU DESCRIBE THE TRADITIONS ASSOCIATED WITH THIS FOREST?

INTERVIEW CODE | DATE | PAGE

SPECIES

ARE YOU FAMILIAR WITH THIS SPECIES? ☐ YES ☐ NO

DO PEOPLE IN YOUR VILLAGE EAT THESE ANIMALS? ☐ YES ☐ NO

IS THE MEAT SOLD? ☐ YES ☐ NO

IF YES, TO WHOM AND FOR HOW MUCH?

DO PEOPLE IN YOUR VILLAGE USE THESE ANIMALS SKIN? ☐ YES ☐ NO

IF YES, PLEASE SPECIFY

ARE THE SKINS SOLD? ☐ YES ☐ NO

IF YES, TO WHOM AND FOR HOW MUCH?

ARE THE ANIMALS USED FOR MEDICINAL PURPOSES? ☐ YES ☐ NO

IF YES, PLEASE SPECIFY

DO PEOPLE IN YOUR VILLAGE TRAP AND SELL THE ANIMALS LIVE? ☐ YES ☐ NO

IF YES, TO WHOM AND FOR HOW MUCH?

DESCRIBE HOW THE ANIMALS ARE TRAPPED OR HUNTED

LOCAL NAMES LANGUAGE NAME

LANGUAGE NAME

LANGUAGE NAME

DO YOU KNOW OF ANY LOCAL STORIES ABOUT THESE ANIMALS? PLEASE SPECIFY USING A SEPARATE SHEET IF NECESSARY

DO YOU KNOW OF ANY LOCAL TRADITIONS ABOUT THESE ANIMALS? PLEASE SPECIFY USING A SEPARATE SHEET IF NECESSARY

INTERVIEW CODE DATE PAGE

SPECIES

HOW FREQUENTLY DO YOU SEE THIS ANIMAL? ☐ ONCE PER DAY ☐ ONCE PER WEEK ☐ ONCE PER MONTH ☐ ONCE PER YEAR ☐ LESS THAN ONCE PER YEAR

WHERE DO YOU SEE THIS ANIMAL? ☐ FOREST ONLY ☐ OTHER, SPECIFY

HAVE YOU NOTICED A CHANGE IN THE ABUNDANCE OF THIS ANIMAL? ☐ YES ☐ NO

IF YES, IS IT: ☐ DECREASING ☐ INCREASING

OVER WHAT TIME PERIOD?

OTHER COMMENTS ON ABUNDANCE

WHY DO YOU THINK THERE HAS BEEN A CHANGE?

☐ DON'T KNOW

DO THESE ANIMALS CAUSE ANY PROBLEMS TO YOU OR OTHER PEOPLE IN YOUR VILLAGE?

☐ YES ☐ NO

IF YES, WHAT KIND OF PROBLEMS?

OTHER BEHAVIOUR OBSERVATIONS ABOUT THIS SPECIES

SPECIES NOT KNOWN FROM THE AREA

SPECIES	NOT FAMILIAR WITH THIS SPECIES	FAMILIAR WITH THE SPECIES BUT NO LONGER FOUND IN THE AREA