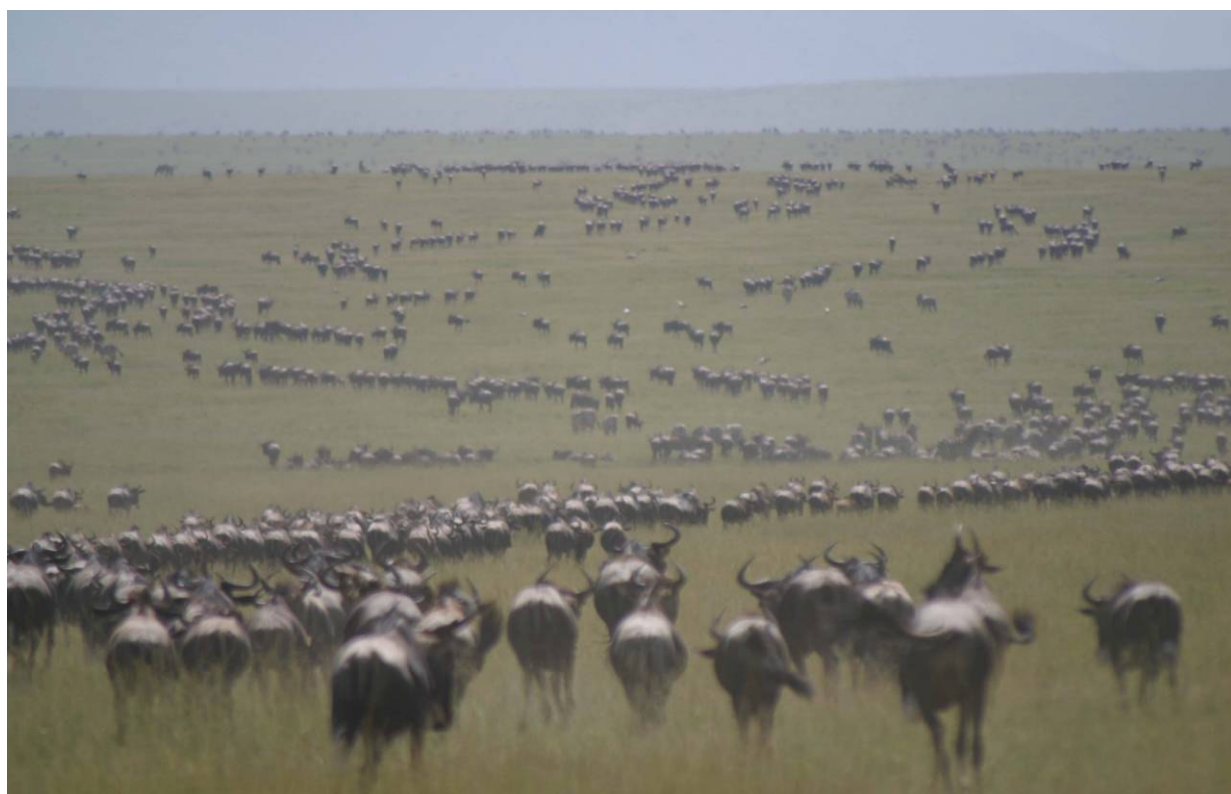# DARWIN INITIATIVE

# A NATIONAL PLAN FOR MAMMAL CONSERVATION IN TANZANIA

# FINAL REPORT

## November 1st 2005 – February 7th 2009



**Zoological Society of London**

In collaboration with

**Tanzania Wildlife Research Institute**

funded by

**The Darwin Initiative for the Survival of Species**

# Darwin project information

| | |
|---|---|
| Project Reference | 162/14/055 |
| Project Title | A national plan for mammal conservation in Tanzania |
| Host country(ies) | Tanzania |
| UK Contract Holder Institution | Institute of Zoology, Zoological Society of London |
| UK Partner Institution(s) | Zoological Society of London |
| Host Country Partner Institution(s) | Tanzania Wildlife Research Institute |
| Darwin Grant Value | £ 214,051 |
| Start/End dates of Project | Oct 2005 – December 2008 |
| Project Leader Name | Dr Sarah Durant, Dr Charles Foley |
| Project Website | www.tanzaniamammals.org |
| Report Author(s) and date | Dr. Sarah Durant, Mr. Alex Lobora,  Dr. Charles Foley, & Dr. Simon Mduma, April 2009 |

**Abbreviations and Acronyms**

| | |
|---|---|
| CBD | Convention on Biological Diversity |
| CIMU | Conservation Information Monitoring Unit at TAWIRI |
| CVTM | Centre for Tropical Veterinary Medicine |
| DFID | Department For International Development |
| FZS | Frankfurt Zoological Society |
| GDP | Gross Domestic Product |
| GIS | Geographical Information Systems |
| GNI | Gross national income |
| QDGS | Quarter Degree Grid Square |
| TANAPA | Tanzania National Parks |
| TAWIRI | Tanzania Wildlife Research Institute |
| TCC | Tanzania Carnivore Centre |
| TCP | Tanzania Carnivore Programme |
| TMAP | Tanzania Mammal Atlas Project |
| WCS | Wildlife Conservation Society |

# 1 Project Background

Tanzania has an extraordinarily rich mammal fauna, ranking 5th in Africa in mammal biodiversity, with the Serengeti ecosystem alone boasting the highest diversity of ungulates in the world and the greatest density in Africa. The conservation of Tanzania's wildlife resources were made a national priority soon after independence under the new president Nyerere's Arusha declaration, by which protection for extensive wilderness areas in Tanzania was assured. Since this time Tanzania has continued to show a commitment to conservation and the country's conservation record is exceptional; 15% of land is set aside entirely for biodiversity conservation, and almost 25% is granted some level of protective status. The abundance of wildlife resources has spawned a large, rapidly expanding wildlife-related tourism industry, revolving around photographic safaris and sport hunting. Tourism is increasingly economically important, as tourism is the second largest earner of foreign exchange, with an estimated value of $825 million in 2005, 25% of the total foreign revenue (Bank of Tanzania 2007; World Bank 2007).. Maintenance and conservation of Tanzania's wilderness areas are thus increasingly seen as a component of the path to development, because of their increasing economic importance due to tourism to these areas.

   However, despite these biological riches, Tanzania remains one of the poorest countries in the world. In 2006 the World Bank ranked Tanzania as 18th lowest in its GNI (Gross National Income) and 4th lowest in its Purchasing Power Parity (World Bank 2007). Tanzania has a human population of 39.5 million in 2007 in an area of nearly one million square kilometres and a per capita income of $350 per year (World Bank 2007). The population is growing at 2.6% per year against a sub-Saharan Africa rate of 2.3% (World Bank 2007). Nevertheless, over recent years Tanzania has had positive economic growth and over 2004-2006 has had an average annual growth rate of around 6% per year (World Bank 2007). The economic benefits of wildlife tourism means that Tanzania's biodiversity, particularly the large mammals sought after by tourists, is important for the country's development. However, despite this, conservation is, by necessity, low on the list of the country's priorities. Far more pressing needs, such as basic education and health, inevitably take precedence. Because of this, Tanzania's rapidly developing wildlife sector depends on external assistance for support. In particular, as a signatory to the biodiversity convention, Tanzania relies on support from developed countries to fulfill its obligations to the convention.

   Whilst Tanzania clearly demonstrates, through its protected area network, a commitment to wildlife conservation, there has been no formal national framework for mammal conservation in the country. Furthermore information on the distribution and status of many mammal species, essential for developing such a framework, has been limited since Tanzania lacks capacity for monitoring its biodiversity. These gaps in capacity led to the development and implementation of this project. The project aimed at helping Tanzania to fulfill its obligations under articles, 7, 8, 10, 11, 12, 13 and 16 of the Convention on Biological Diversity (CBD) by developing a national conservation action plan for its mammal species. In order to do this, national institutions need to be strengthened and capacity to monitor and conserve mammalian biodiversity increased. This project aimed to achieve this by a) developing capacity to monitor mammal distribution and status in areas where little information is available; b) establishing protocols to monitor small and cryptic species, c) collating all existing information to develop a centralized database regrouping information on distribution, status and, where possible, abundance, of all Tanzanian mammals (excluding rodents, bats, insectivores, and marine mammals). These steps have generated sufficient data to develop a series of action plans that will be used as a framework to guide future conservation management and policy in the country.

# 2 Project support to the Convention on Biological Diversity (CBD)

In order to assist Tanzania in meeting its obligations under the Biodiversity Convention the project has:

- Surveyed and monitored mammal diversity in Tanzania and collated all new and existing data into a central database (Article 7, Identification and Monitoring).
- Identified areas and species which may be in need of further protection or management, and devised conservation action plans to ensure their long term conservation (Article 8, In-situ Conservation).
- Explored possible incentives to enhance mammal conservation within the species action plans (Article 11, Incentive measures).
- Provided training in mammal monitoring and promoted mammal research (Article 12, Research and Training).
- Promoted an understanding of the importance of the conservation of mammal biodiversity both within the wildlife sector, with which the project has worked closely, and among the public through project newsletters and web site (Article 13, Public Education and Awareness).

- Ensured that there has been a transfer of expertise and technological advances in monitoring techniques from developed countries to Tanzania (Article 16, Access to and Transfer of Technology).

# 3  Project Partnerships

**Host Country Partner:**

**Tanzania Wildlife Research Institute (TAWIRI):** TAWIRI is mandated to carry out and co-ordinate all wildlife research in the United Republic of Tanzania and disseminate this information to the management authorities and the general public. TAWIRI is the main host country partner for this project, and the project has operated directly under TAWIRI. This project has developed the capacity of TAWIRI to fulfill its mandate with regard to mammal biodiversity. The project is based at the Carnivore Centre, which was built through the TCP, which was a previous Darwin Project, and is located at the headquarters of TAWIRI in Arusha, and the project partner is the Director General of TAWIRI, Dr Simon Mduma. All members of TAWIRI have been extremely supportive of the project. The majority of initial project staff were employed on TAWIRI contracts, and the core of these staff came from the TCP, allowing the project to make use and advance the skills already acquired through this previous project. The project has operated as an effective sub-unit of TAWIRI; reporting activities to TAWIRI, and exchanging information with the other sub-units. Project employees all played an active role in TAWIRI operation and function. Machoke Mwita, the CIMU Database manager, and Rangvald Larsen, a CIMU consultant, were integrally involved with the development and supervision of the project Database.

**Other collaborations with projects in Tanzania:**

*Government*

**Tanzania National Parks** (TANAPA) is responsible for the management of national parks in Tanzania TANAPA have been extremely supportive of the project and have assisted in data collection through the distribution of checksheets to its Ecologists and park rangers. TANAPA has been extremely helpful by providing free entry permits for project staff and collaborators to all parks and assisting with logistical support in the parks, including allowing the team to set up their camps at ranger posts. Park staff were given training in camera trap survey implementation during surveys. The Chief Ecologist of TANAPA Mr. Inyasi Lejora has been instrumental to ensure that data from all national parks are forwarded to the project database. Senior representatives of TANAPA participated in the conservation action planning workshops.

**Wildlife Division (**WD) is responsible for all wildlife outside protected areas and for the management of Tanzania's game reserves. WD is part of the Ministry of Natural Resources and Tourism (MNRT), and obtains its annual budget from the ministry. As with TANAPA, WD have previously been extremely supportive of activities of the project, including the provision of free entry permits for survey teams to conduct surveys in game reserves (including rarely given multi-game reserve permits through 2007-08), participation in action planning workshops and logistical support in the game reserves. Senior representatives of WD have also participated in the action planning workshops.

**Forestry and Beekeeping Division (**FBD) is a governmental organisation within the MNRT responsible for the management of forest reserves and forested areas in Tanzania. Many of the camera trap surveys were carried out in forest reserves or forested areas around the country, and FBD have been extremely supportive by providing blanket permits for project personnel to visit all forests and local forestry officials have provided assistance and logistical support on site during surveys. Reserve staff were given training in camera trap survey implementation during surveys. Senior representatives of FBD participated in action planning workshops.

**Ngorongoro Conservation Area Authority** (NCAA) is a governmental agency withing the MNRT responsible for the management of the Ngorongoro Conservation Area. NCAA has supported the project activities by providing free transit passes to project staff when they need to pass through the area on their way to other protected areas, such as Maswa and Burigi Game Reserves. Senior representatives of NCAA participated in action planning workshops.

*NGOs, projects and private sector*

**WCS Tanzania Program:** Project leaders and the project manager are in regular contact with the Director of WCS's Tanzania program, who have been extremely supportive of the project, and have been involved at all levels of the project's activities. The second survey team, employed through additional funding from ZSL during the project, obtained their employment contracts through the WCS Tanzania

country office (see below). Other WCS staff have continued to send in data from areas around the country, notably from the south.

**Friedkin Conservation Foundation (FCF):** FCF is a registered (US & TZ) non-profit, Non Government Organization incorporated in 1994 with the mission to (1) assist the Government and People of Tanzania in their efforts to conserve and protect the indigenous flora and fauna contained within protected areas, (2) actively involve local people in sustainable conservation practices to improve their economic condition and (3) to monitor and provide information about sustainable conservation practices. In 2007 the project signed a MoU with FCF to assist them in biodiversity monitoring in the areas in which they operate. FCF have provided funds to conduct camera trap surveys in six FCF priority areas. Data is shared between FCF and the project. FCF priority areas all meet the requirements for project survey area priorities.

**Progetto Oikos:** This project is run by an Italian NGO and is conducting a monitoring program in and around Mt Meru and Arusha National Park. The project has loaned Oikos some camera traps, and their personnel are some of our most prolific data contributors.

**Grumeti Reserves:** This is a private company that manages a large tourism and hunting block on the western border of the Serengeti. They have a full time ecologist and a monitoring team who regularly send us sightings.

**Field Museum of Chicago:** Through their Mammal Collection Manager, Bill Stanley, the museum has helped train project staff in sample collection and preservation, has shared survey logistics, and has provided invaluable advice on survey sites.

**The Serengeti Carnivore Disease Project:** This is a project run by the the University of Glasgow, with the TANAPA Veterinary department as a main partner. Close links were already established through TCP and have continued during this project. Members of the Serengeti Carnivore Disease Project conduct regular night transects in the Serengeti and have shared relevant data with the project.

**Tanzania Carnivore Program (TCP):** This program was established in 2002 by a former Darwin Initiative grant culminating, as in the present project, with the development of a conservation action plan. The project is now targeting implementation of the action plan, using funding raised from several sources including a five year commitment of £100,000 from ZSL linked to their lions of the Serengeti exhibit established at Whipsnade and an annual grant of $30,000 from WCS from July 2006. These funds enabled the recruitment and appointment of a second survey team to help us meet our survey commitments to the project, and the retention of our staff over the short term, since the ending of the project. The funding also enabled us to appoint a full time coordinator, Rose Arthur Mosha, based at the centre and who is tasked with coordinating the implementation of the Carnivore Action Plans developed by TCP. Since her appointment Rose has taken an active role in the activities of the project, and the project have helped to support her activities by providing access to the mammal database and contributor and stakeholder network.

**Tanzania Cheetah Conservation Program:** This program evolved from the Serengeti Cheetah Project, and is headed by one of the project leaders (Sarah Durant). The program therefore has a long history of strong partnership with TCP and the project. It has supported the project by loan of vehicles when project vehicles are in the field, and has funded an additional driver throughout the project. The then project manager to TCP, Maurus Msuha, is now finalizing his PhD with this program, and both he and another PhD student, Amy Dickman, have conducted research relevant to the objectives of the project, conducting surveys within two priority areas, the Maasai Steppe in the north and Ruaha in the south.

**Tanzania Bird Atlas Project:** This project has many objectives and methods similar to ours, and thus we have been in regular communication with this project from the beginning. Both projects have extensive field components, and we have sought to assist each other by collecting and exchanging relevant data to each other during field surveys.

**Tarangire Elephant Project:** This is a WCS project that has been operating in Tarangire for 16 years. One of the project leaders (Charles Foley) is co-PI on the project and TEP has provided logistical support and the time and expertise of Lara Foley in developing the database and GIS assistance.

**Frankfurt Zoological Society (FZS):** FZS operates a number of conservation programs within Tanzania and is a key player in Tanzania conservation. They have rendered assistance to the project wherever needed, including assisting with the importation and clearance of the project vehicle and a new TCP vehicle which was allocated to the second survey team. The project manager and the project leaders have ensured that FZS are kept informed of the project activities

*Other collaborations with projects internationally:*

**Global 400 Wildlife Picture Index:** This is a recent initiative between ZSL and WCS that aims to develop tools for monitoring based on camera trapping to address the CBD 2010 targets. The project and TCP have obvious interest in helping to ensure that monitoring outputs are able to feed into policy

and practice at international as well as national scales. The wildlife picture index aims to do this through standardized camera trapping protocols at key international sites. The project is working with this initiative in the mutual interest of addressing wider international aims.

**WCS International:** WCS International (based in New York) has been very supportive of this project from its inception. WCS has provided substantial funding to host a workshop to develop an elephant management plan (see section 4.2). Furthermore, the second survey team was employed through WCS (see WCS Tanzania Program above) as this organization has Tanzanian NGO registration, taking advantage of the close working relationship in Tanzania and the institutional MOU between WCS and ZSL. The team is comprised of Paul Baran, Allen Mmbaga, Eliamani Soye and Rajabu Makwiro. Paul Baran came to us after spending two years working with Maurus Msuha as his assistant for his PhD research using camera trapping surveys, for which he had already received training from the project. Maurus Msuha was the project manager on the DI funded TCP.

**Others:** There are numerous other projects, NGOS, companies and individuals operating in Tanzania which work predominantly or partly with mammals. This project sought to ensure that everyone involved with mammal research or conservation is engaged with the project and is kept informed of the project's activities and provided access to the project's facilities and library resources. To this purpose, we have maintained and increased linkages developed under TCP. These include the Mikumi Animal Behaviour Research Unit, Serengeti Lion Project, Serengeti Hyaena Project, Serengeti Jackal Project, Tarangire Lion Project, Serengeti Biodiversity Project, Southern Highlands Conservation Project, Katavi Research Project, Gombe Research Project and Mahale Mountains Research Project. Within the private sector, Nomad, Sokwe and Dorobo Safari companies and Ndutu lodge are particularly important, as they have provided important regular information about mammal distribution.

# 4 Project Achievements

## 4.1 Impact: achievement of positive impact on biodiversity, sustainable use or equitable sharing of biodiversity benefits

The project was devised to ensure that its activities met an ultimate purpose of developing conservation strategies to ensure the conservation of all medium to large mammals in Tanzania. The project has thus met this purpose in that conservation action plans have been developed, which provide an important framework for the achievement of conservation impact. The action plans, when implemented, should directly meet the DI project key goals a) to achieve the conservation of biodiversity and b) to achieve the sustainable use of the components of biodiversity. In Tanzania, conservation implementation lies largely in the hands of the government sector, and hence requires their support and endorsement. The process devised by TCP, and duplicated in this project, has been effective in terms of attaining a national action plan that can be used to guide conservation effort, however implementation depends on follow through on this plan. One means of increasing the likelihood of implementation, and hence impact, is to create a post project position with the responsibility of following up on the plan and checking on progress towards implementation. This was achieved for the carnivore action plans through subsequent funding from WCS. Ultimately, conservation is also in the economic interest of Tanzania, as the country derives significant financial benefits from tourist trophy hunting and its rural people derive local benefits in the form of access to protein, albeit often through illegal offtake, and increasingly from land lease deals with tourism operators and alternative livelihood opportunities, such as local handicrafts for the tourist market.

In summary the project has achieved its main objectives. The project has harnessed the capacity developed at the carnivore centre within TAWIRI, and has further built on this by hiring and training appropriate personnel and established networks of voluntary data contributors. In order to achieve data gathering objectives, the project has brought together the private and governmental sectors in the common goal of mammal conservation, has established two survey teams who have surveyed a total of 17 areas in Tanzania, and has compiled a comprehensive database of large mammal distribution in Tanzania. Finally, the national mammal conservation action planning process brought together all the wildlife authorities in Tanzania and relevant NGOs in the common goal of developing action plans for mammal conservation. The workshop reports will serve as key documents providing an up to date summary of the biology, status and threats for mammals in Tanzania and a practical toolbox for conservation and monitoring. The project has proven to be highly effective in achieving its objectives and has potential to serve as a model for implementing similar programs elsewhere. Its ultimate impact on biodiversity depends on the implementation of the plans developed. The engagement of key government stakeholders, the increased capacity at TAWIRI and the continued commitment of the project leaders provides the best possible conditions for ensuring that this happens.

## 4.2 Outputs: achievement of the project purpose and outcomes

**Project purpose 'To develop a national monitoring system of large mammals that addresses current geographic and taxonomic data gaps, in order to produce a detailed distributional atlas and conservation action plan for large mammals in Tanzania.'**

The project purpose was ambitious, aiming to put in place sufficient information to establish a conservation action plan for all medium to large mammals in Tanzania. Nonetheless, despite its ambitious aims, it has achieved this purpose. It has produced current and historical distributional maps for 111 species of mammal, all of which can be viewed on the project web site, including updated maps for 35 species of carnivore, a taxon addressed by a previous Darwin Initiative project. It has also produced a conservation action plan for a subset of 58 focal species. Two key species not included in the action planning process, African elephant and Black Rhino, deserve mention. Both these species are highly valuable, both economically and culturally, and attract substantial political interest. Furthermore, because of a national focus on monitoring these species, information on these two species is substantially advanced compared with other species. A management, rather than an action plan, was thus most appropriate for these species, requiring more detailed up to date baseline data, including area specific abundance estimates, than we had the resources during this project to collect. The project therefore focused on working with partners to leverage additional funds to ensure that this planning process can go ahead at a later date. For African elephants substantial funds have been leveraged through WCS, due to the particular interest and expertise of one of the project leaders, Charles Foley, enabling us to initiate a detailed aerial and ground survey process immediately at the end of this project. This is planned to culminate in a detailed management plan to be drawn up between stakeholders at the end of 2010. For black rhino we have been working with Frankfurt Zoological Society, a key collaborator and also probably the foremost conservation NGO involved in rhino conservation currently operating in Tanzania. They are also moving ahead with data collection and consolidation, and expect to initiate a management plan in 2011, which we will help facilitate. An additional third species, which has similarities in status, the Chimpanzee, was included in the primate planning workshop, but will also be addressed by a population specific plan in 2009. The conservation action plans, address some of the wider issues which are less likely to be addressed by management plans, such as broad national legislation and policy, and hence provide important support to species specific management plans.

In the remainder of this section we briefly summarise the project outcomes, which we will cover in more detail in section 4.3.

### 4.2.1 'Mammal monitoring system, which addresses current data deficiencies, in place by 2008.'

In our first year of the project we established a survey protocol and interview questionnaire which we have used throughout our surveys. We also extended and redesigned our database so that it could mesh seamlessly with the existing large ungulate database at CIMU. This system means that we are now able to produce distribution maps for mammal species in Tanzania from a database of 33,000 records, at not much more than a touch of a button. Such information is critically important for wildlife planners and policy makers, but has been previously unavailable. Throughout the project, a network of data contributors has also been engaged to provide additional information on species distribution.

### 4.2.2 'Distribution Atlas of Tanzanian mammals developed by 2008.'

The monitoring system described under 4.2.1 has been used to generate current distribution maps for 111 species of mammal. Throughout its operation, the project has used these maps to identify information gaps and target these areas for on-the-ground surveys using questionnaires and camera traps, which have provided critical additional information on mammal distribution. Finally, the project has established an extensive library on the target species which is now lodged at the TCC at TAWIRI.

### 4.2.3 'Increased skills in mammal monitoring for TAWIRI staff through creation of a new monitoring unit.'

Due to additional support, we were able to establish not just one, but two, highly effective survey teams by the end of the project. These teams are able to carry out all aspects of a camera trap survey including: Camera trap deployment; camera trap maintenance and management; camera trap retrieval; data entry; database management; data analysis; and report writing. We were also able to establish a GIS team based at the TCC, who managed all the data sources to the project, and generated clear distribution maps which were disseminated through the project web site. Finally, we provided in depth

training to a total of 20 staff or interns on the project, in some or all of these activities (see section 4.6 for more details). We also provided additional on-the-job training to over 30 rangers and ecologists at survey sites. All of the staff and volunteers who have worked on the project have remained within the wildlife sector.

### 4.2.4 'Conservation action plan published and widely disseminated by 2008.'

A series of three conservation action plans: Large ungulates; small ungulates, aardvarks and pangolins; and primates were developed during three workshops (see accompanying materials) These action plans provide an overall goal and the objectives, targets and activities needed to ensure the conservation of 58 species of mammals in Tanzania. The action planning process is described in more detail below, and involved representatives from all key stakeholders, including senior representatives from WD, TANAPA, FBD and NCAA. The plans have been distributed to all participants, and will be included in detailed reports, which will be finalised in the next 1-2 months, following the format established by a previous DI funded project to establish a carnivore action plan. These reports will be made available for download from the project web site, and hardcopies will be lodged with the wildlife authorities.

## 4.3 Outputs (and activities)

The project achievements are outlined in detail below, in relationship to the original logframe.

### 4.3.1 'Sub-unit of TAWIRI developed to monitor large mammals in data deficient areas using standardised methods.'

#### 4.3.1.1 '3 new staff and existing TAWIRI staff trained as trainers in mammal monitoring by early 2006.'

<u>Staff and volunteers</u>

Over the course of the project 20 staff and volunteers have worked with us (exceeding our target), all of which have been provided with training to enable them to carry out project activities. Profiles and photographs of our current and past staff and volunteers can be seen on our project web site http://www.tanzaniacarnivores.org/about-us/who-we-are.

Our initial staff were employed under TAWIRI contracts, following an advertisement and recruitment process required by TAWIRI. Subsequent staff were very often recruited from the volunteers that worked with us or with our associated projects, and hence were employed under WCS contracts in order to avoid an unnecessarily expensive and time consuming appointment process.

Staff under TAWIRI contracts:

**Alex Lobora**, project manager, three year contract over duration of the project.

**Mwemezi Rwiza**, Field officer, Jan 2006 to Aug 2007. Mwemezi left us to pursue a masters degree in Natural Resources in Norway.

**Edwin Konzo**, GIS and Database Analyst, Jan 2006 until the end of the project.

**Zawadi Mbwambo**, project driver, chief mechanic and field assistant, three year contract over duration of the project.

**Flora Kipuyo**, Project Administrator, three year contract over duration of the project.

**Chediel Kazaeli**, field assistant, Oct 2005 –Sep 2007. Chediel left us for a permanent position at TAWIRI. He is now pursuing a BSc degree in wildlife management at Sokoine University of Agriculture.

Staff and volunteers based at TAWIRI, but under WCS contracts (funding provided either from DI, WCS or ZSL):

**Jumanne Ramadhani**, project driver, funded by the Tanzania Cheetah Conservation Program, worked with the project over its duration.

**Linus Minushi**, project scientist, March to June 2006. Linus conducted a literature review used by the project in developing the historical database. The data gathered in this process were essential to the action planning process.Linus left us to pursue a PhD on elephants at the Nelson Mandela Metropolitan University, South Africa.

**Paul Baran**, field assistant, Feb 2008- end of project. Paul joined us after working as a field assistant during Maurus Msuha's PhD research, which included camera trap surveys. He received training from the project in this capacity prior to joining the project.

**Allen Mmbaga**, coordinator of the second survey team, Dec 2007 until end of the project.

**Eliamani Godwin**, assistant GIS and database analyst, graduate volunteer Jul 2007 – Nov 2007, appointed as staff in Dec 2007 until end of the project

**Rajabu Makwiro**, project driver, Feb 2008 to end of project, appointed to provide support to second team .

**Emmanuel Lalashe**, field assistant, graduate volunteer Oct 2007 to Aug 2008, Emmanuel left us to join the Mpingo project in Kilwa from Sep 08-Feb 09 and joined Wildlife Division in Mar 2009.

**Boniface Osujaki**, field assistant, volunteer Oct 2007 to Aug 2008. Boniface left us to pursue a Diploma in Wildlife at Mweka Wildlife College.

**Dennis Minja**, database assistant, BSc. graduate volunteer Jul 2008 to Sep 2008. Dennis left us to pursue a Masters degree in Natural Resources Management at Sokoine University of Agriculture.

**Mustafa Mohammed**, database assistant, Mweka graduate volunteer Aug 2008 – Sep 2008. Hassanali left us to join the Tarangire Elephant Project as a research assistant.

**Mwita Chagula**, database assistant, BSc graduate volunteer Oct 2006 – Mar 2007. Mwita left us to join Wildlife Division from Apr 2007 to May 2008, and has been employed as an assistant lecturer at the new University of Dodoma from Jun 2008.

**Wilson Kibasa**, database assistant, Mweka graduate volunteer Oct 2008 until end or project.

**Leah Mollel**, office assistant, funded by TAWIRI but allocated to the project over its duration due to a need for more administrative support, in acknowledgement of the assistance provided by the project to TAWIRI institutional activities.

**Ishmael Kipuyo**, gardener and general assistance over duration of project.



**Fig. 1.    Several members of the project team together with UK project collaborators during a camera trap survey in Maswa Game Reserve.**

*Training in mammal monitoring*

Throughout its duration, the project aimed to provide training targeted at skills important for achieving the objectives of the project. At the start of the project all field staff were trained in implementing camera trap surveys and structured interviews, and were provided with further training in data entry, database management, analysis and report writing over the duration of the project. Skills were maintained despite staff turnover and project expansion through skill transfer from staff trained at the start of the project, thus also confirming their abilities as trainers. Where possible, the project also made use of training courses provided by project partners and collaborators. Care was taken to ensure that training received by any of the staff was transferred to all staff to whom the training was relevant, through dissemination of skills learnt by staff after they return from coursework:

- In February 2005 Dr. Marcella Kelly from the University of Virginia Tech spent four weeks training project field personnel in camera trapping techniques. Marcella has used camera traps extensively for her research on jaguars in Central America and had previously spent 6 weeks training TCP team members in camera trap survey protocols. The aim of her visit was to provide refresher and new training for project personnel to a) develop and implement a camera trapping survey in the field, b) properly catalogue camera trap photographs in a database, c) analyse data to obtain density figures for individually identifiable species, and d) produce a camera trapping protocol document detailing all aspects of the method. Approximately half of the time was spent with the field personnel on database

issues, learning how to properly extract data from photographs (both from a random sample and a grid system), and to categorise and enter data into a database. Project staff then learned how to use Capture-Recapture software to determine densities of individually recognisable species, using data of leopard captures collected during a TCP survey of Tarangire National Park, and produced the first ever estimate of leopard densities using the method in a savanna ecosystem. The final week was spent setting up camera traps on a grid system in Arusha National Park and refining field survey techniques.

- Alex Lobora, the project manager attended an advanced training course in GIS for Wildlife Management hosted by WCS in New York from the 17th to the 28th of October, 2005. The course taught participants how to use ArcGIS and provided training in raster analysis. Alex was also shown how to use and apply modelling software called GARP (Genetic Algorithm for Rule Set Production), which is specialised software that allows users to model the distribution of species using only presence data (most other models also require absence data which is very difficult to obtain). Alex used GARP to predict the distribution of cheetahs and wild dogs in sub Saharan Africa using information on suitable habitat from the Tanzania dataset, and found a good fit with actual distribution, particularly for the cheetah data. Much of the information collected for the project database will only provide presence data, so this technique will prove particularly useful for TAWIRI in the analysis of species distribution and predicting future range in Tanzania.

- In November 2007 Alex Lobora, the project manager was also trained in habitat suitability mapping in a purpose designed course at the carnivore centre. This course provided him with the skills he needed for technical analysis of the substantial amount of data accumulating from ongoing camera trap survey work, including using state of the art spatial analysis techniques such as Ecological Niche Factor Analysis (ENFA) (Hirzel et al. 2006) using presence data obtained through camera traps. This training was provided by Nathalie Pettorelli from ZSL, and was key to the development of the first scientific manuscript from this work (Pettorelli et al. submitted to Animal Conservation). This manuscript demonstrates the potential of this methodology and dataset to build a predictive analysis of the impacts of climate change and human development on mammal biodiversity. Whilst Nathalie led the analysis and development of this first paper, which was on carnivores, it is intended that Alex, who has now been provided with sufficient training, to lead the analysis and development of the following paper, which will be on ungulates.

- In April 2007,a tailor-made training program for our GIS and Database Analyst, Edwin Konzo, was provided by a consultant GIS expert with substantial experience in training and in biodiversity monitoring. The training program was developed in consultation with project leaders and staff and lasted two weeks. The objectives were two-fold: 1) to provide structured, practical training on relevant GIS topics, and 2) to develop an updated and fine scale 'Human Footprint' map of Tanzania (Fig. 2). GIS topics included a review of map projections; an introduction to the ArcView software spatial analysis extension; connecting ArcView to the project database for live updating of species distribution maps and streamlining their production; and developing habitat suitability models. Additionally, a new map template for both printed and web-based maps was created for a more clear and accessible cartographic style.

- In November 2007, Eliamani Godwin and Edwin Konzo were trained in the application of Remote Sensing and Geographic Information Systems to Landcover Mapping, through a course provided by WCS and held at the centre. This course introduced them to the theory of remote sensing and satellite image processing, and provided practical training in how to develop a land cover map



**Fig. 2. Human footprint map of Tanzania developed during the project.**

from raw satellite imagery. These skills are important for enabling project staff to develop GIS layers directly from remote sensing data, which are key for spatial analysis of species distribution data.
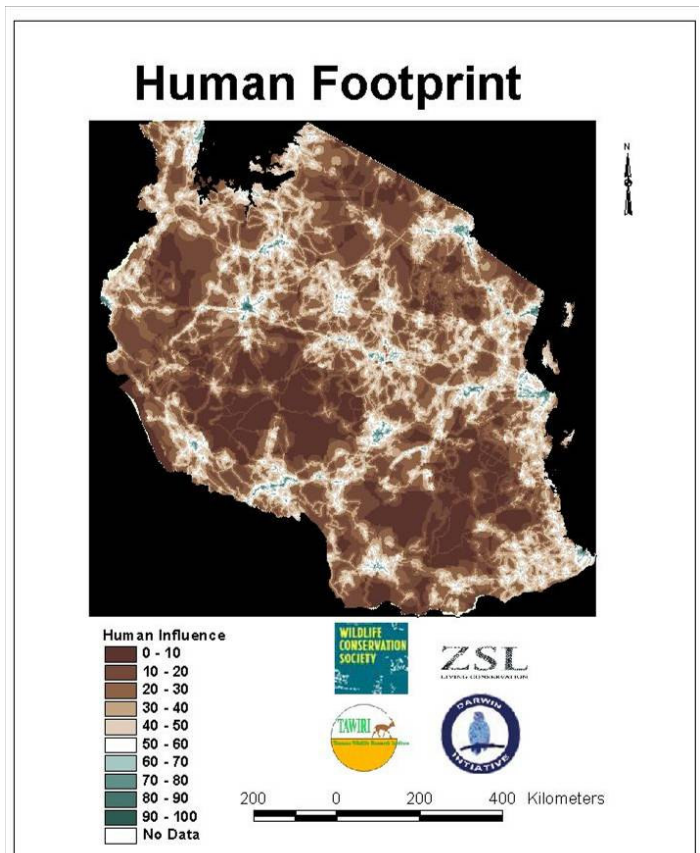
- Flora Kipuyo, the project administrator, undertook two courses on materials management on a part time basis: basic stage from July to November 2007; and foundation stage from January 2008 to May 2009. She passed the both end of course examinations and was awarded certificates in both courses. She has also received a one-on-one course from project leaders on the use of Endnote software which has enabled her to handle the ever expanding project library.

### 4.3.1.2 'Data contributors identified and submitting sufficient mammal sightings regularly to ensure wide coverage of the country.'

This output was achieved through two key approaches: developing a network of data contributors; and disseminating information back to the network. The latter was essential to keep data contributors engaged and hence continuing to ensure that data is contributed.

*Data contributor network*

The project developed a network of 341 individuals (whom 131 proved to be very active contributors) and 142 organizations that have received project materials and submitted data. Two templates for contributor checksheets have been produced: one aimed at collecting purely presence/absence data, provides a complete species list and requests information on whether the species has been seen in a particular grid square (a quarter of a degree) over the course of a year, while the other is a more comprehensive data sheet requesting GPS location data, numbers of individuals seen and habitat type. Digital copies have been sent out to all of our online contributors, and 3,000 hard copies have been printed and circulated to potential contributors. During the first year of the project, the majority of data contributors were from northern Tanzania, but later on the project expanded the network to regions of low coverage, such as the south and west of the country, mostly through direct contact with people known to be working in those areas and camera trapping surveys (e.g. our recent surveys in Lukwika Lumesule Game Reserve and Mbangala Forest Reserve which are located at the Tanzania-Mozambique border). To facilitate data gathering, project staff have visited potential participants and conducted direct interviews with them, with particular emphasis on people in the safari business who spend a lot of time in the field. The Arusha based staff allocated time in their work schedules every month to visit safari companies and gather data from drivers and staff and this has added important additional data into the project database.

*Data dissemination*

*Website*

Development of a professional website was a key priority for the project, as this is key to enable rapid dissemination of information to stakeholders. We have created an interactive site that not only allows users to view distribution maps and information about the mammal species in Tanzania, but also allows users to submit data online, thus providing an easy mechanism for data submission that bypasses the time consuming process of filling out and mailing paper forms, which we believe was a substantial impediment for many potential data contributors to the project, particularly as there are a large number of species to be covered.

After an extensive development process, the website (www.tanzaniamammals.org) was created with the following features:

- A species information page which lists all of the project target mammals found in Tanzania. For each species we provide a short species description highlighting key identification points, a brief description of the species ecology and social structure, and a list of similar species that could possibly cause confusion during identification together with links to their respective pages. Where possible, each species also has a picture and, if we have received geo-referenced sightings of it, the latest distribution map which was updated every two months from our database (see Fig. 3).
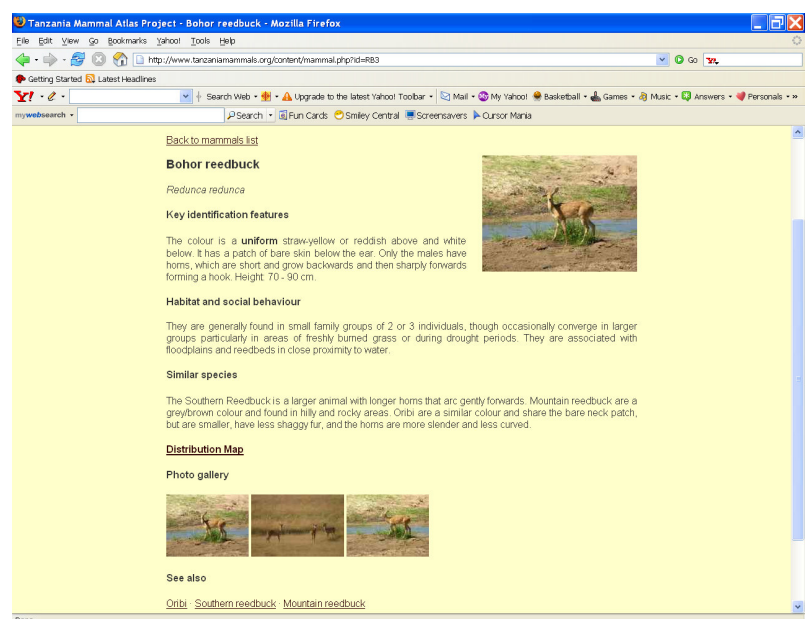


**Fig. 3. Screen-grab of the webpage for Bohor reedbuck from www.tanzaniamammals.org**

- A news page that displays updates from the field and pdf copies of past newsletters.

- Two data submission pages. As with the paper forms there are two versions to enable contributors to submit information in one of two different formats:

  - The first allows users to fill in simple sighting information for each grid square. Users identify their grid square location from a digital map and then check a box next to each species seen in that grid (see Fig. 4).



**Fig. 4. Screen-grab of the online sighting information form. Users can directly send mammal sighting data with a grid square reference which can be obtained from a map on the project website.**

  - The second form requests more detailed information for each species such as a GPS reference, number of individuals seen, habitat type, etc.

  When the user submits the data, the data form is sent to two different email addresses (the database manager and a backup). The data undergo a verification process before being entered into the database.

- A page detailing all books and papers in our library collection with a search function that allows the list to be searched by author, key words, mammal species, etc.

- A page with background information on the aims of the project and brief descriptions of the Darwin Initiative and project partners and collaborators.

  The site was constructed using a combination of coding languages including PHP and MySQL in a way that allows us to readily alter and maintain the site ourselves after a small amount of training. The web designer provided short training sessions with all project staff to enable the project team to maintain the website. A sister web site, www.tanzaniacarnivores.org was developed using separate funds, to manage similar information on carnivores.

  Since its establishment, the project website www.tanzaniamammals.org has been updated regularly. Current distribution maps have been updated from the database every two months, and historical information maps and their corresponding scientific references have now been added for many of the larger ungulate species. At the time of writing it was the first web site returned by a google search on 'Tanzania mammals' and is returned on the first page of many species searches such as 'Tanzania reedbuck' or 'Tanzania pangolin' or species image searches.

*Newsletter*

The project has produced 1,000 copies of each of the four editions of the project newsletter published during the course of the project. This newsletter is an important vehicle to disseminate information on project activities to stakeholders, particularly those without access to the internet. Copies of the newsletter are included with this report and are available for free download on the project website (http://www.tanzaniamammals.org/content/news.php). The newsletter contains articles generated by project staff, as well as articles submitted by the readership, usually wildlife professionals working in Tanzania from both the public and private sectors.

**4.3.1.3 'Mammal distribution data acquired for at least 15 target areas using remote camera traps'**

The project target of fifteen surveys (five each year) throughout its tenure was exceeded, and a total of seventeen camera trap surveys were conducted, namely in Mahale Mountains National Park, Arusha National Park, Serengeti National Park, Minziro Forest Reserve, Coastal Tanga Forests, Saadani National Park, Burigi-Biharamulo Game Reserve, Ukaguru Forests, Muhuwesi Game Reserve, Moyowosi Game Reserve, Ufiome Forests, Gelai forest, Maswa Game Reserve, Uluguru Forests, Ugalla Game Reserve, Lukwika Lumesule Game Reserve and Mbangala Forest Reserve (Fig. 5). Many interesting species were recorded, however, the most exciting finding
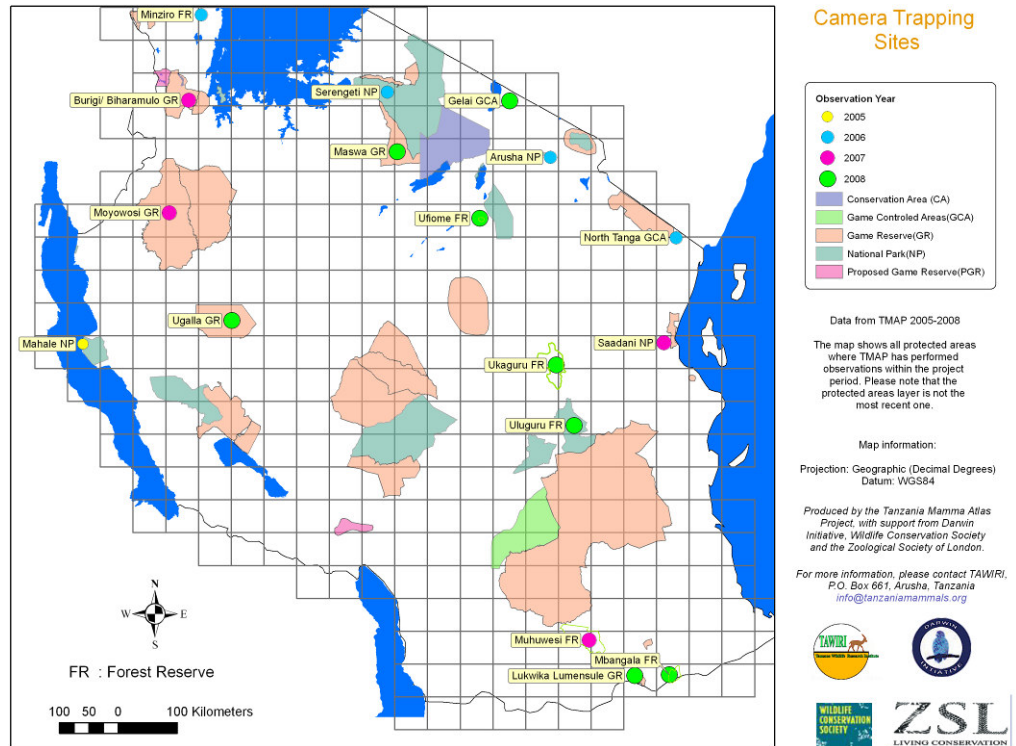


**Fig. 5    Map of survey sites undertaken by the project.**

was of Giant pangolin in both Mahale and Minziro, the first confirmed record of this species for Tanzania (Fig. 6). These surveys have added 10,873 records to the project database. This is over a third of the total database and represents the largest data set of camera trap records in Africa. These surveys had particular value in terms of providing data on species that are rarely seen, such as pangolins and duiker, and for areas where it is very difficult to record mammals by other methods, such as forests. After each field survey, the team returns to the carnivore centre to process and enter data from the surveys into the survey database, and to carry out the analyses necessary for a survey report. Data are verified after entry, and then entered into the project database and added to maps published on the project website. Data management proved to be a time consuming component of the surveys, including developing the film, scanning every negative, identifying all species in the pictures, tagging every picture with the species, date, time and location, and then entering all of these data into an Excel worksheet. Camera trap surveys, combined with interviews of local people in the survey area, provided a key source of data for the project. A draft publication has resulted from the survey work so far, with several more publications planned.

1. Mahale Mountains National Park

The Mahale survey was part funded by a previous Darwin project, the Tanzania Carnivore Program, and was conducted in partnership with a team from WCS, that was carrying out a broad biodiversity survey of the park. This enabled the two teams to share logistical support and reduce overhead costs, which were significant as Mahale Mountains National Park is one of Tanzania's most remote



**Fig. 6 First authenticated record of giant pangolin in Tanzania**

parks, lying on the eastern shores of Lake Tanganyika. The park was particularly interesting to us because it is a Congolese forest remnant and many parts of the park had been poorly surveyed. The logistics of working in these isolated areas is considerable and the team took three days to get to the site using a combination of vehicles, trains and boats. The team spent two months in the park, where they surveyed three different habitat types; thick forest, a mixed forest-grassland site, and a montane site dominated by bamboo. A total of 659 mammal sightings

representing 23 mammal species were recorded over 653 camera trap days. Many interesting species were recorded including brush tailed porcupine (*Atherurus africanus*), a Congolese forest species seldom recorded in Tanzania, cape clawless otter (*Aonyx capensis*), a new species for the park, and Aardvark. However the most exciting finding was the giant pangolin, the first confirmed record of this species for Tanzania (Fig. 6). We had seven records of this species and the high trapping frequency suggests that they are relatively common in the area, suggesting that Mahale may prove to be one of their conservation strongholds in Africa.

2. Arusha National Park survey

This survey was carried out between March and May 2006. The survey doubled as a training survey and was led by Dr. Marcella Kelly from Virginia Tech University, who provided training on survey design, implementation and data processing to established and newly appointed staff. A grid system was set up to cover the forested areas of the west and centre of the park, with 20 cameras set up in pairs at 2km intervals for a total of 1073 trap days. Arusha National Park has been protected since 1977 and this extended period of protection is reflected in the high densities of wildlife in the forest areas. The survey recorded 1297 separate sightings of 27 species of mammal providing a trap success of 1.21 (No. records/camera trap days), the highest recorded during the project. suni, Harvey's duiker and bushbuck were particularly abundant throughout the park. However, despite previous survey work within this area, our survey added a new species – the white-tailed mongoose - to the park list. The survey also revealed a surprisingly high number of bushy-tailed mongoose  – 47 trapped, with a trap success of 0.04. This species was only recently added to the park list and was generally thought to be rare throughout its range in East Africa. This species is almost exclusively nocturnal, and this, combined with its cryptic nature and the difficulty of distinguishing it from the marsh mongoose, has undoubtedly contributed to previous under-reporting. The project has now found this species in eight of the 17 survey areas, and has recorded it in habitat types where it was formerly not known to occur.

3. Serengeti National Park survey

The Serengeti National Park has benefited from numerous aerial surveys over the past decades and there is good information on the density and distribution of large ungulates. However there is surprisingly little information on the smaller and nocturnal mammal species, particularly within the forested areas inside and on the edge of the park. After consulting with other ecologists with long experience working in the park, we selected three areas in which to concentrate survey effort: the Bologonja forest in the far northeast, forested areas in the Loliondo Game Controlled Area outside the park to the east, and the riverine forest along the western corridor of the park. The first two forested areas form part of the northern highland forests, while the western corridor area has vegetation species more representative of the Congolese forest block. The first cameras were put up in late May 2006 and taken down in July 2006, for a total of 1219 camera trap nights. The majority of species photographed were relatively common savannah mammals. A total of 29 species were recorded. The survey documented a new addition to the species list for the Serengeti ecosystem: large spotted genet (Sinclair & Arcese 1995), which was commonly observed in the riverine valleys. The extent of the riverine forest in all the areas surveyed has diminished greatly in recently years as a result of uncontrolled burning within the park, and these habitats are likely to disappear without concerted action from the park management.

4. Minziro Forest Reserve survey

The Minziro Forest Reserve is in the far northwest of Tanzania on the border with Uganda. It is one of the few forests in Tanzania that is part of the Congolese biome, and is also unusual in being a seasonally flooded forest, with large areas of the forest being inundated annually by overflow from the Kagera River. The area has been well surveyed in the past by ornithologists, but there were no documented lists of mammals; it therefore provided an exciting opportunity to survey an area that was likely to harbour species that were new to the Tanzania list.  The survey was carried out in the dry season from August to September 2006. 54 camera traps were set for a total of 1503 trap nights. The highlight of the survey was the observation of two species of pangolin within the same area: the Giant and the Tree pangolin. The giant pangolin was recorded for the first time in Tanzania in our survey of Mahale National Park, so this is a large range extension for the country. There is one previously reported record of Tree Pangolin in Tanzania (on the western shore of Lake Victoria) (Kingdon 1977), and hence our sighting represents the second record of this species for the country. A total of two tree pangolin were captured on film and a skeleton of a third was shown to us by a local resident. Several people interviewed mentioned seeing the species regularly, suggesting that it might be quite common in the area, although there is potential for confusion with the giant pangolin. We found numbers of mammals in the forest to be very low, which is an indication of illegal unsustainable hunting by villagers. Only 113 records were obtained of 14 mammal species, giving a very low trap success of 0.07, only slightly higher than that found in the Uluguru survey, where the

lowest trap success was recorded. Several snares were found in the forest and high snaring levels were confirmed by many villagers during interviews. This survey was carried out in conjunction with a team from the Field Museum of Chicago that was surveying the small mammal population. They added six new species (three rodents and three bats) to the Tanzania mammal list, demonstrating the importance of the forest for biodiversity in this country.

5. North Tanga survey

This is an area where very little mammalian survey work has been done, and consequently little is known about the local mammalian biodiversity. The vegetation is a combination of coastal rag, small forest patches, and dry savannah. We were particularly interested to discover whether any of the rare coastal species found in southeast Kenya, such as Ader's duiker, golden-rumped elephant shrew (*Rhynchocyon chrysopygus*) and Sokoke dog mongoose, extended into northern Tanzania. The team found very little undisturbed habitat close to the coast suitable for a survey, so they moved 30km inland to a hunting block dominated by coastal savannah bushland east of the Mkomazi Game Reserve. The survey took place between November and December 2006 and a total of 42 stations were placed in a 1km grid system resulting in 67 exposed films. A total of 29 species were recorded. The most common species were dik-dik and olive baboon; 11 records of lesser kudu, a dry area species uncommon in Tanzania, were recorded and three pictures of an unusual looking mongoose were sent to specialists for further identification, these were thought to be a white-tailed mongoose (a common species in the area) with wet fur.

6. Saadani National Park survey

Saadani National Park is one of the largest remaining tracts of forest on the Tanzanian coast and considered to be of high importance for biodiversity. It has an area of about 1,100 km$^2$ (430 miles$^2$) and is located on the north coast, roughly 100km (60 miles) northwest of Dar es Salaam. It has been protected as a game reserve since the 1960s, and in 2002 was established as a national park, and expanded to encompass twice its former area by incorporation of the former Zoraninge forest reserve within its boundaries. The reserve suffered greatly from unsustainable illegal hunting prior to the late 1990s, but, since plans were established to upgrade the reserve to a National Park, there has been a marked turnaround, due to a concerted clampdown on poachers and community outreach programs. Our team surveyed the area between April and May 2007, concentrating their efforts in the Zoraninge forest, which is one of the largest remaining tracts of coastal forest which had never been properly surveyed. A total of 41 cameras were set up at 1km intervals, providing data over a total of 1065 trap nights. The survey recorded 19 species: suni, Harvey's duiker and yellow baboon were all particularly abundant. Other notable species included the bushy tailed mongoose and aardvark. The project used the camera trap data and interviews with camp managers, researchers and park staff to compile a new comprehensive mammal list for the park, which was published in the project newsletter (included with this report).

7. Burigi and Biharamulo Game Reserves

The Burigi-Biharamulo Game Reserves lie to west of Lake Victoria in the far north-west of the country. The vegetation is characterised by a mosaic of Miombo woodland (*Brachystegia* spp.), Acacia woodland, gallery forest and wetlands. In the west of Burigi the landscape is steeply dissected, with gallery forest in the gullies and grassland on the slopes. Some of this gallery forest may have remnant patches of Congolese biome forest, and we were interested to discover if any mammal species representative of this biome were found in the area. The two game reserves are used for tourism hunting, but have suffered heavy poaching in the past decade from nearby refugee resettlement camps. The area was surveyed in June and July 2007 with 50 cameras being set at least 1km apart. The results show the area has a high diversity of large mammals with 30 species recorded. The most common species were grey duiker with a capture rate of 0.06, bushbuck (0.035) and blue duiker (0.034). Other notable species were bushy tailed mongoose, which were recorded for the first time in this area, and the chequered elephant shrew, which also represents a significant range extension for the species. However, despite the high mammalian diversity, the density of large ungulates was found to be extremely low, with only 1 African buffalo, 5 giraffe, 4 common zebra, 1 roan antelope and 1 topi recorded during the survey, suggesting that these species have suffered heavily from poaching. There is a high risk that, without increased protection, large ungulates may be eliminated from these game reserves entirely.

8. Ukaguru Mountains-Mamiwa catchment forests

This survey took place over a forest reserve covering the sharp mountain ridge southwest of Mandege Forest Station in the Ukaguru Mountains. The survey area ranged from 1500 to 2250m in altitude, across the Eastern Arc forest ecoregion, a habitat with a restricted geographic range, and rich in endemic species. The reserve was chosen as it held the highest species diversity and the largest number of endemic and rare plants of the four main montane forest reserves in the Ukaguru

mountains. The survey took place between August and September 2007 and 60 camera traps were deployed separated by 1km, providing data over a total of 675 trap nights. A total of 14 mammal species were recorded during the survey, including our first record of an African palm civet, and chequered elephant shrew. The most common species recorded was the giant pouched rat followed by the chequered elephant shrew (*Rhynchocyon cirnei*), which is a good indication that the forest has been heavily hunted for its larger mammal species.

9. Muhuwesi Forest Reserve survey

Muhuwesi Forest Reserve covers an area of over 1,700km$^2$ and is located to the south of the Selous Game Reserve. It is extremely remote and difficult to access, and is one of the furthest surveys conducted by the team since the beginning of this project. The government's Forestry and Beekeeping Division and the Wildlife Division hold a combined mandate over the reserve because it is classified as a Game Controlled Area, as well as a forest reserve. This means that the reserve is used as a hunting block, and is allocated to a hunting company under the management of the Wildlife Department. Our team visited the area at the end of the 2007 dry season, from October to November, when roads were more likely to be usable, and access to the area is possible. The vegetation is characterized by low Miombo woodland with a thick grass cover. A total of 55 camera traps were set out, providing data over a total of 1288 trap nights. Records covered 31 species of mammal, including the first records of wild dog (Fig. 7) and Sharpe's grysbok since our survey work began at the end of 2004 under TCP. Grey duiker, sable antelope, elephant and hippopotamus were all particularly abundant in the reserve.



**Fig.7 Wild dogs were captured for the first time during our camera trap surveys in Muhuwesi Forest Reserve**

10. Moyowosi Game Reserve survey

This survey was our first survey under our FCF collaboration (see section 3). Moyowosi Game Reserve is located in western Tanzania, within the Malagarasi-Moyowosi wetland, part of the Zambezian flooded grassland ecoregion, and is a large and excellent example of untouched African floodplain wetlands. The wetland was the first designated RAMSAR site in Tanzania (designated in 2000) and provides an important dry season refuge and feeding area for migratory animals including water birds and large mammals. It is also an important breeding area for rare water birds including the wattled crane and the shoebill stork. As with the previous survey, the area is remote and access is difficult. Our team surveyed the area during the short rainy season in 2007, between November and December. A total of 47 stations were placed in a 1km grid system for a period of 968 trap days, and recorded 28 species of mammal. The success rate was hampered by the heavy rains, which appeared to trigger some of the cameras resulting in some rolls of blank pictures. Olive baboon, elephant, bushbuck, giraffe and grey duiker were all particularly frequently recorded during this survey. Roan antelope and sable antelope were also photographed in the area, as well as side-striped jackals which, although probably widespread across the country, have rarely been recorded elsewhere during our surveys. Because the area is so vast, the team was only able to survey the very northern section of the reserve, and did not penetrate far into the wetland. During the next dry season the team will to return to the southern areas in the reserve, where there are reports of chimpanzees, and will attempt to place some cameras in the main wetlands.

11. Ufiome Forest Reserve survey

This is a forest reserve in north-central Tanzania, to the east of Babati, where particularly little is known about the local mammalian biodiversity. The reserve ranges to over 2,000m. The lower slopes are covered by dense secondary thicket and scrub up to 1,750m with forest in the valleys and woodland on rocky soils. Stunted woodland and open grassland occur in rocky areas with forest clumps at higher altitudes. Dry montane forest covers the upper slopes above 1,750m. Fire and grazing appears to have played a role in modifying the vegetation of the lower slopes and the forest edge may be fire maintained. The forest itself is much disturbed by logging and there were also many signs of illegal hunting activity (e.g. snares). Large mammals such as elephants and buffalo were previously recorded in the area. Our team surveyed the area between February and March 2008. A total of 43 stations were placed in a 1km grid system for a period of 1052 trap nights. The

**Fig. 8 One of our most unusual photos was obtained during the Ufiome Forest survey. Here a bushbuck is seen interacting with a galago.**

survey recorded 604 mammal sightings, giving a trap success of 0.6, which is high, particularly for a forest reserve, and recorded 24 species of mammal, which is also high for a montane forest. This proved to be one of our most interesting survey areas, as it had a high density of small carnivores (bushy tailed mongoose, large spotted genet and palm civet were all present in good numbers), and provided our first camera trap records of African hedgehog and Tanganyika mountain squirrel. In addition to this we captured some unusual behaviour showing a female bushbuck interacting with a greater galago (Fig 8).

## 12. Maswa Game Reserve

This survey was also conducted under our FCF collaboration. Maswa Game reserve lies along the western boundary of the Serengeti and the south-western corner of the Ngorongoro Conservation Area. The Reserve was created in 1962, to act as a buffer zone for the Serengeti National Park and to allow tourist hunting of wildlife within the Serengeti ecosystem. Maswa is a dry season refuge for many of the Serengeti animals seeking water in the springs and pools formed in the sand rivers in the area. The wildebeest migration passes through Maswa in January and February, feeding on the new growth of grass that appears after the short rains. This survey was used as a representative site for a field visit between UK experts in camera trapping techniques from the Zoological Society of London (ZSL) and our survey team based at TAWIRI, funded through the new Royal Society UK-Tanzania networking scheme. The survey was initiated in the first week of June 2008, in a window of the dry season just before the start of the hunting season. Because of time constraints a large number of cameras (a total of 79 camera traps) were set up at 1km intervals covering all landcover types and left over a short period of only 22 days. A large number of traps over a short period was still able to meet our minimum trapping effort requirement of 1,000 camera trap days. In total, the sruvey provided data over 1260 camera trap days and recorded 46 mammal species with a trap success of 0.99 sightings/camera trap day, second only to Arusha National Park. The most frequently observed species were olive Baboon with capture rate of (0.122), Kirk's dik-dik (0.092), impala (0.085), zebra with (0.082) and warthog with (0.061). The lowest capture rates were recorded for wild cat, bush pig and bat-eared Fox.

## 13. Gelai Mountains Game Controlled Area survey

This is another collaborative survey with FCF. The survey area is located 200km north-west of Monduli, close to the Kenyan border, and falls under the Serengeti volcanic grasslands ecoregion. Whilst the area is reasonably close to Arusha, there is limited road access, making it difficult to survey. Within the area the Gelai Mountain rises to an altitude of 2,942m; it is an important condenser of moisture in an otherwise very arid area. The area has no formal protection, but is leased out as a hunting concession by the Wildlife Division, and is managed by Tanzania Game Trackers. Our team surveyed the area between March and April 2008, and a total of 54 stations were placed in a 1km grid system for a period of 30 days. 38 mammal species were recorded over a total of 1099 camera trap days. Structured interviews were also conducted to supplement the information obtained from camera trapping. During this survey we obtained our first photograph of a cheetah, although this species is likely to have been resident in many of the areas we have surveyed, it is rarely photographed, probably on account of its extremely low density. In this area we also recorded a good number of striped hyaena, aardwolf, lesser kudu and fringe eared oryx, all species which thrive in more arid areas, and which, particularly the latter two, have limited distributions restricted to northern Tanzania.

## 14. Uluguru Mountains

The Uluguru Mountains are one of thirteen mountain ranges that comprise the Eastern Arc Mountains, sweeping from Southern Kenya through Tanzania. The Eastern Arc Mountains have

been recognised as a Biodiversity Hotspot, a Globally Important Ecoregion` and an Endemic Bird Area (www.easternarc.or.tz). The area is located on the main Uluguru range, Eastern Tanzania and covers an area of approximately 180km$^2$ and lies approximately 26 km south of Morogoro town. It was gazetted in 1906 for its extremely important water catchment value and to protect the remaining high altitude forests. It is near the Selous Game Reserve to the south and Mikumi National Park to the south west. Our team visited the area between August and September 2008 and a total of 70 camera traps were set out over a period of 30 days giving a total effort of 1810 camera trap days. Despite this high survey effort, only 9 mammal species were recorded throughout the survey period, and the overall capture rate was 0.02 sightings per trap day, the lowest recorded during the project. It it is likely that illegal hunting is a contributing factor to the low trap rates observed. Other mammals recorded by camera were: blue duiker, blue monkey, giant pouched rat (*Cricetomys emini*), marsh mongoose, African palm civet and black and white colobus monkey. Of particular interest were the records of the servaline genet and red-legged sun squirrel (*Heliosciurus rufobranchium*) which were not recorded in the past surveys conducted in this Forest Reserve and the suni antelope, whose presence in the reserve was last reported in 1950

15. Ugalla Game Reserve

This survey was another conducted under our FCF collaboration. Ugalla Game Reserve is a low-lying, flat area located in central-western Tanzania. The reserve covers 4,744km$^2$. The Ugalla River runs through the area after which it is named, and the open flood plain alongside this ranges from 1-9km across. Away from the river, the area is characterized by open Miombo woodland. During the rains, much of the reserve is inaccessible due to extensive flooding, while in the dry season Ugalla forms a haven for much of the game from surrounding areas. The river stops flowing during the dry season but large pools remain throughout the year. Ugalla is home to an array of relatively rare mega fauna; sable and roan antelope abound throughout the reserve, as do oribi, elephant, lion and leopard. Wild dog enjoy a healthy population, with at least 3 packs scattered within the Reserve's boundaries. Cheetahs are also seen on occasion. Ugalla is a unique place that deserves more attention, particularly considering that the reserve is an extension of the Malagarasi-Moyowosi RAMSAR Ecosystem. Ugalla's contribution to the overall balance and well-being to this internationally important wetland ecosystem is significant. Our team implemented a camera trap survey in Ugalla Game Reserve in October 2008, at the end of the dry season when access was possible. A total of 70 camera traps were set out over 30 days, providing 1431 camera trap days. 36 mammal species were recorded, and the species most often recorded were hippopotamus with a capture rate of 0.1124, elephant (0.0677), grey duiker (0.0495) and impala (0.0419). Warthog, giraffe, spotted hyaena and Coke's hartebeest, buffalo, crested porcupine, common waterbuck, lion and marsh mongoose were also recorded.

16. Mbangala Forest Reserve (November 2008)

This survey was conducted with funding raised from Rufford Small Grants and was the first ever survey since the reserve was gazetted in 1958. Like Lukwika, Mbangala forest reserve is situated in southern Tanzania on the Ruvuma river on the border with Mozambique. Mbangala is one of the least visited wilderness areas in the country. Herds of wildlife migrate across the Ruvuma River to Mozambique. It covers an area of 370km$^2$ and contains part of a vast and complex riverine floodplain wetland in the basin of the southern highlands. All rivers from the north, west and southwest of the forest flow ultimately into the Ruvuma River. Our team surveyed the area between November to December 2008. A total of 34 stations were placed in a 1km grid system for a period 30 days culminating 815 camera trap days. The survey recorded 22 mammal species, and the most frequently recorded species were grey duiker (capture rate of 0.0322), yellow baboon (capture rate of 0.0218), four toed elephant shrew (capture rate of 0.0218) and suni (capture rate of 0.0198), though aardvark, banded mongoose, greater kudu, bushbuck and bush hyrax were also recorded. Most importantly, these camera trap surveys have provided the first baseline data for mammal densities in this reserve which will allow managers to determine future trends in the relative abundance of wildlife and hence assess whether conservation efforts are successful. Evidence of a substantial amount of illegal activity was present in the reserve, and a total of 150 wire snares were removed by our team during the survey. In Tanzania, forest reserves fall under FBD and Game Reserves under WD. Although both areas are protected by Law, FBD receives little support from the government to enable law enforcement as required, whereas WD has substantially more income by way of hunting fees which enables them to better protect areas under their jurisdiction and this may best explain as to why the team located so many snares in Mbangala, yet found none in Lukwika-Lumesule Game Reserve (see below).

17. Lukwika-Lumesule Game Reserve

This survey was also conducted with funding raised from the Rufford Small Grants programme. The reserve was gazetted in 1995 and this was the first survey of the reserve. The Reserve is about

100km south of Masasi town and borders the Ruvuma River which runs along the border with Mozambique, and that country's massive "Reserva do Niassa" which is considered to hold the largest concentration of elephants in Mozambique. The reserve is very little known and has received very little attention from researchers and government, but it supports important populations of lions, elephants, hippo, crocodiles and buffalo, covering an area of 433km$^2$. This lack of attention is because of its distance from main centres of research, and because the poor infrastructure in the south inevitably discourages work in these areas. However, the reserve provides a vital link in the efforts to create a wildlife corridor between Niassa in Mozambique and the Selous Game Reserve in Tanzania, which is one of the largest protected areas of the world. Our team surveyed the area in November 2008, placing 60 camera stations in a 1km grid system culminating in 11106 camera trap days, providing records of 31 mammal species. The most frequent species were grey duiker (capture rate of 0.0321), Warthog (capture rate of 0.0299), elephant (capture rate of 0.0254) and African civet (capture rate of 0.0082). Sharpe's grysbok, serval, chequered elephant shrew, slender mongoose, spotted hyena, zorilla, leopard and lion were also recorded. Of particular interest was the photo-trapping of several individual Meller's mongoose. This was the first time this species had been trapped in our surveys, and may be one of the first times it has been photographed in the wild.

| Survey description | Area km$^2$ | Number of cameras | Duration of survey (days) | Actual effort (camera trap days) | Number of species | Start date | End date |
|---|---|---|---|---|---|---|---|
| Mahale Mountains National Park | 1,613 | 67 | 13 | 653 | 23 | 21/10/05 | 11/03/05 |
| Arusha National Park | 137 | 20 | 79 | 1073 | 27 | 07/03/06 | 26/05/06 |
| Serengeti National Park | 14,763 | 40 | 40 | 1219 | 29 | 27/05/06 | 07/06/06 |
| Minziro lowland forest | 311 | 54 | 30 | 1503 | 14 | 01/08/06 | 01/09/06 |
| North Tanga | NA | 42 | 27 | 949 | 29 | 19/11/06 | 16/12/06 |
| Saadani National Park | 1,062 | 41 | 30 | 1065 | 22 | 04/01/07 | 05/01/07 |
| Burigi-Biharamulo Game Reserves | 736 | 50 | 22 | 893 | 30 | 09/06/07 | 01/07/07 |
| Ukaguru mountain-Mamiwa catchment forest | 86 | 60 | 19 | 675 | 14 | 12/08/07 | 01/09/07 |
| Muhuwesi Forest Reserve | 1,758 | 55 | 24 | 1225 | 31 | 13/10/07 | 07/11/07 |
| Moyowosi Game Reserve | 11,482 | 47 | 30 | 968 | 28 | 11/10/07 | 12/10/07 |
| Ufiome Forest Reserve | 54 | 43 | 30 | 1052 | 24 | 02/02/08 | 02/03/08 |
| Maswa Game Reserve | 2,675 | 81 | 22 | 1260 | 46 | 03/06/08 | 25/06/08 |
| Gelai Mountain Game Controlled Area | NA | 54 | 30 | 1099 | 38 | 03/07/08 | 04/08/08 |
| Uluguru Forest Reserve | 176 | 70 | 30 | 1810 | 9 | 16/08/08 | 15/09/08 |
| Ugalla Game Reserve | 4,744 | 70 | 24 | 1421 | 36 | 03/10/08 | 27/10/08 |
| Mbangala Forest Reserve | 368 | 34 | 25 | 815 | 22 | 06/11/08 | 01/12/08 |
| Lukwika-Lumesule Game Reserve | 433 | 60 | 21 | 1106 | 31 | 09/11/08 | 28/11/08 |

**Table 1. Summary of the surveys undertaken during the project.**

### 4.3.1.4 'Manual of survey protocols produced.'

A manual of survey protocols was produced at the end of the training program in camera trap survey implementation conducted in February 2006. This manual outlines and explains camera trap survey techniques and protocols for use by the project staff (see accompanying materials).

In addition, a mammal identification guide was developed for use during interviews with local villagers. Proper identification of mammal species can be a problem for many of our current and potential contributors, who often have little access to accurate field guides, and this consequently affects the reliability of their sightings. Many of the National Park staff, for instance, are unable to distinguish between common similar species of antelope for lack of an identification manual. The new guide includes pictures and descriptions of each mammal species collected from project collaborators and from the web and is available on our web site. A printed version of the guide is used by project personnel during interviews with local people to assess the presence of mammal species in their area. This includes scaled pictures against an
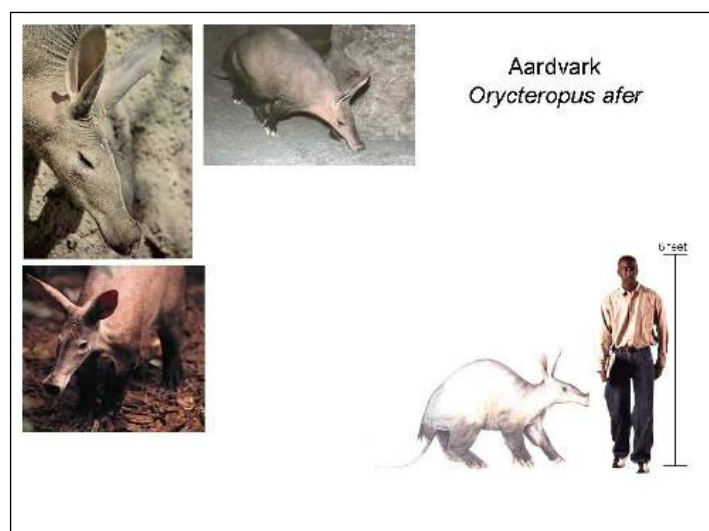


**Fig 9 Mammal identification sheet for Aardvark**

average human male for large species, or a human hand for smaller species (see Fig 9).

A field questionnaire was developed and used by the project team, with a focus on obtaining information on mammal distribution and abundance, local threats to wildlife and any local uses for different species. Interviews were targeted at villagers with a good knowledge of wildlife species in their area, often hunters. This has helped supplement data about mammal diversity collected from camera traps.

### 4.3.2 Centralised database of mammal distribution and status that integrates historical records, and information from CIMU, TCC and proposed project.

By the end of the project, a database containing 32,997 records, covering 111 species of medium to large mammals in Tanzania was established at TAWIRI. This data integrates information from the aerial survey program conducted by CIMU, past data collected by the TCP (8995 records), contributor data, survey data and data from published and unpublished manuscripts. This data has been disseminated to data contributors and project stakeholders through distribution maps posted onto the project website. Here we detail aerial survey data from CIMU and published data (for contributor and survey data see sections 4.3.1.2 and 4.3.1.3 respectively).

#### 4.3.2.1 Centralised database of mammal distribution on file at TAWIRI

The project converted the TCC database template, which was originally built in Access, to a server driven database using MYSQL programming language. A server to host the database was donated to the project by Rangvald Larsen from the University of Norway and a team of experts designed a new integrated database. This team was comprised of Ragnvald Larsen (a database expert from the University of Norway), Lara Foley of Tarangire Elephant Project ( a GIS expert who also helped design the original TCP Database), Machoke Mwita (the CIMU Database manager) as well as Edwin Konzo and Alexander Lobora from the project. The new database format in MYSQL allowed the project database to be fully compatible with the CIMU database holding aerial survey records, to enable direct data transfer between the two systems. The CIMU database contains over 20 years of data from aerial censuses conducted around the country. The key features of the project database are outlined in detail in our 2007 report.
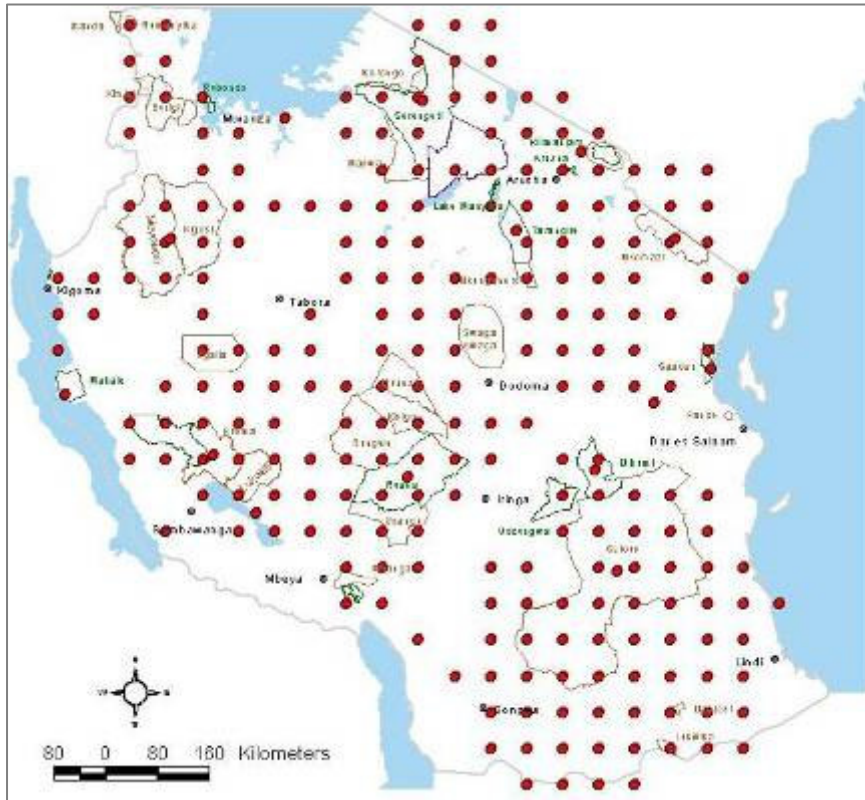
Over the course of the project a substantial quantity of recent and historical geo-referenced data on mammal species in Tanzania were added to this database. This includes data contributed by stakeholders; data extracted from aerial surveys conducted by CIMU; data from the 17 surveys conducted by the project; and data extracted from an extensive library of papers related to mammals in Tanzania, including important unpublished documents detailing historical mammal distribution in the country. Data coverage across the country is much improved since the start of the project, although there remains a bias towards protected areas where most survey work is undertaken (e.g. Fig. 10).

In order to plan effectively for conservation, it is not only important to have updated maps of current distribution of species, but also to consolidate information about historical distribution. This enables the identification of marked contractions (or expansions) in range. Throughout its operation, the project has continued to collect an extensive library of papers related to mammals in Tanzania, and has located some important unpublished documents detailing historical mammal distribution in the country (see 4.3.2.2). Information from these documents has been extracted, and the data entered into the main database. In addition, historical maps obtained from the literature; in particular, those from Sale et al. (1977) have been digitized. A graduate intern with GIS expertise , Eliamani Soye, was appointed to assist this process and was later appointed as project staff (see above). We carefully sifted through all archived documents and extracted information on mammal distribution, density and status, for inclusion in a 'historical' dataset. We also recorded details of the original methods of data collection, the source of the information and the year of publication. In cases where the exact grid square could not be determined, the general location was recorded – for instance 'Tarangire National Park' or 'Pangani district'. Toward the end of the project, this dataset had a total of 10,610 sighting records for 111 mammal species stretching back to the 1950's, and provides an extremely valuable historical database.

#### 4.3.2.2 Library of historical data established and both hard and electronic filed copies at TAWIRI.

A key aim of the project was to establish a library, both digital and hardcopy, of papers relating to mammal status, distribution and abundance in Tanzania that will be easily accessible to students and scientists stationed at TAWIRI. The project gathered data using a variety of methods, including visits to libraries at various institutions in East Africa, accessing websites and contacting scientists and conservation practitioners directly. Libraries visited included those at TAWIRI, TANAPA, the College of African Wildlife Management at Mweka, the University of Dar es Salaam, the Department of Zoology at the University of Dar es Salaam, the head offices of GTZ and WWF in Dar es Salaam and at Nature Kenya and the National Museum of Kenya.

**(a) Historical (prior to 1998) range of Cape Eland**     **(b) Recent (last 10 years) range of cape Eland**
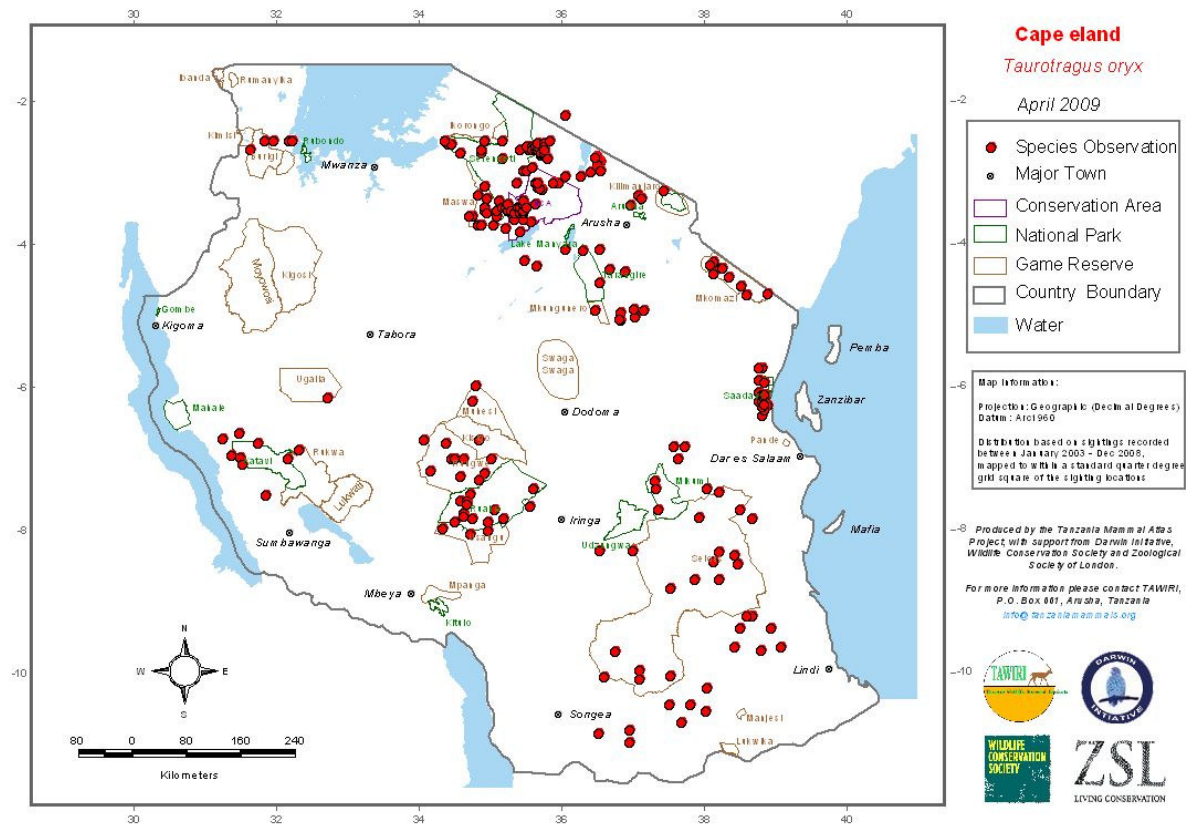


Fig. 10. Historical (a) and current (b) distribution of Cape Eland, as plotted from the project database, demonstrating a recent contraction in range across the country.

A total of 350 documents including published papers, unpublished manuscripts, internal project reports and PhD and Msc theses were accumulated. Among these were extremely valuable and rare references from the grey literature showing distributions of mammals in Tanzania from the 1960's. A Tanzania Mammal Archive has been developed with a reference list of all available literature, and each document has been coded to facilitate retrieval. A specially designed library cabinet has been installed in the reception area to house hard copies of all the documents (and documents on carnivores previously collected by TCP), which visiting students and scientists are able to sign out to read on the premises. All documents have been scanned and are also available digitally, although copyright restrictions do not allow us to post these directly on our web site.

### 4.3.2.3 Distribution atlas for targeted mammal species

By the end of the project, all of the historical and current data that we have managed to locate has been included in the database and can be viewed as maps of historical and current distribution on the project website www.tanzaniamammals.org. An example of the recent contraction in historical range is clearly demonstrated by the cape eland (Fig. 10). Whereas the species used to be widespread across the entire country, records are now largely constrained to protected areas.

Our data show presence only, and hence an absence of a record does not necessarily mean absence. Survey data is biased towards protected areas and hence maps should be used as a guide only, and should not be considered to be definitive, particularly for the smaller species which are capable of living in human altered environments or in areas with high levels of poaching. Nonetheless, our distribution maps largely resonated with the impression of most experienced wildlife professionals in Tanzania during action planning workshops (see below)

## 4.3.3 Conservation Action Plan for Tanzania's mammals developed to identify conservation priorities for each species and establish areas of data deficiency.

### 4.3.3.1 Action Plan supported and endorsed by governmental wildlife agencies and NGOs in Tanzania.

A key output of the project is the production of a series of medium to large mammal conservation action plans, which will be consolidated into one action plan for the large mammals of Tanzania. The project has accumulated sufficient data to develop these plans and the planning process started in April 2008. Three separate workshops were planned for this process for large ungulates; small ungulates, pangolins and aardvarks; and primates. These groups were chosen in order to segregate species according to likely threats and hence by activities to address these threats. Generally large ungulates tended to be wide ranging and hence were likely to be particularly vulnerable to habitat loss and fragmentation, small ungulates, with smaller ranges, are more predictable but because of this are vulnerable to snaring, whilst they tend to be secretive and difficult to monitor, whilst primates are largely or partially arboreal and hence are particularly vulnerable to timber extraction and forest loss.

The structure and development of the strategic plan followed a process recently used by one of the project leaders (Sarah Durant) for a range–wide process for the conservation of cheetahs and wild dogs (IUCN SSC 2007, 2008). This process was modified from one developed by IUCN for elephant and lions (IUCN 2005, 2006) and is now the IUCN recommended approach for species conservation planning.

The workshop process included the following key components:
1. *Engagement of stakeholders*
   Key individuals and institutions best able to implement the plan – including government authorities, species specialists and relevant NGOs – were all involved in the action planning process
2. *Summary of knowledge*
   The mapping process within the workshop built on the project database to establish up-to-date information on the status and distribution of each species. This provided essential information for the development of the action plan.
3. *Problem analysis*
   A problem analysis was conducted to identify threats, as well as the gaps and constraints impacting participants' ability to conserve the species. The problem analysis provided information critical for the development of the objectives of the action plan.
4. *Action plan*
   A cascading plan was constructed, starting at a goal, to a series of objectives devised to meet the goal, and then a number of targets and activities to address each objective (Fig. 11).

The planning process was participatory and consensus driven, with all stakeholders engaged in the development of the plan. The process was conducted in this way to ensure that the expertise and knowledge of all participants informed the plan, and also to ensure that the plan was jointly owned by

relevant institutions and individuals, facilitating its implementation. The plan needed to be realistic. The specifics of the action plan and its development are described below.

The planning process was made up of six key stages:
1. The development of a goal
2. A problem analysis.
3. The development of a number of objectives which address the problems identified by the problem analysis
4. The development of a number of targets to address each objective
5. The development of a number of activities to address each target
6. Adding actors, timelines and measurable indicators to each activity.



**Fig. 11 Structure of the action plans.**
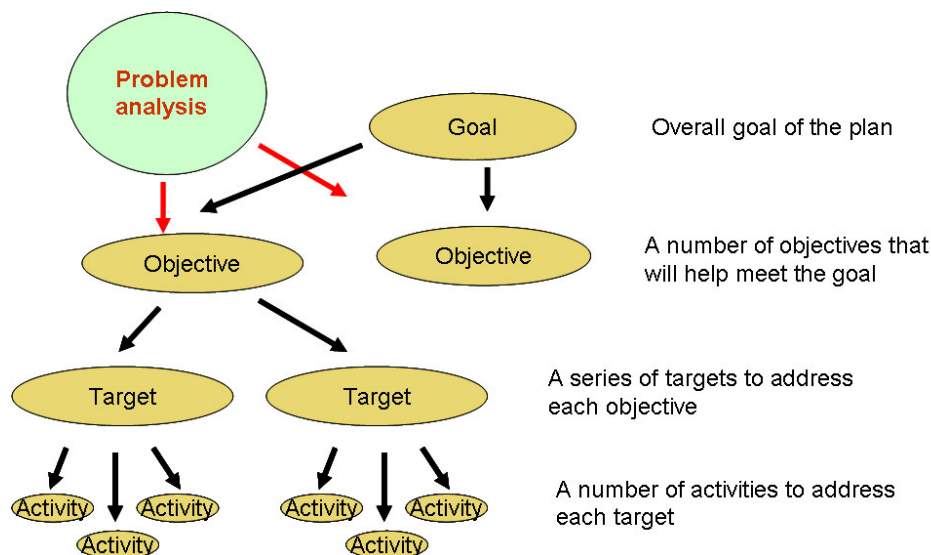
A feature of the planning process used here was planning for several species together. This could generally be justified as species were already grouped according to vulnerability to the same kinds of threats, e.g. most large ungulates are vulnerable to habitat fragmentation and illegal hunting, whilst most primates are vulnerable to forest loss. However, whether this was the case for each group of species examined was tested in the workshop during the problem analysis, as during this process problems specific to particular species were identified. In general, such problems were rare, as most affected all species to a varying degree, however where species specific problems existed, groups were asked to make sure they were addressed through activities in the action plan, where the target species were specified. More details on the process are available through IUCN/SSC 2007 and 2008 and will be included in the action plan reports.

Action plans emanating from all three workshops have been completed and circulated to all workshop participants for comments and are included with this report (see accompanying materials). The project leveraged additional support for more detailed management plans to be drawn up for elephants and Rhino, including for the accumulation of the detailed data necessary for this type of planning exercise.

## 4.4   Project standard measures and publications

Project standard measures and publications are quantified in Annex 4 and 5.

## 4.5   Technical and Scientific achievements and co-operation

The project had the following technical and scientific achievements:

• A detailed and up to date map of the human footprint that can be used for all spatial analyses of georeferenced mammal data.

• An extensive database of 10,872 geo-referenced and verified mammal sightings obtained during camera trap surveys, possibly the highest camera trap survey coverage of any country in Africa. This database will certainly lead to a wealth of scientific publications over the coming years.

• A peer reviewed scientific paper currently under review after an invited resubmission (see accompanying materials).

The project contributed to technical and scientific co-operation in the following ways:

• The project itself was a node of co-operation between ZSL and TAWIRI, whereby skills based within ZSL were transferred to project staff.

- The project leveraged additional funds for co-operative ventures including:
    - Two visits from Alex Lobora and one visit from Simon Mduma to London to meet with scientists at ZSL (Marcus Rowcliffe, Chris Carbone, Nathalie Pettorelli, Ben Collen, Jonathan Baillie) and at Imperial College London (E.J. Milner Gulland).
    - Three visits to Tanzania by Nathalie Pettorelli to introduce project staff to new data analysis and GIS techniques.
    - A royal society UK Tanzania networking award which involved a visit from UK based scientists (Marcus Rowcliffe, Nathalie Pettorelli, Ben Collen and Maurus Msuha) to Tanzania to exchange expertise on biodiversity monitoring.
    - A series of meetings, visits, dialogue between project staff and scientists and conservationists within WCS to exchange information on GIS and mammal conservation.

## 4.6 Capacity building

One of the major aims of the project was to further develop capacity for mammal monitoring and conservation within Tanzania. This aim has been successfully achieved, both in terms of trained personnel, but also in terms of resources and facilities available for mammal monitoring and conservation. Evidence for this includes the vibrant and active Tanzania carnivore centre, where this project was based, the ongoing survey program using funding partly leveraged by project staff, the office facilities, project vehicles and the project extensive database.

Several core staff became permanent TAWIRI staff during the previous Darwin initiative funded TCP project, hence providing training to these staff increased the permanent institutional capacity of TAWIRI. The remaining staff are all committed to the wildlife sector, as evidenced by the continuing career development of staff leaving the project (see below), hence their training increases the overall expertise of wildlife professionals in Tanzania. In its conception, the project focussed on the professional community, and hence relatively well trained individuals. As a result, training needs were usually specific to particular staff, therefore the project addressed training needs on a case by case basis.. 'Course' selection and content of training was agreed in open quarterly meetings after in depth discussion. Assessment of the effectiveness of training was conducted by project leaders and project manager on the basis of improvement in staff effectiveness post training. As training was selected to address specific needs, outcomes were generally clear. General courses attended by staff were accredited with certificates, however these were generally less useful than one-on-one training targeted specifically at project needs. The latter, by its nature had no standardised accreditation scheme.

In 2008, the project received a grant from the Royal Society to establish a UK-TZ networking team (Institute of Zoology, Imperial college and TAWIRI). The networking visit allowed UK scientists from IOZ and Imperial College to meet with Tanzanian scientists to discuss options for analysing a substantial amount of biodiversity data collected by the project and agreement on a way forward for future biodiversity monitoring. These discussions were preceded by a 4 day field trip to participate in the setting up of a biodiversity survey in the southern Serengeti ecosystem. The team identified several specific research areas using existing data leading to scientific publications In addition, two major avenues for research were identified as priorities for future work:

- Understanding human drivers of mammalian biodiversity loss.
- Establishing a national index of biodiversity based on the Living Planet index.

Training specific to each staff member is detailed below:

All staff received one-on-one mentoring by the project leaders.

Alex Lobora, Chediel Kazaeli, Edwin Konzo, Mwemezi Rwiza, Zawadi Mbwambo, received nearly two months on the job training in camera trap survey techniques from Marcella Kelly . The success of this training program has been apparent by the successful implementation of a number of subsequent surveys many of which have had no involvement from the project leader as well as the successful training of volunteers and new staff. Paul Baran joined the team for four days of this training.

Individual specific training:

Alex Lobora, was awarded a scholarship by WCS to attend an advanced Geographic Information Systems for Wildlife Conservation course in New York in October 2005. He also attended a number of international meetings, including the Range-wide priority setting workshop for the conservation of Lion in Southern and Eastern Africa, from 8-10 January 2006 in the Republic of South Africa; two separate familiarization meetings at ZSL in December 2005 and December 2008; and a meeting held at

Imperial College which aimed at identifying potential productive and synergistic collaborations between the UK institutions (ZSL and Imperial College) and Tanzanian institutions (TAWIRI).

Mwemezi Rwiza, one-on-one mentoring by project leaders, but also on the job training in camera trapping techniques.

Edwin Konzo, received a one on one training on GIS and modelling which led to the development of the first 'Human Footprint' map of Tanzania. He also received one on one training on database management from Machoke Mwita, the CIMU Database manager, and Rangvald Larsen, a CIMU consultant, on the development and supervision of the project Database.

Chediel Kazaeli, one-on-one mentoring by project leaders, but also on the job training in camera trapping techniques.

Flora Kipuyo, one-on-one mentoring by project leaders and two materials management courses in Arusha.

Zawadi Mbwambo, one-on-one mentoring by project leaders and on the job camera trap training enabling him to move from a driver position to that of a field assistant.

Jumanne Ramadhani, has received extensive on the job training in car repairs and maintenance from Zawadi Mbwambo.

Rajabu Makwiro, has received extensive on the job training in car repairs and maintenance from Zawadi Mbwambo.

Allen Mmbaga and Paul Baran have received training in data entry, species identification from photos, data analysis, camera trap survey techniques and report writing from project leaders and other senior project staff.

Eliamani Godwin has received on the job training in GIS and database management from Alex Lobora and Edwin Konzo.

Emanuel Lalashe, Bonifas Osujaki, Dennis Minja, Hassanali Mustapha, Paul Baran, Mwita Chagula and Wilson Kibasa have all received training in data entry, species identification from photos, data analysis, camera trapping techniques and report writing from project leaders and other senior project staff.

**Equipment purchase**

The new project is housed at the Carnivore Centre offices at TAWIRI that were built by the Tanzania Carnivore Programme, and has made use of much of the equipment purchased for that original project. New purchases include four new computers for project staff and a high quality scanner for scanning in camera trap pictures. All computers are wired into an independent ethernet network at the Carnivore Centre, allowing fast and efficient email and internet access, and also providing a much needed facility for visiting scientists in Arusha. During 2008 there were extensive nationwide power cuts due to a nationwide shortage of power and this forced us divert some of our budget to purchase a small petrol generator, which has the capacity to run all the lights and computers in the office, and allowed project activities to continue unhindered. The project also purchased a Landrover TDI station wagon which was imported without duty through our strong relationshipwith Frankfurt Zoological Society. The vehicle was budgeted in the original Tanzania Mammal Atlas Project grant and was essential for our field surveys and other project activities. A large amount of camping equipment was also purchased for the field survey work including large rucksacks, tents, sleeping gear, cooking gear, torches, waterproof clothing, footwear, binoculars, camera traps and one digital camera.

## 4.7 Sustainability and Legacy

This project is testament to the impact of a previous Darwin Project, the TCP, and has drawn on and extended the impacts of this successful project. The key specific impacts of this project are finding and hiring project staff, providing the continuation and expansion of the vibrant office atmosphere that was established during TCP. The field surveys have also been very successful, with a new species added to the Tanzania mammal list in our very first outing. Our surveys, together with thousands of photographs, have helped advertise our work and highlighted the potential of the project to our partner organisations. On an international level, there has been an increasing interest in the use of camera trap techniques as a tool for monitoring for the 2010 CBD biodiversity targets.

TAWIRI, our main partner organization, has shown its commitment to the project by having made many of our staff permanent TAWIRI employees. TANAPA, NCAA, FBD and WD have been extremely pleased with the results of the project, particularly the fact that the project is playing a pivotal role in developing comprehensive mammal species lists for all the National Parks, something that has thus far

been sorely lacking. Several high level delegations have visited the Centre. These include the then Permanent Secretary of the Ministry of Natural Resources and Tourism, Mr. Salehe Pamba who visited project in November 2006 to familiarize himself with the centres activities, and 35 members of the national assembly comprising the Land, environment and Natural Resources Parliamentary committee who visited the project in January 2007 to familiarize themselves with the our work.

The results of our camera trap surveys have attracted substantial attention and we envisage that the survey program will become a core long-term activity of TAWIRI. We anticipate it functioning in a similar manner to CIMU, where operating and core costs are obtained from biodiversity surveys commissioned by wildlife management authorities or NGOs. The funding provided by FCF fits this model. Further funding has been acquired for the following year from Rufford Small Grants (£5,829) aiming to survey mammals in the south of Tanzania, a region where we have large information gaps and the International Foundation for Science (US$ 11,800) aiming to survey mammals in the central part of the country.

# 5   Lessons learned, dissemination and communication

*Dissemination*

Dissemination of information to stakeholders is an integral and essential part of this project. The project has developed an active and attractive website, maintained communication with an increasing network of data contributors and stakeholders, maintained a regular visiting schedule to the major safari companies and tour operators in Arusha, and produced four editions of the project newsletter detailing information on the project activities. 1000 copies of each newsletter were printed for dissemination to interested parties. These include all data contributors to the project as well as partner organizations and potential donor organizations. PDF copies of the newsletters are available for download on the project website. Information on interesting survey findings have been presented to our partner organizations as well as the local media, resulting in a mention being given in parliament of the giant pangolin finding and an article in the Daily News newspaper on the 27th of November 2006.

*Lessons learned*

The quarterly meeting process, previously used in our last Darwin Initiative project, and employed by this project remained highly effective. These meetings were like a mini-workshop, often taking up an entire day, and were treated seriously by staff and helped to ensure that everyone from administrator and driver to project manager and leader felt included as an integral part of the project team. The quarterly meeting process also demonstrated the value that a well constructed logframe can play in project implementation. The process also demonstrated the value of engaging project staff in the direction and implementation of the project and provided a good environment for more junior staff to learn the fundamentals of project management.

## 5.1   Darwin identity

The project has advertised the Darwin Initiative in a number of ways:

- The project vehicle has used the Darwin logo and is seen regularly around Arusha and on visits to tour operators.
- All publicity materials display the Darwin logo prominently
- All reports and publications arising from the work credit the Darwin Initiative
- All presentations given by the project team credit the Darwin Initiative and provide a short explanation of the Darwin Initiative program – time permitting.
- All popular articles have mentioned the Darwin Initiative.
- Darwin logos have been printed on banners and placed at the reception and the board room of the project building which is frequently used by all wildlife stakeholders in the country.

## 6   Monitoring and evaluation

The project is monitored and evaluated in the same manner as the TCP, as this strategy proved to be extremely effective in implementing this program. The activities of the project are monitored against quarterly work plans drawn up at quarterly planning meetings attended by the entire project team including project leaders. These work plans are based on the logical framework in the original proposal. Each project staff member writes a monthly work plan based on the needs detailed at our quarterly meetings, and this work plan is submitted to the project manager and project leaders who use it to determine progress. The project manager collates the information and submits monthly reports to the project leaders and ZSL which are also used to monitor progress against the work plans and logical framework. In this way the entire team is engaged in the project implementation and is kept fully aware of project goals and targets and can adjust work plans and timetables to ensure that the project outputs are

met. We are particularly fortunate to be able to compare our progress against the baseline provided by TCP, which successfully achieved a similar overall aim of national conservation action plans for all carnivore species.

## 6.1 Actions taken in response to annual report reviews

Our reviews have largely been very positive, for which we are very grateful, however we outline below the actions taken in response to reviews (where we have not taken action, a detailed explanation was included in the relevant annual report):

- A reviewer pointed out the need to build a historical database of mammal distribution as well as a current database: This is an important point and one which we have addressed. We have amalgamated a more or less complete historical record of the scientific and grey literature on mammal distribution across the country, and we have entered this data into our database. The use of this database to demonstrate the extensive loss of range experienced by most species provided a sobering point in our action planning workshops.
- A reviewer was interested in whether our database integrated with other databases: Our database is largely sighting information and hence has the same format as most atlas databases of this type. It is not a particularly complex database and can be exported into different data formats. Addressing the needs of our local partner, TAWIRI, has been our first consideration in the design of the database, however project leaders have discussed with the relevant IUCN specialist groups about the format of the database. The database is the same format as the carnivore database and the cheetah database has been exported readily into the IUCN Cat SG database.
- A reviewer was interested in whether we had fully explored opportunities of linking GIS and the database: There are important advantages in linking analyses between our database and GIS and we are exploring possible options. One approach is using a habitat selection analysis based on where species are recorded, and this is the approach a project collaborator (Nathalie Pettorelli (based at IOZ is investigating). However we are aware that there is a potential danger, when using very high tech techniques, that analyses can become dominated by the UK partner. In order to avert this risk in this situation, we made use of IOZ funds to bring Nathalie out to Tanzania to provide training to those of our staff who already have sufficient baseline skills, bringing them up to date with the techniques. The training so far has worked very well, and although this slows down the production of scientific outputs, this is a small price to pay to continue to ensure an equal partnership. Furthermore, project staff very much appreciate having the opportunity to learn new skills, which helps to maintain interest and enthusiasm for the project. Our first manuscript covering this analysis has been submitted to Animal Conservation (see accompanying materials).

# 7 Finance and administration

| Item | Budget (please indicate which document you refer to if other than your project application) | Expenditure | Balance |
|---|---|---|---|
| Rent, rates, heating, overheads etc | | | |
| Office costs (e.g. postage, telephone, stationery) | | | |
| Travel and subsistence | | | |
| Printing | | | |
| Conferences, seminars, etc | | | |
| Capital items/equipment | | | |
| Others | | | |
| Salaries (specify) | | | |
| Tanzanian staff | | | |
| UK staff | | | |
| **TOTAL** | | | |

\* indicates budget lines deviating by 10% or more.

There was an overspend on rent and overheads, travel and subsistence, and underspend on printing and conferences.
- The overspend on rent and overheads includes a generator and fuel that we were compelled to buy to provide ourselves with electricity during almost continuous power cuts during the project lifespan. This was a major cost that we did not anticipate.
- The overspend on travel and subsistence was principly due to field activities (there was an underspend on international travel), many of these activities cost more than we had anticipated, partly due to rapid increases in prices during the course of the project.
- The underspends on printing and workshops were planned in order to recoup funding for the extra expenses incurred on overheads and travel and subsistence. This was the only area where there was a possibility of reducing costs, which was achieved by reducing the number of editions of the project newsletter, and by cancelling the inception workshop which was originally planned. Given the previous activities of the carnivore project, these did not have major detrimental impacts as the project team were already well known in Tanzania.

## 7.1 Additional funds or in-kind contributions secured

The project has leveraged a substantial amount of additional funds (total c. $380,000) during its implementation:

- A total of $ 200,000 from WCS for developing an elephant management plan
- A total of $11,800 from the International Foundation for Science (IFS) for surveying the southern edge of the country (Lukwika Lumesule Game Reserve and Mbangala Forest Reserve).
- A total of £ 5,829 from Rufford Small Grants for surveying the central part of the country (Swagaswaga Game Reserve)
- A total of $ 36,000 from Friedkin Conservation Foundation(FCF) for conducting surveys in selected areas which are also project priority areas.
- A total of $39,000 from St Louis Zoo
- A total of £6,900 from the Royal Society
- A total of $40,000 from the Howard G Buffett Foundation for a second vehicle.
- Support from Frankfurt Zoological Society in importation of the second vehicle and the Darwin Initiative funded vehicle saving around $30,000 in import duty.

Thoughout its operation the project benefited from the constant support of TAWIRI, through administrative support, security and assistance in leveraging support from project stakeholders.

## 7.2 Value of DI funding

The project was ambitious, yet has managed to achieve all of its key goals, with the help of leveraged additional support. It has thus delivered extremely good value for money to the DI. This is, in part, due to the long experience of the project leaders in operating in Tanzania, as it would have been difficult to implement this project without having a solid number of years experience in country, and virtually impossible to make the progress that has been made.

In particular, the project has gained good value by:
- Taking advantage of a foundation of trust built up under TCP since 2002 through relationships and collaborations between TCP with local governmental institutions and NGOs, as evidenced by the attendance of all the relevant wildlife authorities at the workshops.
- Building on capacity already established through the TCP, enabling the project to be able to do substantially more in a 3 year period than it would have been able to do had it started from scratch.
- Drawing on each project leader's 18 years of experience in the country, and a foundation of trust built up over many years through long term relationships and collaborations between the project leaders with local governmental institutions and NGOs, as evidenced by the recruitment of an excellent team of project staff and the high degree pf support of the research community, government and the private sector.
- Being able to leverage additional funding, through the contacts of the project leader, and the increasing skills of the project team in raising funds. This enabled the employment of the second survey team and the acquisition of a second vehicle which gave substantial extra value for money.
- Being able to draw on the international community for advice and support through the contacts of the project leaders. This included internationally respected field biologists and camera trapping experts such as Marcella Kelly and Marcus Rowcliffe; statistical and GIS experts such as Nathalie Pettorelli;

monitoring experts such as Ben Collen; and socio-economists such as E.J. Milner Gulland. All gave their time freely and enthusiastically.

## Index of latin names for species covered by project

| Taxon | Common name | Latin name | Distribution map | Action plan |
|---|---|---|---|---|
| *List of mammal species found within Tanzania covered by project (listed in EANHS "Mammals of East Africa" and updated through this project))* | | | | |
| *Insectivora* | | | | |
| *Erinaceidae* | | | | |
| | African hedgehog | *Atelerix albiventris* | Y | N |
| *Primates* | | | | |
|   *Galagonidae* | | | | |
| | Large eared greater galago | *Otolemur crassicaudatus* | Y | N |
| | Small eared greater galago | *Otolemur garnetti* | Y | N |
| | Silver greater galago | *Otolemur monteiri (or argentatus)* | Y | N |
| | Mohol lesser galago | *Galago moholi* | Y | N |
| | Senegal galago | *Galago senegalensis* | Y | N |
| | Zanzibar galago | *Galagoides zanzibaricus* | Y | N |
| | Grants galago | *Galagoides granti* | Y | N |
| | Diani lesser galago | *Galagoides cocos* | Y | N |
| | Mountain galago | *Galagoides orinus* | Y | N |
| | Rondo galago | *Galagoides rondoensis* | Y | N |
|   *Cercopithecidae* | | | | |
| | Grey cheeked mangabey | *Cercocebus albigena* | Y | Primate workshop |
| | Sanje mangabey | *Cercocebus sanjei* | Y | Primate workshop |
| | Kipunji | *Cercocebus kipunji* | Y | Primate workshop |
| | Vervet monkey | *Allenopithecus nigroviridis* | Y | Primate workshop |
| | Red tailed monkey | *Cercopithecus ascanius* | Y | Primate workshop |
| | Blue monkey | *Cercopithecus mitis* | Y | Primate workshop |
| | Patas monkey | *Erythrocebus patas* | Y | Primate workshop |
| | Olive baboon | *Papio anubis* | Y | Primate workshop |
| | Yellow Baboon | *Papio cynocephalus* | Y | Primate workshop |
|   *Colobinae* | | | | |
| | Angolan black and white colobus | *Colobus angolensis* | Y | Primate workshop |
| | Guereza black and white colobus (syn Abyssinia black and white colobus) | *Colobus guereza syn Colobus abyssinicus* | Y | Primate workshop |
| | Zanzibar red colobus | *Piliocolobus kirkii* | Y | Primate workshop |
| | Udzungwa red colobus | *Piliocolobus gordonorum* | Y | Primate workshop |
| | Central African red colobus | *Piliocolobus oustaleti* | Y | Primate workshop |
|   *Pongidae* | | | | |
| | Chimpanzee | *Pan troglodytes* | Y | Primate workshop |
| *Carnivora* | | | | |
|   *Canidae* | | | | |
| | Side striped jackal | *Canis adustus* | Y | N |
| | Golden jackal | *Canis aureus* | Y | N |
| | Black backed jackal | *Canis mesomelas* | Y | N |
| | Wild dog | *Lycaon pictus* | Y | N |
| | Bat eared fox | *Otocyon megalotis* | Y | N |
|   *Mustelidae* | | | | |
| | African clawless otter | *Aonyx capensis* | Y | N |
| | Spotted necked otter | *Lutra maculicollis* | Y | N |
| | Zorilla | *Ictonyx striatus* | Y | N |
| | Honey badger | *Mellivora capensis* | Y | N |
| | Striped weasel | *Poecilogale albinucha* | Y | N |
|   *Viverridae* | | | | |
| | Civet | *Viverra civetta* | Y | Achieved in last DI Project |
| | Common genet (syn Small spotted genet) | *Genetta genetta* | Y | Achieved in last DI Project |

| Taxon | Common name | Latin name | Distribution map | Action plan |
|---|---|---|---|---|
| *List of mammal species found within Tanzania covered by project (listed in EANHS "Mammals of East Africa" and updated through this project))* | | | | |
| | Servaline genet | *Genetta servalina* | Y | Achieved in last DI Project |
| | Large spotted genet | *Genetta tigrina* | Y | Achieved in last DI Project |
| | Miombo genet | *Genetta angolensis* | Y | Achieved in last DI Project |
| | African palm civet | *Nandinia binotata* | Y | Achieved in last DI Project |
| *Herpestidae* | | | | |
| | Marsh mongoose | *Atilax paludinosus* | Y | Achieved in last DI Project |
| | Bushy tailed mongoose | *Bdeogale crassicauda* | Y | Achieved in last DI Project |
| | Jackson's mongoose | *Bdeogale jacksonii* | Y | Achieved in last DI Project |
| | Sokoke dog mongoose | *Bdeogale omnivora* | Y | Achieved in last DI Project |
| | Somali dwarf mongoose | *Helogale hirtula* | Y | Achieved in last DI Project |
| | Dwarf mongoose | *Helogale parvula* | Y | Achieved in last DI Project |
| | Egyptian mongoose | *Herpestes ichneumon* | Y | Achieved in last DI Project |
| | Slender mongoose | *Herpestes sanguineus* | Y | Achieved in last DI Project |
| | White tailed mongoose | *Ichneumia albicauda* | Y | Achieved in last DI Project |
| | Banded mongoose | *Mungos mungo* | Y | Achieved in last DI Project |
| | Mellers mongoose | *Rhynchogale melleri* | Y | Achieved in last DI Project |
| *Hyaenidae* | | | | |
| | Spotted hyeana | *Crocuta crocuta* | Y | Achieved in last DI Project |
| | Striped hyeana | *Hyeana hyeana* | Y | Achieved in last DI Project |
| | Aardwolf | *Proteles cristatus* | Y | Achieved in last DI Project |
| *Felidae* | | | | |
| | Cheetah | *Acinonyx jubatus* | Y | Achieved in last DI Project |
| | Caracal | *Felis caracal* | Y | Achieved in last DI Project |
| | Serval | *Felis serval* | Y | Achieved in last DI Project |
| | Wild cat | *Felis libyca* | Y | Achieved in last DI Project |
| | Lion | *Panthera leo* | Y | Achieved in last DI Project |
| | Leopard | *Panthera pardus* | Y | Achieved in last DI Project |
| *Proboscidae* *Elephantidae* | | | | |
| | Savanna elephant | *Loxodonta africana* | Y | Funding leveraged for future management plan 2011 |
| *Perissodactyla* *Equidae* | | | | |
| | Burchell's zebra | *Equus burchelli* | Y | Large ungulate workshop |
| | Family | | | |
| *Rhinocerotidae* | | | | |
| | Black rhinoceros | *Diceros bicornis* | Y | Working with stakeholders to establish future management plan probably in 2011 |
| *Hyracoidea* *Procaviidae* | | | | |
| | Southern tree hyrax | *Dendrohyrax arboreus* | Y | N |
| | East African tree hyrax | *Dendrohyrax validus* | Y | N |
| | Rock hyrax | *Procavia johnstoni* | Y | N |
| | Bush hyrax | *Heterohyrax brucei* | Y | N |
| *Tubulidentata* *Orycteropodidae* | | | | |
| | Aardvark | *Orycteropus afer* | Y | Small ungulate workshop |
| *Artiodactyla* *Suidae* *Phacochoerinae* | | | | |
| | Warthog | *Phacochoerus africanus* | Y | Small ungulate workshop |
| *Suinae* | | | | |
| | Bushpig | *Potamochoerus porcus* | Y | Small ungulate workshop |
| *Hippopotamidae* | | | | |
| | Hippopotamus | *Hippopotamus amphibius* | Y | Large ungulate workshop |

| List of mammal species found within Tanzania covered by project (listed in EANHS "Mammals of East Africa" and updated through this project)) | | | Distribution map | Action plan |
|---|---|---|---|---|
| Taxon | Common name | Latin name | | |
| *Giraffidae* | | | | |
| | Giraffe | *Giraffa camelopardis* | Y | Large ungulate workshop |
| *Bovidae* | | | | |
| *Alcelaphinae* | | | | |
| | Coke's hartebeest | *Alcelaphus buselaphus* | Y | Large ungulate workshop |
| | Lichtenstein's hartebeest | *Alcelaphus lichtensteinii* | Y | Large ungulate workshop |
| | Blue wildebeest | *Connochaetes taurinus* | Y | Large ungulate workshop |
| | Topi | *Damaliscus lunatus* | Y | Large ungulate workshop |
| *Antelopinae* | | | | |
| | Impala | *Aepyceros melampus* | Y | Large ungulate workshop |
| | Grant's gazelle | *Gazella granti* | Y | Large ungulate workshop |
| | Thomson's gazelle | *Gazella thomsoni* | Y | Large ungulate workshop |
| | Gerenuk | *Litocranius walleri* | Y | Large ungulate workshop |
| *Bovinae* | | | | |
| | African buffalo | *Syncerus caffer* | Y | Large ungulate workshop |
| | Cape eland | *Taurotragus oryx* | Y | Large ungulate workshop |
| | Greater kudu | *Tragelaphus strepsiceros* | Y | Large ungulate workshop |
| | Lesser kudu | *Tragelaphus imberbis* | Y | Large ungulate workshop |
| | Bushbuck | *Tragelaphus scriptus* | Y | Small ungulate workshop |
| | Sitatunga | *Tragelaphus spekei* | Y | Small ungulate workshop |
| *Cephalophinae* | | | | |
| | Ader's duiker | *Cephalophus adersi* | Y | Small ungulate workshop |
| | Natal red duiker | *Cephalophus natalensis* | Y | Small ungulate workshop |
| | Blue duiker | *Cephalophus monticola* | Y | Small ungulate workshop |
| | Abbott's duiker | *Cephalophus spadix* | Y | Small ungulate workshop |
| | Peter's duiker | *Cephalophus callipygus* | Y | Small ungulate workshop |
| | Grey duiker | *Sylvicapra grimmia* | Y | Small ungulate workshop |
| *Hippotraginae* | | | | |
| | Roan antelope | *Hippotragus equinus* | Y | Large ungulate workshop |
| | Sable antelope | *Hippotragus niger* | Y | Large ungulate workshop |
| | Oryx | *Oryx gazella* | Y | Large ungulate workshop |
| *Neotraginae* | | | | |
| | Kirk's dik-dik | *Rhynchotragus kirki* | Y | Small ungulate workshop |
| | Suni | *Neotragus moschatus* | Y | Small ungulate workshop |
| | Klipspringer | *Oreotragus oreotragus* | Y | Small ungulate workshop |
| | Oribi | *Ourebia ourebia* | Y | Small ungulate workshop |
| | Sharpe's grysbok | *Rhaphicerus sharpei* | Y | Small ungulate workshop |
| | Steenbuck | *Raphicerus campestris* | Y | Small ungulate workshop |
| *Reduncinae* | | | | |
| | Common waterbuck | *Kobus ellipsiprymnus* | Y | Large ungulate workshop |
| | Puku | *Kobus vardonii* | Y | Large ungulate workshop |
| | Southern reedbuck | *Redunda arundiaum* | Y | Large ungulate workshop |
| | Mountain reebuck | *Redunca fulvorufula* | Y | Large ungulate workshop |
| | Bohor reedbuck | *Redunca redunca* | Y | Large ungulate workshop |
| *Pholidota* | | | | |
| *Manidae* | | | | |
| | Ground pangolin | *Manis temminckii* | Y | Small ungulate workshop |
| | Tree pangolin | *Phataginus tricuspis* | Y | Small ungulate workshop |
| | Giant pangolin | *Manis gigantea* | Y | Small ungulate workshop |

## References

IUCN 2005. Strategy for the conservation of West African elephants. IUCN, Gland.

IUCN 2006. Regional conservation strategy for the lion *Panthera leo* in Eastern and Southern Africa. IUCN, Gland.

IUCN SSC 2007. Regional conservation strategy for the cheetah and wild dog in eastern Africa. IUCN SSC, Gland.

IUCN SSC 2008. Regional conservation strategy for the cheetah and wild dog in southern Africa. IUCN SSC, Gland.

Kingdon, J. 1977. East African mammals: An altas of evolution in Africa volume IIIA carnivores. London, Academic Press

Sinclair, A. R. E., and P. Arcese, editors. 1995. Serengeti II: Dynamics, management and conservation of an ecosystem. University of Chicago Press, Chicago.

# Annex 1  Report of progress and achievements against final project logframe for the life of the project

| Project summary | Measurable Indicators | *Progress and Achievements October 2005- December 2008* | Actions required/planned for next period |
|---|---|---|---|
| ***Goal:*** *To draw on expertise relevant to biodiversity from within the United Kingdom to work with local partners in countries rich in biodiversity but constrained in resources to achieve*<br><br>*The conservation of biological diversity,*<br><br>*The sustainable use of its components, and*<br><br>*The fair and equitable sharing of the benefits arising out of the utilization of genetic resources* | | The project has made good progress in data collection that will form the basis of a national conservation action plan for all medium to large mammals in Tanzania. This plan will set out priorities for conservation of each species, which, if implemented will enable their conservation. | *(do not fill not applicable)* |
| Purpose<br>To develop a national monitoring system of large mammals that addresses current geographic and taxonomic data gaps, in order to produce a detailed distributional atlas and conservation action plan for large mammals in Tanzania. | Mammal monitoring system, which Addresses current data deficiencies, in place by 2008.<br><br>Distribution atlas of large mammals developed by 2008.<br><br>Increased skills in mammal monitoring for TAWIRI staff through creation of a new monitoring unit.<br><br>Conservation action plan published and widely disseminated by 2008. | An effective monitoring system has been established which targets geographic and taxonomic data gaps.<br><br>Two fully trained camera trap survey teams established; a large list of data contributors; and a sophisticated database with over 30,000 entries of large mammal distribution. | |
| **Output 1.**<br>Sub-unit of TAWIRI developed to monitor large mammals in data deficient areas using standardized methods | **Indicator 1.1** 3 new staff and existing TAWIRI staff trained as trainers in mammal monitoring by early 2006.<br><br>**Indicator 1.2** Data contributors identified and submitting sufficient mammal sightings regularly to ensure wide coverage of the country. | All project staff have been trained in camera trap survey techniques including data collection and analysis. Field staff at the start of the project (three) were able to train new staff in the techniques, demonstrating their ability to operate as trainers.<br>20 staff and volunteers trained in some or all aspects of species identification, database management, data entry and data analysis, and GIS.<br>341 individuals and 142 organizations identified as data contributors and over 10,000 geo referenced mammal records submitted to database.<br>Data disseminated back to contributors through active and attractive project web site www.tanzaniamammals.org to encourage continual data submissions.<br>4 copies of the project newsletter produced and each distributed to 1000 project stakeholders – these newsletters are also used to disseminate information back | |

| | **Indicator 1.3** Mammal distribution data acquired for at least 15 target areas using remote camera traps<br>**Indicator 1.4** Manual of survey protocols produced | to contributors.<br>17 camera trap surveys completed to date contributing over 10,000 records to project database. A second team has played a significant role in the achievement of this target.<br>Survey protocol manual completed and details uploaded onto project web site. |
|---|---|---|
| **Output 2.** Centralized database of mammal distribution and status that integrates historical records, and in formation from CIMU, TCC and proposed project. | **Indicator 2.1** Centralised database of mammal distribution on file at TAWIRI.<br>**Indicator 2.2** Library of historical data established and both hard and electronic filed copies at TAWIRI<br>**Indicator 2.3** Distribution atlas for targeted mammal species | A further c. 26,000 new records added to project database.<br><br>A total of 350 documents lodged at TAWIRI, all of which contain records of valuable historical data. Data has also been extracted and entered into project database.<br>Distribution atlas for 111 mammal species available to view on www.tanzaniamammals.org |
| **Output 3.** Conservation Action Plan for Tanzania's mammals developed to identify conservation priorities for each species and establish areas of data deficiency. | **Indicator 3.1** Action plan supported and endorsed by governmental wildlife agencies and NGOs in Tanzania. | Three workshops (namely for large ungulates; primates and small ungulates-aardvark and pangolins) have been held and conservation action plans have been developed for 58 species of medium to large mammals of Tanzania.<br>Workshops were attended by senior representatives from all the major wildlife departments in Tanzania and action plans were developed through consensus ensuring highest possible likelihood of future endorsement. |

# Annex 2   Project's final logframe, including criteria and indicators

We did not change the logframe from that submitted

| Project summary | Measurable Indicators | Means of verification | Important Assumptions |
|---|---|---|---|
| **Goal** | | | |
| To draw on expertise relevant to biodiversity from within the United Kingdom to work with local partners in countries rich in biodiversity but poor in resources to achieve the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of benefits arising out of the utilisation of genetic resources | | | |
| **Purpose** | | | |
| To develop a national monitoring system of large mammals that addresses current geographic and taxonomic data gaps, in order to produce a detailed distributional atlas and conservation action plan for large mammals in Tanzania. | Mammal monitoring system, which addresses current data deficiencies, in place by 2008.<br><br>Distribution Atlas of Tanzanian mammals developed by 2008.<br><br>Increased skills in mammal monitoring for TAWIRI staff through creation of a new monitoring unit.<br><br>Conservation action plan published and widely disseminated by 2008. | Reports summarising database records and a manual covering monitoring protocols produced.<br>Distribution maps published and disseminated via the project website<br><br>TAWIRI team conducting surveys independently as part of their annual workplan.<br><br>Conservation Action Plan published by target date. | TAWIRI remains supportive and committed to the project.<br><br>Key stakeholders endorse Conservation Action Plan. |
| **Outputs** | | | |
| Sub-unit of TAWIRI developed to monitor large mammals in data deficient areas using standardised methods. | 3 new staff and existing TAWIRI staff trained as trainers in mammal monitoring by early 2006.<br><br>Data contributors identified and submitting sufficient mammal sightings regularly to ensure wide coverage of the country.<br><br>Mammal distribution data acquired for at least 15 target areas using remote camera traps<br><br>Manual of survey protocols produced. | Training report submitted and attendees have proven aptitude in survey methods.*<br>Contributor contact list and correspondence on file at TAWIRI HQ.<br><br>Interview forms and reports from each survey filed and submitted to project library.<br>Copies of survey manual available at TAWIRI HQ | Network of data contributors keen and willing to send in data.<br><br>Data can be collected from all parts of the country.<br>Key stakeholders support data collection activities. |

| | | | |
|---|---|---|---|
| Centralised database of mammal distribution and status that integrates historical records, and in formation from CIMU, TCC and proposed project. | Centralised database of mammal distribution on file at TAWIRI.<br><br>Library of historical data established and both hard and electronic filed copies at TAWIRI.<br><br>Distribution atlas for targeted mammal species | Database accessible to authorised personnel at HQ.<br><br>Library available for viewing by authorised personnel. Copies to be sent on CD to Darwin and key stakeholders. Atlas distributed to all stakeholders in hardcopy or electronic form and published on the web. | Data contributors prepared to supply data |
| Conservation Action Plan for Tanzania's mammals developed to identify conservation priorities for each species and establish areas of data deficiency. | Action Plan supported and endorsed by governmental wildlife agencies and NGOs in Tanzania. | Action Plan published and distributed to all stakeholders.<br><br>Letters of endorsement by government and relevant authorities. Copies to be sent to Darwin Initiative. | Sufficient data exist to produce a meaningful plan.<br><br>Sufficient buy-in from all stakeholders to ensure endorsement of plan. |

# Annex 3   Project contribution to Articles under the CBD

## Project Contribution to Articles under the Convention on Biological Diversity

| Article No./Title | Project % | Article Description |
|---|---|---|
| 6. General Measures for Conservation & Sustainable Use | 30 | Develop national strategies that integrate conservation and sustainable use. |
| 7. Identification and Monitoring | 30 | Identify and monitor components of biological diversity, particularly those requiring urgent conservation; identify processes and activities that have adverse effects; maintain and organise relevant data. |
| 8. In-situ Conservation | | Establish systems of protected areas with guidelines for selection and management; regulate biological resources, promote protection of habitats; manage areas adjacent to protected areas; restore degraded ecosystems and recovery of threatened species; control risks associated with organisms modified by biotechnology; control spread of alien species; ensure compatibility between sustainable use of resources and their conservation; protect traditional lifestyles and knowledge on biological resources. |
| 9. Ex-situ Conservation | | Adopt ex-situ measures to conserve and research components of biological diversity, preferably in country of origin; facilitate recovery of threatened species; regulate and manage collection of biological resources. |
| 10. Sustainable Use of Components of Biological Diversity | | Integrate conservation and sustainable use in national decisions; protect sustainable customary uses; support local populations to implement remedial actions; encourage co-operation between governments and the private sector. |
| 11. Incentive Measures | | Establish economically and socially sound incentives to conserve and promote sustainable use of biological diversity. |
| 12. Research and Training | 15 | Establish programmes for scientific and technical education in identification, conservation and sustainable use of biodiversity components; promote research contributing to the conservation and sustainable use of biological diversity, particularly in developing countries (in accordance with SBSTTA recommendations). |
| 13. Public Education and Awareness | 10 | Promote understanding of the importance of measures to conserve biological diversity and propagate these measures through the media; cooperate with other states and organisations in developing awareness programmes. |
| 14. Impact Assessment and Minimizing Adverse Impacts | | Introduce EIAs of appropriate projects and allow public participation; take into account environmental consequences of policies; exchange information on impacts beyond State boundaries and work to reduce hazards; promote emergency responses to hazards; examine mechanisms for re-dress of international damage. |
| 15. Access to Genetic Resources | | Whilst governments control access to their genetic resources they should also facilitate access of environmentally sound uses on mutually agreed terms; scientific research based on a country's genetic resources should ensure sharing in a fair and equitable way of results and benefits. |
| 16. Access to and Transfer of Technology | | Countries shall ensure access to technologies relevant to conservation and sustainable use of biodiversity under fair and most favourable terms to the source countries (subject to patents and intellectual property rights) and ensure the private sector facilitates such assess and joint development of technologies. |

| Article No./Title | Project % | Article Description |
|---|---|---|
| 17. Exchange of Information | 10 | Countries shall facilitate information exchange and repatriation including technical scientific and socio-economic research, information on training and surveying programmes and local knowledge |
| 19. Bio-safety Protocol | 0 | Countries shall take legislative, administrative or policy measures to provide for the effective participation in biotechnological research activities and to ensure all practicable measures to promote and advance priority access on a fair and equitable basis, especially where they provide the genetic resources for such research. |
| Other Contribution | 5 | Smaller contributions (eg of 5%) or less should be summed and included here. |
| Total % | 100% | Check % = total 100 |

# Annex 4 Standard Measures

| Code | Description | Totals (plus additional detail as required) |
|---|---|---|
| **Training Measures** | | |
| 1a | Number of people to submit PhD thesis | 0 (although 1 post DI project manager (Maurus Msuha) conducted PhD supervised by project leader – he was provided with logistical support by project) |
| 1b | Number of PhD qualifications obtained | 0 |
| 2 | Number of Masters qualifications obtained | 0 |
| 3 | Number of other qualifications obtained | 4 |
| 4a | Number of undergraduate students receiving training | 2 |
| 4b | Number of training weeks provided to undergraduate students | 12 |
| 4c | Number of postgraduate students receiving training (not 1-3 above) | 0 |
| 4d | Number of training weeks for postgraduate students | 0 |
| 5 | Number of people receiving other forms of long-term (>1yr) training not leading to formal qualification( ie not categories 1-4 above) | 17 |
| 6a | Number of people receiving other forms of short-term education/training (ie not categories 1-5 above) | 47 |
| 6b | Number of training weeks not leading to formal qualification | 45 |
| 7 | Number of types of training materials produced for use by host country(s) | 5 |
| **Research Measures** | | |
| 8 | Number of weeks spent by UK project staff on project work in host country(s) | 120 |
| 9 | Number of species/habitat management plans (or action plans) produced for Governments, public authorities or other implementing agencies in the host country (s) | 3 plans covering 58 species |
| 10 | Number of formal documents produced to assist work related to species identification, classification and recording. | 2 |
| 11a | Number of papers published or accepted for publication in peer reviewed journals | 1 (requested resubmission) |
| 11b | Number of papers published or accepted for publication elsewhere | 0 |
| 12a | Number of computer-based databases established (containing species/generic information) and handed over to host country | 2 |
| 12b | Number of computer-based databases enhanced (containing species/genetic information) and handed over to host country | 0 |
| 13a | Number of species reference collections established and handed over to host country(s) | 0 |

| Code | Description | Totals (plus additional detail as required) |
|---|---|---|
| 13b | Number of species reference collections enhanced and handed over to host country(s) | 0 |
| **Dissemination Measures** | | |
| 14a | Number of conferences/seminars/workshops organised to present/disseminate findings from Darwin project work | 3 |
| 14b | Number of conferences/seminars/ workshops attended at which findings from Darwin project work will be presented/ disseminated. | 5 |
| 15a | Number of national press releases or publicity articles in host country(s) | 2 |
| 15b | Number of local press releases or publicity articles in host country(s) | 4 |
| 15c | Number of national press releases or publicity articles in UK | 0 |
| 15d | Number of local press releases or publicity articles in UK | 0 |
| 16a | Number of issues of newsletters produced in the host country(s) | 4 |
| 16b | Estimated circulation of each newsletter in the host country(s) | 950 |
| 16c | Estimated circulation of each newsletter in the UK | 50 |
| 17a | Number of dissemination networks established | 2 |
| 17b | Number of dissemination networks enhanced or extended | 2 |
| 18a | Number of national TV programmes/features in host country(s) | 0 |
| 18b | Number of national TV programme/features in the UK | 0 |
| 18c | Number of local TV programme/features in host country | 0 |
| 18d | Number of local TV programme features in the UK | 0 |
| 19a | Number of national radio interviews/features in host country(s) | 0 |
| 19b | Number of national radio interviews/features in the UK | 0 |
| 19c | Number of local radio interviews/features in host country (s) | 0 |
| 19d | Number of local radio interviews/features in the UK | 0 |
| **Physical Measures** | | |
| 20 | Estimated value (£s) of physical assets handed over to host country(s) | 30,000 |
| 21 | Number of permanent educational/training/research facilities or organisation established | 1 |
| 22 | Number of permanent field plots established | 0 |
| 23 | Value of additional resources raised for project | 217,000 |
| **Other Measures used by the project and not currently including in DI standard measures** | | |

# Annex 5   Publications

| Type * (e.g. journals, manual, CDs) | Detail (title, author, year) | Publishers (name, city) | Available from (e.g. contact address, website) | Cost £ |
|---|---|---|---|---|
| Newsletter | TMAP Newsbites | TAWIRI, Arusha | www.tanzaniamammals.org | Free |
| Sighting-sheet | TMAP sighting-sheet | TAWIRI, Arusha | www.tanzaniamammals.org | Free |
| Poster | To promote wildlife in the southern game reserves | TAWIRI, Arusha | TAWIRI, PO Box 661, Arusha | |

# Annex 6  Darwin Contacts

| | |
|---|---|
| **Ref No** | 162/14/055 |
| **Project Title** | A national plan for Mammal conservation in Tanzania |
| | |
| **UK Leader Details** | |
| Name | Dr. Sarah Durant and Dr. Charles Foley |
| Role within Darwin Project | Project Leader |
| Address | Zoological Society of London |
| Phone | |
| Fax | |
| Email | |
| **Other UK Contact (if relevant)** | |
| Name | |
| Role within Darwin Project | |
| Address | |
| Phone | |
| Fax | |
| Email | |
| **Partner 1** | |
| Name | Dr. Simon Mduma |
| Organisation | Tanzania Wildlife Research Institute |
| Role within Darwin Project | |
| Address | P.O Box 661 |
| Fax | . |
| Email | |
| **Partner 2 (if relevant)** | |
| Name | |
| Organisation | |
| Role within Darwin Project | |
| Address | |
| Fax | |
| Email | |