# Udzungwa Ecological Monitoring Centre
# (Udzungwa Mountains National Park)

## Annual Technical Report
## Year 7 (January - December 2013)

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*Cover photo: the Director General of TANAPA, Mr. Allan Kijazi, inaugurates the Udzungwa rainforest greenhouse inside the new MUSE – Science Museum, together with the world-famous architect Renzo Piano (photo F. Rovero).*

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**Summary**

The Udzungwa Ecological Monitoring Centre (UEMC, http://www.udzungwacentre.org) is a facility of the Udzungwa Mountains National Park (UMNP) established in 2006 with the aim of promoting and facilitating biological research and monitoring in order to increase the understanding of the Udzungwa Mountains of Tanzania, and to utilize this information to develop more effective conservation management and community education plans that will improve the long-term conservation of the UMNP and the adjacent forests. This is the seventh year technical report (January - December 2013), and it is aimed at presenting the results of monitoring and training activities, and other programmes conducted, as well as summarizing the short and medium-term plans so that it can also serve as a strategic document.

An important event that took place in 2013 is the visit by Mr. Kijazi, TANAPA's Director General, to Italy as a special guest of the inauguration of the new MUSE – Science Museum, a world-class museum of science that contains among its exhibitions a 600 $m^2$ tropical greenhouse dedicated to the Udzungwa Mountains.

UEMC accommodated and facilitated national and international researchers, with the overall number of researchers hosted that raised to over 200 by end of 2013. Besides provision of technical advisory to the Ecology Department of UMNP, training of ecologists and field assistants, and its own monitoring efforts, UEMC continued to facilitate the TEAM project (*Tropical Ecology Assessment and Monitoring*) that reached the fifth year of standardized annual data collection on climate, vegetation and terrestrial mammals. By using the hostel for students, UEMC facilitated important training schemes, such as a field course by Pennsylvania State University, the third edition of the international Summer School on GIS and field tools for studying tropical biodiversity, and a training workshop for TANAPA forest park ecologists at national level. UEMC also continued the provision of training scholarships for staff.

The primate and red duiker monitoring programme continued through 2013 and reached 684 (2684 km walked) and 289 (1284 km waked) transect repetitions in Mwanihana forest (UMNP) and in the southern Uzungwa Scarp Forest Reserve (USFR), respectively, conducted during 2002-2013. Results confirm a clear trend of relative population stability in Mwanihana and, in contrast, a dramatic decline in USFR. Local extinction of colobus monkeys will occur in the latter forest unless effective ground protection is urgently allocated.

UEMC continued to conduct an environmental education programme in partnership with *Association Mazingira* and to facilitate its broader, community conservation project: 13 primary and 5 secondary schools are involved; community conservation mainly involves tree nurseries establishment, tree planting (including agro-forestry) and introducing energy-efficient technologies. Within this programme, preliminary activities to promote eco-tourism have also initiated in 2013, and a project proposal to build by the park's HQs a Visitor Information Centre has been funded by Trento Autonomous Province and works are expected to begin by mid-2014.

The reports ends with a summary of activities planned for 2014 in the context of the Memorandum of Understanding that regulates the collaboration between TANAPA and MUSE-Science Museum for the management and objectives of UEMC.

## 1. Background and report aim

The Udzungwa Ecological Monitoring Centre (UEMC) is a facility of the Udzungwa Mountains National Park (UMNP) that was inaugurated on the 10th of November 2006. The establishment of the UEMC was promoted and funded by Trento Science Museum in partnership with Tanzania National Parks (TANAPA). The UEMC has been donated to Tanzania National Parks (TANAPA) and it is managed by Trento Science Museum under the conditions stated in a Memorandum of Understanding. The first MoU has run from 2006-2011, and a new MoU was signed in January 2012 (for 2012-2016), therefore this report relates to the third second year of the new UEMC management agreement. The report aims to present the monitoring data collected and other activities, as well as summarizes the updated short and medium-term plans so that it can also serve as a strategic document. All previous technical reports are available in the UEMC website at http://www.udzungwacentre.org/resources.asp.

The aim of the UEMC is to promote and facilitate biological research and monitoring in order to increase the understanding of the Udzungwa Mountains, and to utilize this information to develop more effective conservation management and community education plans that will improve the long-term conservation of the UMNP and the adjacent Forest Reserves/Nature Reserves. Other than providing accommodation and research resources to visiting scientists, the activities originally planned include delivering technical advice to TANAPA (especially UMNP's Ecology Department), implementing monitoring programs, organizing courses for rangers, scouts, park ecologists and university students, promoting school education programs for school children, and networking with other biological field stations in the tropics and organizations supporting monitoring centres.

### 1.1. Summary of UEMC set-up and personnel

Whilst this is neither a management nor a financial report, the following information are summarized to complete the background to the UEMC functioning. Currently, the UEMC consists of 6 buildings: one includes an office, store and large seminar room and next to it are three researchers' houses, each with two double rooms. In February 2010, an annexed hostel was inaugurated, and it consists of a dormitory block (four rooms each with three double-deck beds) and of a dining hall, with kitchen and two stores. This structure is mainly dedicated to hosting student groups hence enhancing training capacity of the centre.

The staffs working at UEMC did not change in 2013. In addition to Trento Museum's institutional representative (Dr. Rovero), it included: UEMC coordinator (Philipo Jacob), a school environmental education officer (Alatupoka Sanga), two field technicians, two gardeners, 2 house-keepers and four watchmen. Moreover UEMC hosts the TEAM network project that begun in mid-2009 and is run by a staff of 4 people, including a site manager, 2 field technicians and a driver.

UEMC in 2013 continued to co-fund scholarships for staff training. Thus, Mr. Arafat Mtui - former UEMC coordinator – continued with his studies in Mweka Wildlife College pursuing his B.Sc. degree in Wildlife Management and Aggrey Uisso – one of TEAM's field technicians completed his certificate in wildlife management. However, the bulk of funding for these

scholarships were generously donated by Drs. Larry Gorenflo and Brian Larry of Penn State University.

## 27 July 2013: Mr. Allan Kijazi, Director General of TANAPA, participated to the inauguration of the new MUSE – Science Museum in Trento, Italy

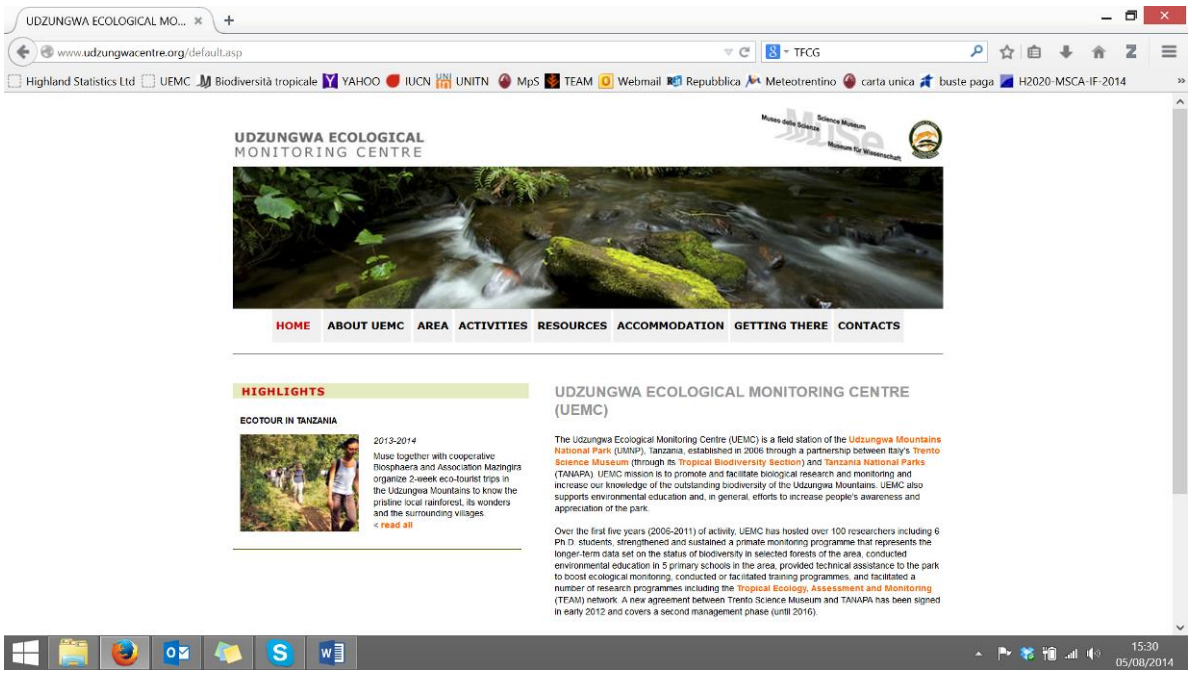
In July 2013 Trento Museum opened its new building, a world-class museum of science designed by the famous architect Renzo Piano. At the 2-day inauguration event over 30,000 people attended, and among the special guests was Mr. Allan Kijazi, TANAPA's Director General, who had the honour to inaugurate the green house dedicated to the Udzungwa forests together with Renzo Piano (see cover photo).

Below are two views of the museum's building from the greenhouse side (above) and inside the greenhouse (below).

The visit by Mr. Kijazi witnesses of the solid partnership between Trento Museum and TANAPA and helped its further consolidation. Mr. Kijazi held meetings with MUSE and Trento Province's representatives. During his visit, the proposal for realizing a Visitor Information Centre at UMNP was presented to the International Cooperation department of the Province (the proposal was subsequently funded and it is currently under implementation). There were also detailed discussions on the management of UEMC and way forward beyond the current management phase (more details in section 7). Mr. Kijazi expressed very positive comments on the work conducted by UEMC in collaboration with UMNP, and considers UEMC a model for other National Parks in Tanzania.

## 2. Summary of activities planned and activities implemented

**Web-site view statistics:** since 2012 UEMC has a new web-site to help promoting international public access to its resources (visit it at www.udzungwacentre.org). In 2013, the web-site was visited 5,400 times for nearly 13,500 access to different web-site pages.



This section provides an overview of activities implemented until the end of 2013 against the baseline goals that have been set since 2006 and summarized below (details in previous reports).

1. Provide **advisory and technical assistance to the UMNP/Ecology Department** on all issues related to ecological monitoring.

This fundamental activity continued both through the routine primate and duiker monitoring programme in Mwanihana forest, and through more general advisory on ecological monitoring, including for the on-going monitoring of large mammals from remote ranger posts. A significant boost to this activity has been the training workshop for TANAPA's forest park ecologists that included UMNP ecologists (more details under point 4.).

2. Implement **ecological monitoring** protocols in conjunction with the Ecology Department in the UMNP and with the Forestry Division in the Forest Reserves.

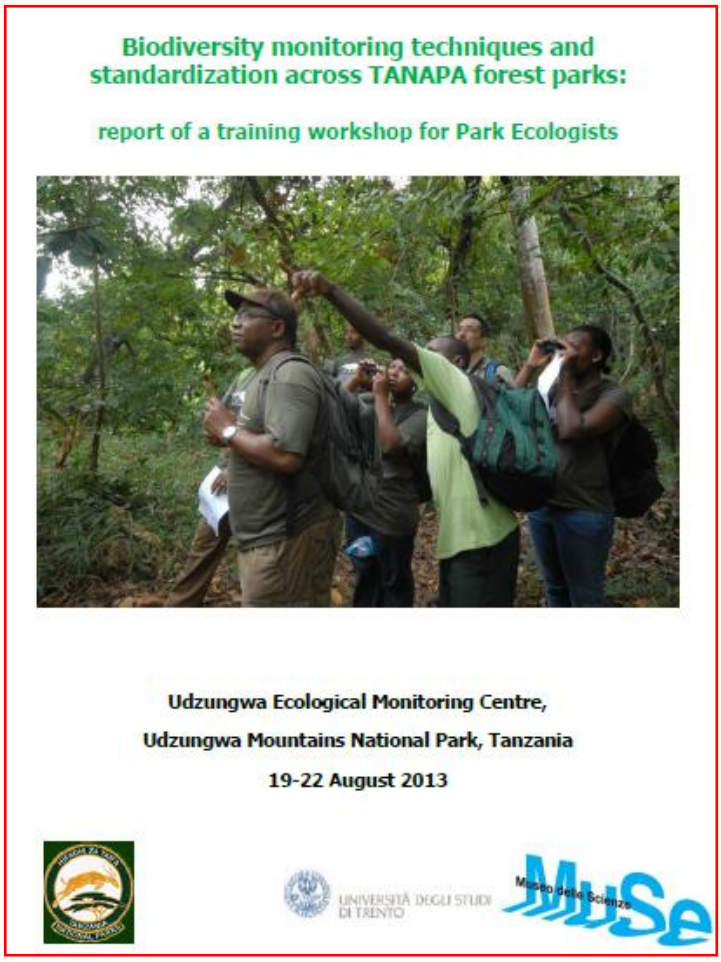
UEMC continued the primate monitoring programme both in Mwanihana (UMNP) and in the southern Uzungwa Scarp Forest Reserve (USFR), thus raising data for both TANAPA and Forestry Division. Due to the alarming situation of biodiversity destruction found in USFR as highlighted in the previous reports and papers, data for USFR are of particular conservation relevance. Moreover, all data collected by TEAM project in Mwanihana forest within UMNP since 2009 are also readily available (details below).

3. **Facilitate visiting researchers** and conservation agencies through providing accommodation, information, research facilities (Internet, computers, seminar room etc.).

In 2013 UEMC hosted 4 long-term researchers plus a number of guest researchers visiting on shorter term basis, adding up to a total number of around 200 researchers accommodated in the hostel and houses during the 7 years of activity. Overall, the resources raised from fees for accommodation in 2013 contributed to around 50% of UEMC running costs (of which over 30% are due to revenues from training courses at the hostel). A dominant portion of these fees were from institutions conducting training at UEMC, notably Penn State University and Trento Museum/the University of Trento. UEMC continued to facilitate the TEAM programme as well as the community-conservation project run by Association Mazingira. Since 2013 moreover, UEMC is providing support to the University of Copenhagen who is resuming its research presence in the area and is interested in joining hands with Trento Museum for the long-term support to conservation in the area.

4. Organize **training courses** in ecological monitoring to rangers, park ecologists and students.

Capitalizing on the success of the second edition, UEMC hosted the **third edition of the summer school in 'GIS and field tools for assessing, monitoring and mapping'**, that was held from 24$^{th}$ August to 6$^{th}$ September 2013 and organized by Trento Museum and the University of Trento. The school was attended by 21 international students and 3 Tanzanian students, in addition to UEMC and TANAPA staff members.




Before the summer school, a **5-day workshop for TANAPA's forest park ecologists** (from Kiloimanjaro, Arusha, Mikumi, Udzungwa Mountains, Mahale, Gombe and Tarangire National Parks) was held to train ecologist on GIS and field methods for monitoring biodiversity and standardize ecological monitoring across parks.

The full report (image above) of this important initiative can be downloaded at: http://www.udzungwacentre.org/documents/Reports/TANAPA_Udzungwa_ecologists_workshop_2013.pdf

5. Organize **education activities for school children**

This programme continued in 2013 thanks to the initiation of a broader community conservation programme led by **Association Mazingira**, a small Italian NGO that works with Trento Museum and in collaboration with Tanzania Forest Conservation Group (TFCG). The 3-year project is implemented in close coordination with the park's Community Conservation Service and since 2012 has expanded the Environmental Education programme originally conducted with 5 primary schools to an 13 primary schools and 5 secondary schools overall.

Details of activities are reported under chapter 6.

6. Establish a **GIS database** on Udzungwa biodiversity.

The GIS database was established in 2009 (see previous UEMC reports and web-site). No further developments were done in 2013.

7. Promote **external collaborations and networking** with other monitoring programmes, ecological centres and field stations in the tropics.

The continuation and consolidation of **TEAM project** (Tropical Ecology, Assessment and Monitoring), with its expanding network of field sites and field stations (currently 16, www.teamnetwork.org) continue to represent the major contribution towards this goal. Although based at UEMC, this project is run independently of UEMC routine activities. However, given the great relevance to UEMC activities and biodiversity assessment in UMNP, a summary report of activities and data collected is included in this report. Besides TEAM, at local level UEMC continued to facilitate and/or collaborate with Penn State University, Udzungwa Elephant Project, Udzungwa Forest Project/Flamingo Land, TFCG and other agencies working in the area.

## 3. Ecological monitoring results: primate and forest antelope monitoring

### 3.1. Primate monitoring in Mwanihana forest

The Primate Monitoring Program established in 1997 in Mwanihana forest, uses transects established along tourist trails maintained by the park. Details of transect length and habitat types are reported below (Table 1). Transects are repeated every two weeks by one observer that walks slowly (1 km per hour) and records all sightings of primate groups, together with its position, distance to each group, number of individuals (when possible) and observer's position along the transect.

Table 1. Characteristics of four transects used for primate censuses in Mwanihana Forest, Udzungwa Mountains National Park, Tanzania

| Transect | Length of transect (km) | Altitude | Gross forest type and portion along the line (km) |
|---|---|---|---|
| T1 (Camp Site 3) | 4.0 | 350 - 800 | Deciduous (0.8 km), semi-deciduous (0.6 km), open area (0.4 km), evergreen (2.2 km). |
| T2 (Mwanihana Trail) | 4.0 | 320 - 590 | Deciduous (1.4 km), semi-deciduous (0.4 km), evergreen (2.2 km). |
| T3 (Sanje Falls) | 3.7 | 330 - 700 | Mixed deciduous and semi-deciduous (0.8 km), evergreen (2.9 km). |
| T4 (Msolwa) | 4.0 | 330 - 600 | Mixed deciduous and semi-deciduous (1 km), evergreen (3 km). |

The updated list of data-sets collected by various observers over the years is presented in Table 2. As elaborated in previous reports however, data collected during 1998-2001 were deemed unreliable mainly because inter-observer consistency in data collection was not ensured. Therefore, from the 2013 it was decided not to include these data (which remains available on request), and hence present data from 2002-2013. Inter-observer consistency in data collection has been regularly checked for this data-set, and it was also ensured by minimizing the number of data-collectors involved.

Table 2. Number of primate censuses conducted by each observer and data-set in Mwanihana Forest, Udzungwa Mountains National Park, Tanzania

| N° | Observer | Period | Transect | | | |
|---|---|---|---|---|---|---|
| | | | C3 | MW | SJ | MSO |
| 4 | FR | July 2002 - January 2003 | 13 | 14 | 14 | - |
| 5 | ASM1 | February-August 2003 | 14 | 14 | 13 | - |
| 6 | ASM2 | February-December 2004 | 20 | 20 | 19 | - |
| 7 | AK (UEMC) | April 2007-August 2008 | 20 | 19 | 20 | 13 |
| 8 | ASM3 (UEMC) | December 2008-October 2009 | 21 | 21 | 21 | 20 |
| 9 | ASM4 (UEMC) | November 2009-January 2011 | 28 | 28 | 28 | 28 |
| 10 | ASM+MK (UEMC) | February 2011-January 2012 | 23 | 23 | 23 | 23 |
| 11 | MK (UEMC) | February 2012 - December 2012 | 22 | 22 | 22 | 22 |
| 12. | PJ+MK | January 2013 – December 2013 | 24 | 24 | 24 | 24 |
| | All observers | | **185** | **185** | **184** | **130** |

The updated data-set 2002-2013 for Mwanihana consists overall of 684 transect repetitions, for 2,680 km walked. This constantly increasing data-set remains the largest and longer-term monitoring data-set available for the area (Table 2). To assess raw trends in relative abundance with time, the charts below present, for each transect (Fig. 2), and then for all transect combined (Fig. 3), the results quantified as mean primate group's encounter rate, computed per each period of data collection (broadly corresponding to years).

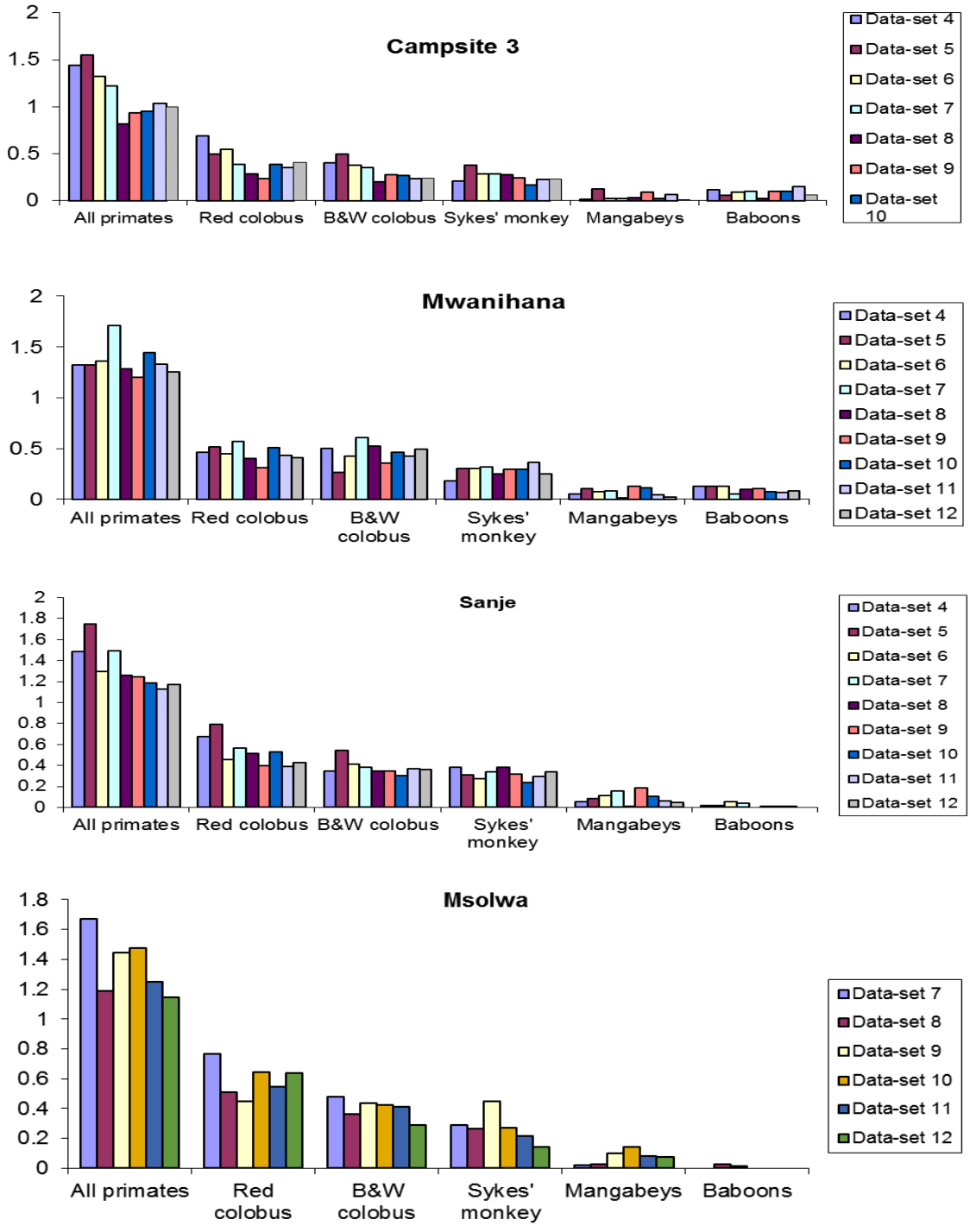



Fig. 1. Results of primates' encounter rate by observer for the 4 transects in Mwanihana forest.

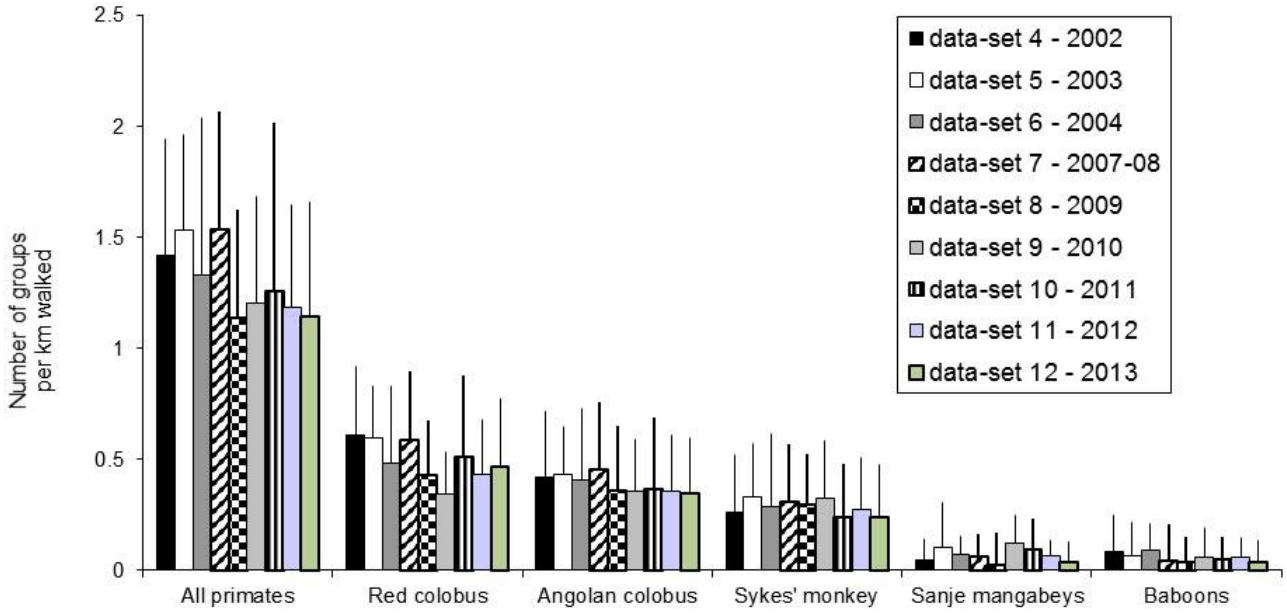



Fig. 2. Results of primates' encounter rate by observer for all transects pooled in Mwanihana forest.

Transect-specific results do not reveal striking trends of changes in abundance, as observed from earlier comparisons. Mwanihana and Sanje appear the transects with more constant results, Msolwa has some variations which may be due the fact that this transects has a more limited data-set. Results for Campsite 3 reveals no further evidence of the apparent decrease observed in previous years and that was mainly emerging for red colobus.

The simple, ANOVA statistical analysis performed on earlier data-sets was not repeated with the Updated data, first because it will certainly not highlight any chance, second and most importantly because a very solid analysis of population dynamics has been completed in early 2014 and the resulting manuscript is currently submitted for publication. For the three most detected and arboreal species (two colobines and Sykes' monkey) this analysis clearly reveals that the abundance trend for Mwanihana is stable during 2002-2012, and no effect of observer or season was found to affect this trend. This is well apparent from the chart with pooled data in Fig. 2.

### 3.2. Primate monitoring in Uzungwa Scarp Forest Reserve

The same line-transect technique and sampling design used for censuring primates in Mwanihana was also used in the Uzungwa Scarp Forest Reserve (USFR) beginning in 2004 by F.R. and continued by UEMC coordinators and field technicians (Table 4). Effort by end of 2013 totalled 293 repetitions, equivalent to 1,000 km walked.

Table 4. Number of primate censuses conducted by each observer and data-set in Uzungwa Scarp Forest Reserve

| | | | Transect | | | | | |
|---|---|---|---|---|---|---|---|---|
| N° | Observer | Period | Ikule | Mkaraji | JKT | Kitol | Tazara | All |
| 1 | FR+ASM | July 2004 - June 2005 | 23 | 21 | 22 | 20 | na | 86 |
| 2 | AMANI | January 2007 - June 2008 | 14 | 14 | 10 | na | na | 38 |
| 3 | ASM | January-September 2009 | 9 | 9 | na | na | 7 | 25 |
| 4 | ASM | October 2009-January 2011 | 13 | 13 | na | na | 13 | 39 |
| 5 | ASM+MK | February 2011-January 2012 | 12 | 12 | na | na | 12 | 36 |
| 6 | MK+PJ | February - December 2012 | 11 | 11 | na | na | 11 | 33 |
| 7 | MK+PJ | January-December 2013 | 12 | 12 | na | na | 12 | 36 |
| All | | | 94 | 92 | 32 | 20 | 43 | 293 |

One high-elevation transect (Kitolomero) was only used in 2004 and could not be repeated for the difficult access. JKT transect was forced to be closed by the military station nearby, and it was therefore replaced by Tazara transect, which samples an equivalent portion of forest in terms of habitat and elevation zone.

As per Mwanihana, the charts below show the results of primates' encounter rate for all each transect (Fig. 3) and for the pooled transects (Fig. 4). In contrast with Mwanihana, the dramatic pattern of decreasing abundance continues to occur for the two colobine monkeys, with NO sightings of these monkeys throughout the all year except for ONE sighting along the Ikule transect. In addition, the decreasing trend is now apparent also for Sykes' monkeys and Sanje mangabeys.

The new analysis for this forest indeed confirm a statistically declining trend for both colobine monkeys but not the Sykes' monkey. The risk of local extinction for both colobines in this forest is now, therefore, an imminent reality.

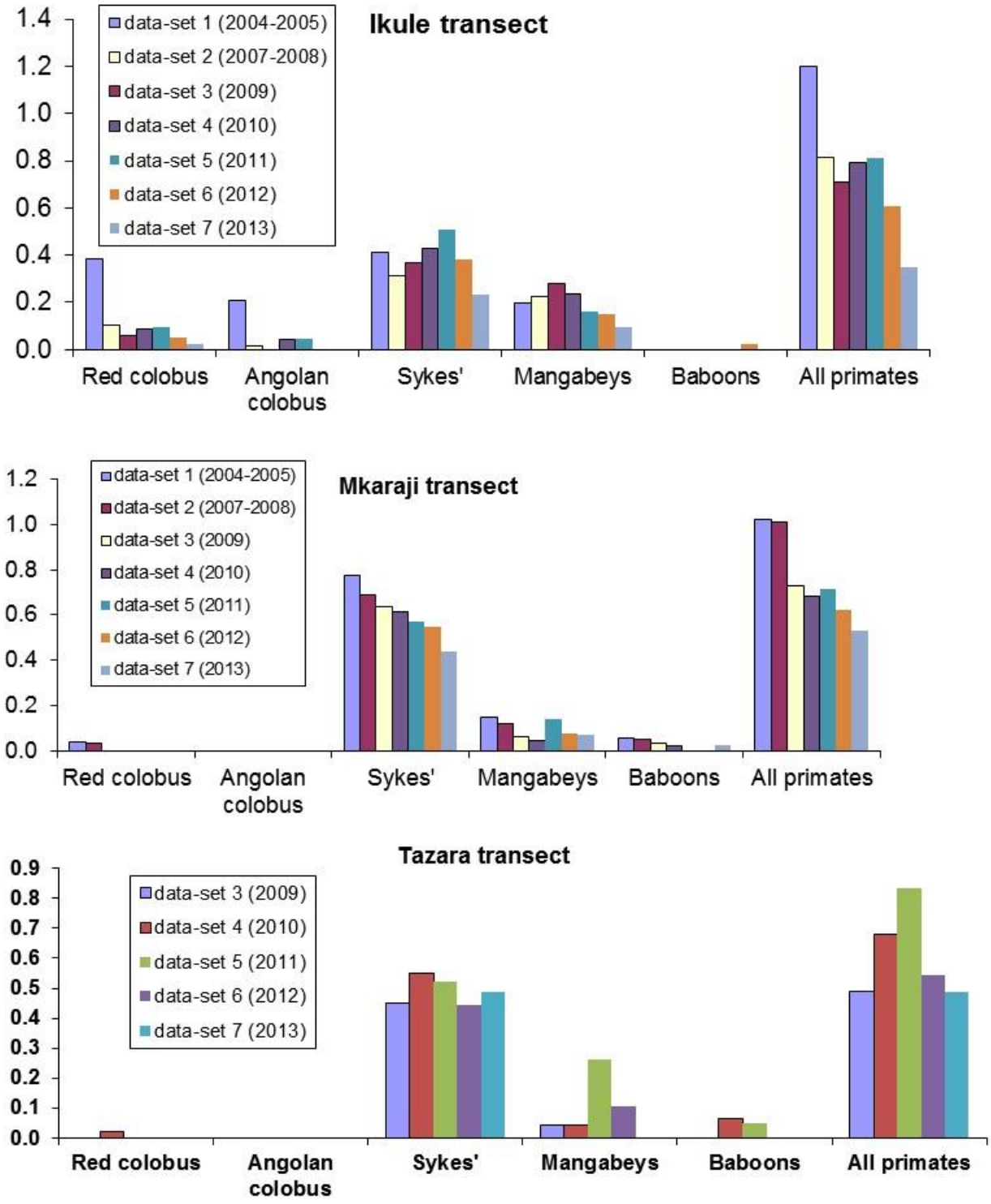



Fig. 3. Results of primates' encounter rate by observer and transect, for the 3 active transects in Uzungwa Scarp.

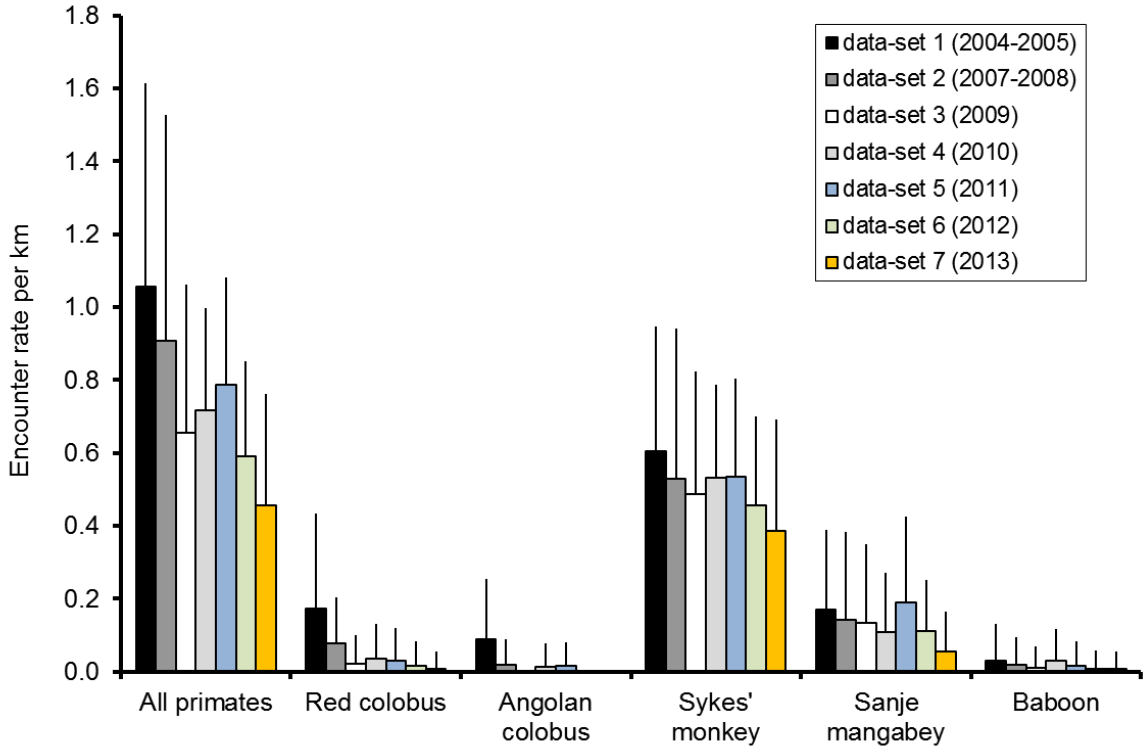
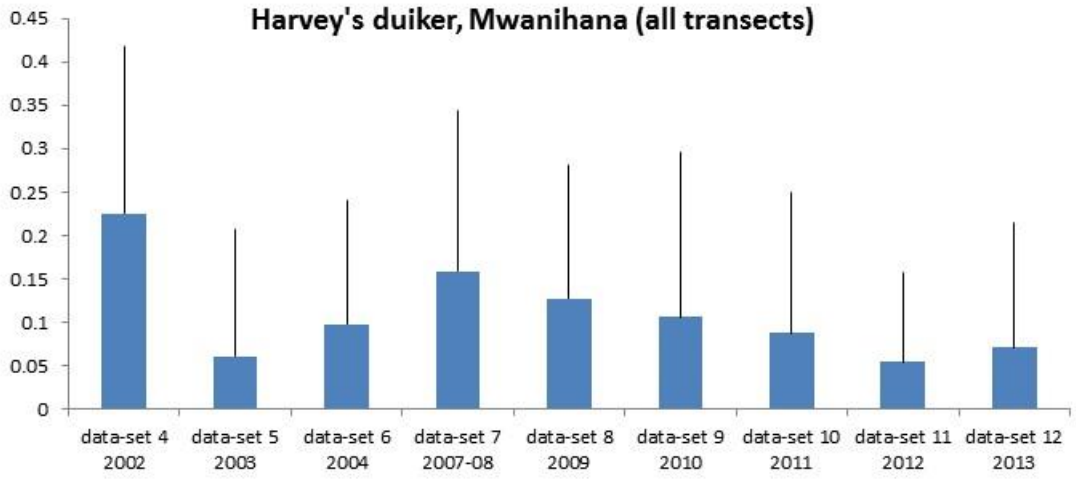



Fig. 4. Results of primates' encounter rate by observer for all transects pooled in Uzungwa Scarp forest.

### 3.3. Monitoring of Harvey's duiker in Mwanihana and Uzungwa Scarp Forest Reserve

The results of monitoring of the Harvey's red duiker (*Cephalophus harveyi*) are not of straightforward interpretation, and because of the low sample size due to their inherent difficult detectability, mean values per data-set have large variation which is well shown by the large standard error bars in Fig. 5. However, for Mwanihana there continue to appear a stable trend while for Uzungwa scarp the particularly low number prevents any meaningful conclusion. Surely hunting of this and other ground dwelling mammals continues to occur (as recently witnessed by Master student conducting a detailed study using camera trapping; C. Hegerl, pers. comm.), as indicated by the small encounter rate reported for this species in 2013.



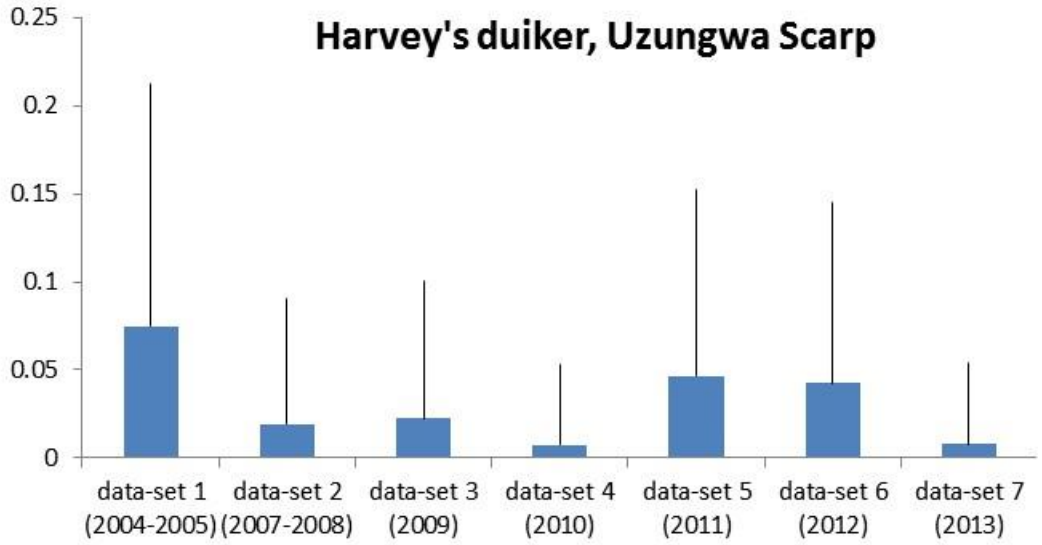




Fig. 5. Results of Harvey's duiker encounter rates for all transects by data-set in Mwanihana (above) and Uzungwa Scarp (below).

### 3.4. Interpretation of monitoring results

The increased time span and recent detailed analysis conducted allow for a clear interpretation of the monitoring results, especially for the two colobus and the Sykes' monkeys due to their sufficiently high detection allowing for inferential analysis. It is clear that while primate populations in Mwanihana continue to be well protected, local extinctions of colobus in

Uzungwa scarp may be imminent (at least along the lower elevation zone monitored through this programme).

This calls for the **need of urgent ground protection of this forest**, which is apparently under upgrading to Nature Reserve by the Tanzania Forest Service.

Hereunder is a quote from the comprehensive analysis conducted by Rovero et al. (submitted), that contains important points on the value of this locally-based and long-term monitoring programme:

"*The main result we found on population trends is that estimated group abundance appears stable for all species in the protected Mwanihana forest, while in the unprotected Uzungwa Scarp forest there was a marked decline for both colobus monkey species but not for the Sykes' monkey. This finding agrees with previous analysis of part of the data using raw encounter rates as well as the more recent and forest-wide abundance estimation study. Decline of colobus in US is best explained by increasing human disturbance, in the form of both targeted hunting pressure by the local tribe for subsistence and habitat degradation mainly through tree and pole cutting. Sykes' monkeys, on the contrary, are seemingly highly resilient to disturbance and capable of sustaining themselves in secondary, degraded forests, which dominate part of the areas sampled by the study transects. In view of these considerations, the declining trend we report on group abundance may in fact be conservative, as the abundance of individuals in US will not only be proportionally lower due to smaller group size, but may also have declined at a steeper rate than in Mwanihana as a result of a negative trend in both group and individual abundance.*

*The second important result we obtained is that despite the number of different observers involved in data collection, the unexplained variability in detection probability among transects is greater than the variability due to observers. This is of critical significance, as it indicates that the simple field training given to all field technicians in transect walk procedures, species identification and recording of observations is adequate to collect consistent data. Third, the lack of seasonal differences in both primate abundance and detectability supports the concentration of sampling in dry seasons for future studies. Monitoring in the dry season has logistic benefits and is considerably more cost-efficient than monitoring throughout the year, because walking transects during the rainy season involves higher risk of failure due to the frequent rains, in addition to poorer road conditions making access to remote forests more difficult.*"

## 4. Park-wide monitoring of large mammals

This programme begun in 2008 with transects establishment and training of rangers. Two transects for censusing large mammals, 6 km in length and marked with aluminium tag every 100 m, were established from each of the following ranger posts: Lumemo (SE), Ruipa (SW), Udekwa (W), Mbatwa (N) and Kidatu (NE). Following training in data collection done in 2009, a preliminary data-set was collected in 2010 by UEMC staff and UMNP assistant ecologists together with rangers allocated to this activity per each ranger post (see UEMC 2010 report). Census were planned to take place at monthly intervals and using a standard data collection form. Responsibility for data collection was then handed over to the Park rangers in August

2009, with the agreement that one trained field assistant or assistants to the park ecologist would continue to visit at least two or three ranger posts each month to assist rangers on data collection and ensure consistency and data quality. This arrangement was carried on from September 2009 to May 2010 (UEMC 2011) however it was not very consistent and often the census had to be fully conducted by the trained assistants. Partly because of logistic issues (shortage of rangers, transport problems for the assistants to reach the ranger posts) partly because rangers' commitment and empowerment to collect ecological data of required quality resulted limited, in view of other important duties, especially law enforcement. As a result, this programme was discontinued.

However, in view of the promising initial results, UMNP ecologist and UEMC staff reviewed the programme in 2012 and decided for continuation, with responsibility for data collection entirely shifted to trained field assistants instead of rangers. The sampling design was also reviewed, by both planning for a number of new, park-interior transects (which were only established in part), and by changing the frequency of sampling from 1-2 monthly census to 2-4 census repetitions conducted quarterly. The programme resumed towards the end of 2012 with a number of new transects established and the new system for data collection being set. Unfortunately however, only few data were collected in 2013 and we do not feel these are of enough quality or consistent to be shown, nor they would allow for average values to be derived with enough sample size.

While the model of using trained technicians to collect data appear to work best, it was recently (mid-2014) decided that the layout of transects should then be reduced to the initial, more limited but still comprehensive set of transects from the ranger post. These transects are more easily maintained and the logistic of their access is easier, hence involving affordable costs, that can therefore allow for sustainable and long-term data collection.

## 5. TEAM project (Tropical Ecology, Assessment and Monitoring) in Mwanihana

Since its establishment in 2009 in the Udzungwa Mountains, TEAM project (www.teamnetwork.org) continued by conducting its fifth year of sampling. Three standardized monitoring protocols are implemented solely in Mwanihana forest: terrestrial vertebrates, vegetation and climate (see previous reports for more details). The results hereafter are from the annual report presented to the Tanzania Wildlife Research Institute.

**Terrestrial Vertebrates**: Table 6 presents a synthesis of results from camera-trapping for 2009-2013 sampling, conducted each year at 60 camera trap sites evenly distributed in the forest. Over 12,000 images were produced each year, however given that cameras shoot in continuous (thus the same individual animals would be photographed more than once within minutes), data are first screened to calculate the number of images per day and/or per hour depending in subsequent analysis (deemed independent events).

Table 6. Sampling effort and summary results for TEAM's terrestrial vertebrate sampling during 2009-2013.

| | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|
| Num of camera set | 60 | 60 | 60 | 60 | 60 |
| Num of cameras functional | 58 | 59 | 59 | 60 | 54 |
| Camera-trap days (24 h periods) | 1818 | 1874 | 1829 | 1842 | 1666 |
| Mean camera-trap days per camera | 31.3 | 31.8 | 31 | 30.7 | 30.9 |
| Total number of events (1-hr interval) | 1395 | 1766 | 1593 | 1523 | 1631 |
| Total mammal species recorded | 27 | 28 | 27 | 23 | 24 |

Descriptive analysis revealed that with 32 species trapped overall, a very high portion of the mammalian community known for Udzungwa was recorded in Mwanihana, the cumulative checklist being presented in Table 7. Trap-rate (number of events per sampling effort) is used as a gross index of relative abundance and allows to highlight those species that are most frequently encountered (the top 5 species trapped in decreasing order are: giant-pouched rat bushy-tailed mongoose, Harvey's duiker, Sanje mangabey and grey-faced sengi or elephant-shrew).

Table 7. List of mammals camera-trapped by the TEAM project and photographic events per year (2009-2012).

| Latin name | Common name | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|
| *Atilax paludinosus* | Marsh mongoose | 3 | 3 | 13 | 5 | 6 |
| *Bdeogale crassicauda* | Bushy-tailed mongoose | 130 | 308 | 295 | 318 | 352 |
| *Cephalophus harveyi* | Harvey's duiker | 367 | 250 | 271 | 379 | 361 |
| *Cephalophus spadix* | Abbott's duiker | 60 | 53 | 56 | 29 | 49 |
| *Cercocebus sanjei* | Sanje mangabey | 73 | 100 | 118 | 152 | 110 |
| *Cercopithecus mitis* | Sykes' monkey | 22 | 9 | 12 | 21 | 16 |
| *Civettictis civetta* | African civet | 1 | NA | NA | NA | NA |
| *Colobus angolensis* | Angolan colobus | 1 | 2 | 1 | 2 | 2 |
| *Cricetomys gambianus* | Giant pouched-rat | 276 | 353 | 380 | 313 | 404 |
| *Crocuta crocuta* | Spotted hyena | NA | 4 | 3 | NA | NA |
| *Dendrohyrax validus* | Tree hyrax | 23 | 42 | 36 | 50 | 56 |
| *Genetta servalina* | Lowe's genet | 18 | 64 | 54 | 59 | 36 |
| *Homo sapiens* | Human | 2 | 3 | NA | 1 | NA |
| *Hystrix africaeaustralis* | Hystrix | 11 | 1 | NA | 2 | NA |
| *Leptailurus serval* | Serval cat | NA | NA | 1 | NA | NA |
| *Loxodonta africana* | Savannah elephant | 11 | 5 | 7 | 12 | 9 |
| *Mellivora capensis* | Honey badger | 7 | 6 | 7 | 13 | 10 |
| *Mungos mungo* | Banded mongoose | 2 | 7 | 1 | NA | 2 |
| *Nandinia binotata* | African palm civet | 2 | 7 | 9 | 11 | 7 |

| | | | | | | |
|---|---|---|---|---|---|---|
| *Nesotragus moschatus* | Suni | 114 | 135 | 91 | NA | 38 |
| *Panthera pardus* | Leopard | 8 | 2 | 7 | 6 | NA |
| *Papio cynocephalus* | Yellow baboon | 3 | NA | 2 | NA | NA |
| *Paraxerus vexillarius* | Tanganyika mountain squirrel | 46 | 60 | 59 | 40 | 57 |
| *Petrodromus tetradactylus* | Four-toad sengi | 3 | 7 | 36 | 12 | 15 |
| *Philantomba monticola* | Blue duiker | NA | 1 | NA | NA | NA |
| *Potamochoerus larvatus* | Bushpig | 18 | 23 | 16 | 22 | 20 |
| *Procolobus gordonorum* | Udzungwa red colobus | 5 | 2 | 8 | NA | 3 |
| *Rhynchocyon cirnei* | Chequered sengi | 4 | 4 | 8 | NA | 1 |
| *Rhynchocyon udzungwensis* | Grey-faced sengi | 45 | 88 | 95 | 61 | 69 |
| *Syncerus caffer* | African buffalo | 4 | 5 | 3 | 3 | 5 |
| *Thryonomys swinderianus* | Cane rat | NA | NA | 2 | 4 | 1 |
| *Tragelaphus scriptus* | Bushbuck | NA | 4 | 2 | 8 | 2 |
| **Species richness** | | **27** | **28** | **28** | **23** | **24** |

In 2013, efforts to analyse data continued steadily. This included descriptive analysis, species-specific analysis and occupancy modelling, allowing for determining presence/absence of species under a rigorous statistical framework. An example of results for the grey-faced sengi or elephant-shrew is in Rovero et al. (2013, *Journal of Mammalogy*). The core species' modelling analysis uses occupancy (sites occupied on sites sampled) as the state variable of abundance and allows for assessing the influence of environmental covariates. For example, in Fig. 6 a spatially-explicit model of the Sanje mangabey is shown, indicating that this endemic monkey prefers highly the montane forest versus the lowland forest.

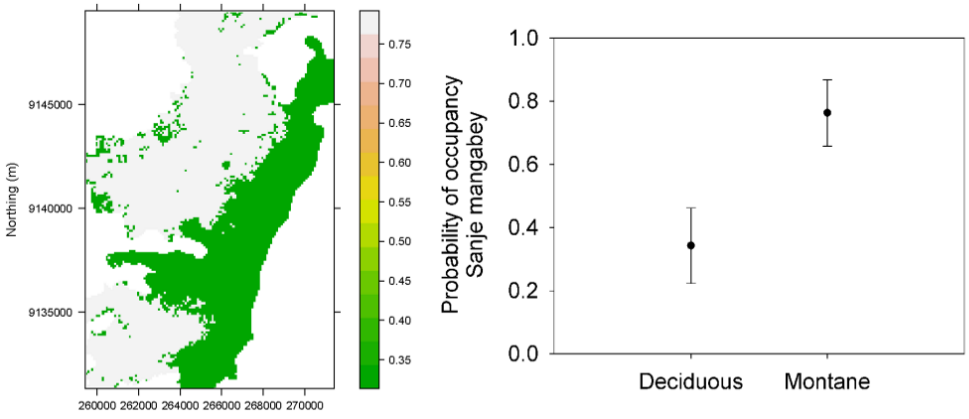



Fig. 6. Left: occupancy model for the Sanje mangabey in Mwanihana forest. Right: occupancy probability values (and S.E.) in deciduous and montane forest (from Rovero et al. 2014, PLOS ONE, http://www.plosone.org/article/info%3Adoi%2F10.1371%2Fjournal.pone.0103300)

Besides single-season analyses (a detailed baseline result paper is currently near submission), the analysis of temporal dynamics will be conducted at community and species level, which after 5 year of monitoring is expected to begin to be informative on community changes. As already reported, moreover, TEAM data have the great advantage of being comparable to other sites across the tropics.

**Vegetation:** all trees above 10 cm DBH in the 6 vegetation plots (each 1 ha) were re-measured in 2013. The plots are located at different altitudes in order to capture variations within Mwanihana forest. Sampling was conducted in October-November 2013. A comparison of number of trees recorded per plot by 2012 and 2013 are shown in the Table 8: the number of stems ranged between 469-710 (mean 589) and 468 – 710 (mean 545) for year 2012 and 2013 respectively. While the number of species ranged between 22-45 (mean 34) and 20 – 45 (mean 35) by year 2012 and 2013 respectively.

Table 8. Results of vegetation plot sampling 2012-2013.

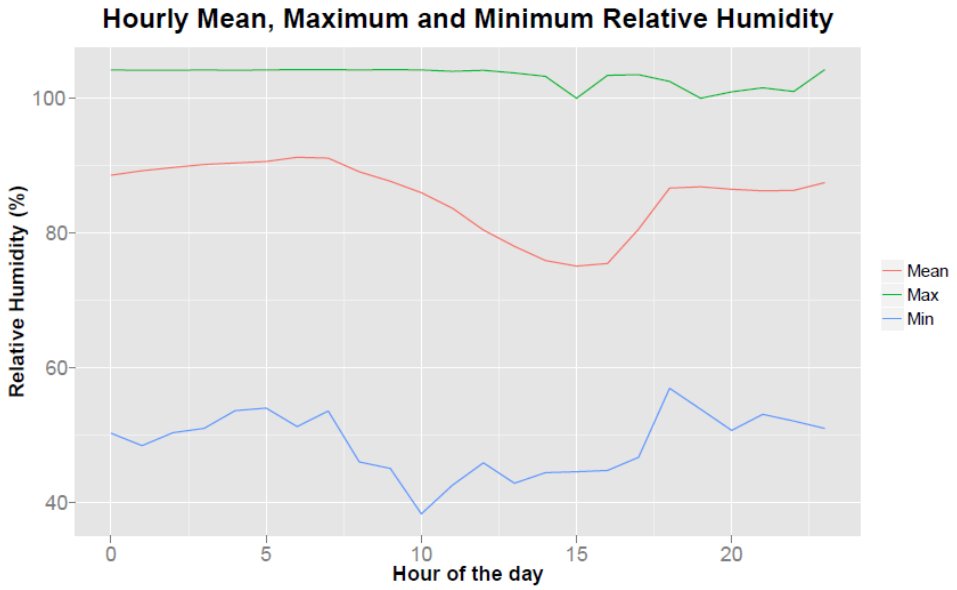
| | **Number of stems** | | **Number of species** | |
|---|---|---|---|---|
| **Plot (name and altitude)** | **Year 2012** | **Year 2013** | **Year 2012** | **Year 2013** |
| Plot 1 (Gologolo chini) 1127 m a.s.l | 471 | 465 | 42 | 35 |
| Plot 2 (Gologolo juu) 1795 m a.s.l | 555 | 541 | 45 | 45 |
| Plot 3 (Sanje chini) 778 m a.s.l | 469 | 468 | 22 | 20 |
| Plot 4 (Sanje juu) 1425 m a.s.l | 710 | 710 | 55 | 50 |
| Plot 5 (Campsite Chini) 781 m a.s.l | 482 | 480 | 26 | 26 |
| Plot 6 (Campsite juu) 1519 m a.s.l | 609 | 610 | 41 | 38 |
| **Total** | **3296** | **3274** | **128** | **101** |

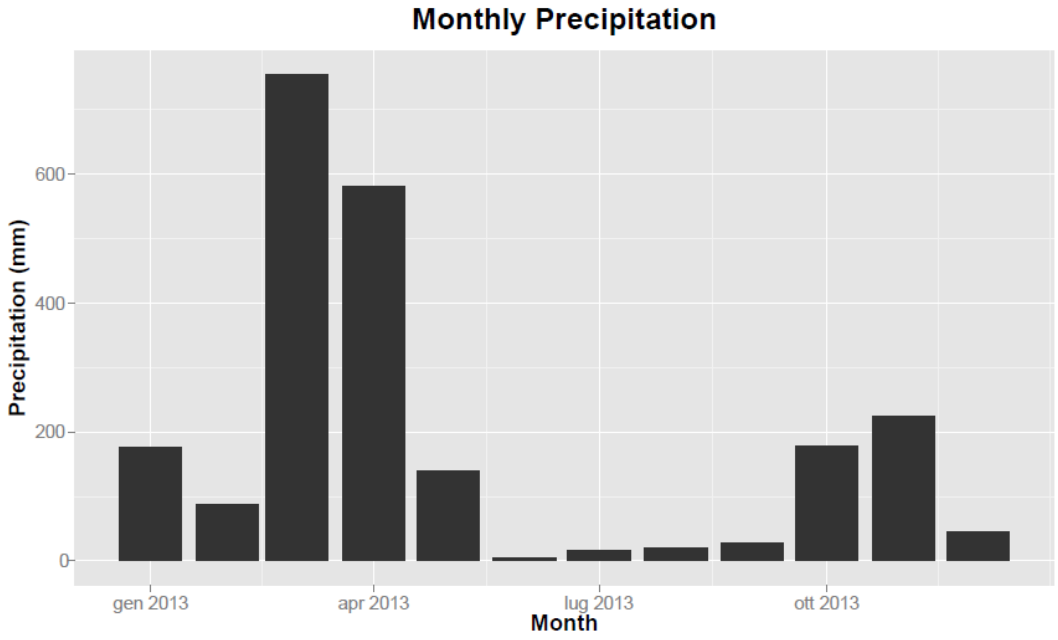
For 2013 data, DBH size classes distribution was also done and the results are shown in Table 9. As it was expected, majority of trees and lianas falls in the 10-20 cm DBH class, with the number of stems per class decreasing for larger size classes.

Table 9. Distribution of DBH size classes for 2013 sampling of vegetation plots.

| **DBH class (cm)** | **Num. of stems** | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Plot 1** | **Plot 2** | **Plot 3** | **Plot 4** | **Plot 5** | **Plot 6** | **Total** |
| 10=20 | 319 | 287 | 270 | 459 | 276 | 361 | 1972 |
| 20=30 | 37 | 95 | 88 | 130 | 115 | 121 | 586 |
| 30=40 | 34 | 59 | 44 | 40 | 42 | 49 | 268 |
| 40=50 | 31 | 44 | 23 | 24 | 23 | 41 | 186 |
| 50=60 | 14 | 24 | 60 | 22 | 13 | 10 | 143 |
| 60=70 | 8 | 10 | 12 | 15 | 2 | 4 | 51 |
| 70=80 | 6 | 4 | 6 | 7 | 6 | 8 | 37 |
| 80=90 | 4 | 9 | 8 | 1 | 1 | 9 | 32 |
| 90=100 | 5 | 3 | 3 | 6 | 1 | 1 | 19 |
| >100 | 8 | 6 | 4 | 6 | 1 | 6 | 31 |

**Climate monitoring:** Through the use of an automatic weather station locate at around 1200 m a.s.l in southern Mwanihana, TEAM project continued to collect data on four weather parameters namely rainfall, solar radiation, temperature and relative humidity. Once the data have been retrieved from the data-logger, they immediately become uploaded into TEAM website http://www.teamnetwork.org/data/query for public consumption freely of charge but after adhering to the TEAM data use policy. Data were analysed using automatic report-generation routines in software 'R' and developed by TEAM Head office. Below, a sample of climate profiles (relative humidity and rainfall) generated for 2013 are shown, while additional data and information can be provided upon request.



## 6. School education and community conservation activities

Activities with schools ranged from lessons in class and visits to the park and night cinema projections. UEMC initiated this programme towards the end of 2007 with five nearby primary schools in Mang'ula, namely Mlimani, Mwaya, Mgudeni, Mang'ula A and Msalise primary schools. The programme continued successfully throughout 2013 and expanded to 13 more schools which were continued in the 2013 including Ichonde, Kisawasawa, Sanje, Kiberege, Darajani, Udzungwa, Tumaini, and Sonjo, and 5 were secondary schools (St. Mary secondary school, Bokela, Kisawasawa, Udzungwa, and Mang'ula). Class lessons on environmental education were carried out regularly, and other activities including taking them inside the park, trees nurseries, tree planting around the schools, study tours and poster competitions. The environmental programmes worked with standard five and six in each school, each class received one teaching period of 40 minutes per week. The average number of students per class were 150, so UEMC roughly reached 2700 students in 2013 as it was in the 2012.

With the support of UMNP, UEMC has also accompanied one class from every school on a field trip to hike in the National Park. UEMC has been showing these children to various tree plantations, to see the value of tree planting in the long run. Trips were greatly appreciated by the students, and they involved about 40 students and 2 school teachers each time.

In addition, UEMC in connection to Association Mazingira continued with the extended programs to communities where the same 14 villages (Signali, Nkasu, Kiberege, Kisawasawa, Ichonde,

Mgudeni, Mwaya, Mang'ula A, Mang'ula B, Sole, Sonjo, Mkula, Sanje and Msufini) continued to be actively engaged in conservation especially through energy-saving and agro-forestry activities.

In addition, other community conservation components have been activated, as follows:

- continued the environmental education programme to 13 primary schools and 5 secondary schools; in 2013, 62 teachers were trained on how to develop environmental educational curriculum;
- training for both tree nurseries and agro-forestry programmes;
- training on making energy-saving stoves was done with 68 people and they build the energy saving stoves within their own villages; in addition to mud stoves, the project is introducing biomass-made briquette stoves and Mayon stoves that use biomass such as rice husks;
- an eco-tourism component of the project was also initiated.

The project plans also include support to the park for boosting tourism promotion.

Related to this, as mentioned at the beginning of the report on the visit to Trento by Mr. Kijazi, MUSE-Science Museum in partnership with Mazingira and other partners presented the proposal for the realization of a **new Visitor Information Centre at the park HQs,** as provided for by the new MoU for management of UEMC.

## 7. Activities planned for 2014 and strategic planning

UEMC plans to conduct the following activities in 2014:

- continue the primate and duiker monitoring with the standard, monthly frequency in Mwanihana and USFR;
- continue to support with technical advisory and training the park-wide monitoring of mammals and help establishing a sustainable system that can ensure data-collection;
- whilst the fourth edition of the summer school has been postponed to 2015 due to logistic constraints and other commitments by the organizers, UEMC will continue to boost the standardization of monitoring efforts at national level in forest parks, taking forward the dedicated workshop conducted in 2013 by assisting with technical advisory to other parks which are committed to standardized data collection, with a view for arranging a second workshop in 2015 to assess progresses;
- continue to support and facilitate the environmental education programme and the environmental cooperation activities by Association Mazingira,
- support Mazingira and other partners for beginning the implementation of the Visitor Information Centre at the park premises;
- continue and consolidate implementation of TEAM project, that will enter into its sixth year of monitoring.

In conclusion, UEMC will continue to facilitate and promote research and conservation activities in the Udzungwa mountains. The current management phase of UEMC is well under implementation of its second MoU between TANAPA and MUSE (running 2012-2016). Hence, meetings between Mr. Kijazi and MUSE's representatives during his visit in Trento in July 2013 included preliminary discussion on the best and mutually benefitting model for a continued collaboration beyond this phase capable to ensure progressive handing over of UEMC management to TANAPA.