Udzungwa Ecological Monitoring Centre
(Udzungwa Mountains National Park)

Annual Technical Report
Year 6 (January - December 2012)

Table of contents

Contact details:
Udzungwa Ecological Monitoring Centre
c/o Udzungwa Mountains National Park
Box 99, Mang'ula, Tanzania
Web-site: www.udzungwacentre.org

For UEMC and MUSE - Trento Science Museum
Dr. Francesco Rovero
francesco.rovero@muse.it

For UMNP/TANAPA
Mr. Vitalis P. Uruka, Chief Park Warden
vitalis.uruka@tanzaniaparks.com

Cover photo: forest interior in the Udzungwa Mountains, photo by F. Rovero

Summary

The Udzungwa Ecological Monitoring Centre (UEMC, please visit the new website realized in 2012 at http://www.udzungwacentre.org) is a facility of the Udzungwa Mountains National Park (UMNP) established at the end of 2006 with the aim of promoting and facilitating 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. This is the sixth year technical report (January - December 2012), and it is aimed at presenting the results of monitoring and training activities, and other programmes conducted, as well as summarize the short and medium-term plans so that it can also serve as a strategic document.

Generally, UEMC continued the provision of accommodation and facilitation to national and international researchers, with the overall number of researchers hosted that raised to over 150 people in 2012. Besides the 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 fourth year of annual data collection on climate, vegetation and terrestrial mammals. By using the hostel for students, UEMC facilitated important training schemes, such as those organized by Pennsylvania State University (14 students) and the second edition of the Summer School on GIS and field tools for studying tropical biodiversity organized by Trento Museum and the University of Trento (20 participants). UEMC also continued the provision of training scholarships for staff.

UEMC continued the primate and duiker monitoring programme in Mwanihana forest (UMNP) and in the southern Uzungwa Scarp Forest Reserve (USFR), and the results from relative abundance data collected were compared to previous data collected since 2002. The latest set of data makes a significant contribute, as it consists of 12 months of census. This raised the amount of data-set to 588 census repetitions in Mwanihana (over 2300 km walked during 2002-2012), and 257 repetitions, equivalent to over 900 km walked. Overall, it is maintained a clear trend of relative population stability in Mwanihana while the dramatic decline earlier reported for USFR persists, especially for the colobine monkeys. Conservation recommendations for both forests spanning from the results are proposed, and particularly stress the need for effective ground protection in USFR, which is currently a proposed Nature Reserve. It is also recommended that the monitoring programme continues with the methodological consistency so fare achieved.

In the context of school education and community conservation, in 2012 a new community conservation programme implemented by Trento Science Museum and Association Mazingira begun under facilitation of UEMC and in close collaboration with UMNP, and major achievements included: continued and expanded the environmental education programme to involve 13 primary schools and 5 secondary schools; trained representatives from 14 villages on establishment of tree nurseries and initiation of agro-forestry; supplied tools for tree nursery to 14 villages and established tree nurseries in these same villages.

The reports ends with a summary of activities planned for 2013 in the context of the Memorandum of Understanding that regulates the collaboration between TANAPA and Trento 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 first 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 can be downloaded in the UEMC website (www.udzungwacentre.org).

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 officially 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 dedicated to enhancing training capacity.

The staff working at UEMC was only slightly changed in 2012. 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 recruited In addition 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 2012 continued to co-fund scholarships for staff training. Thus, Mr. Arafat Mtui - former UEMC coordinator - begun to attend in September 2012 Mweka Wildlife College to pursue a B.Sc. degree in Wildlife Management and Aggrey Uisso – one of TEAM's field technician - began a 1-year Certificate in Wildlife Management. However, the bulk of funding for

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

2. Summary of activities planned and activities implemented

UEMC HAS A NEW WEB SITE!

As of 2012, UEMC has realized a completely new web-site. Please visit it at www.udzungwacentre.org.

This section provides an overview of activities implemented until the end of 2012 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 and through advisory for the large mammal monitoring at remote UMNP ranger posts

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 report (UEMC 2010), 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).

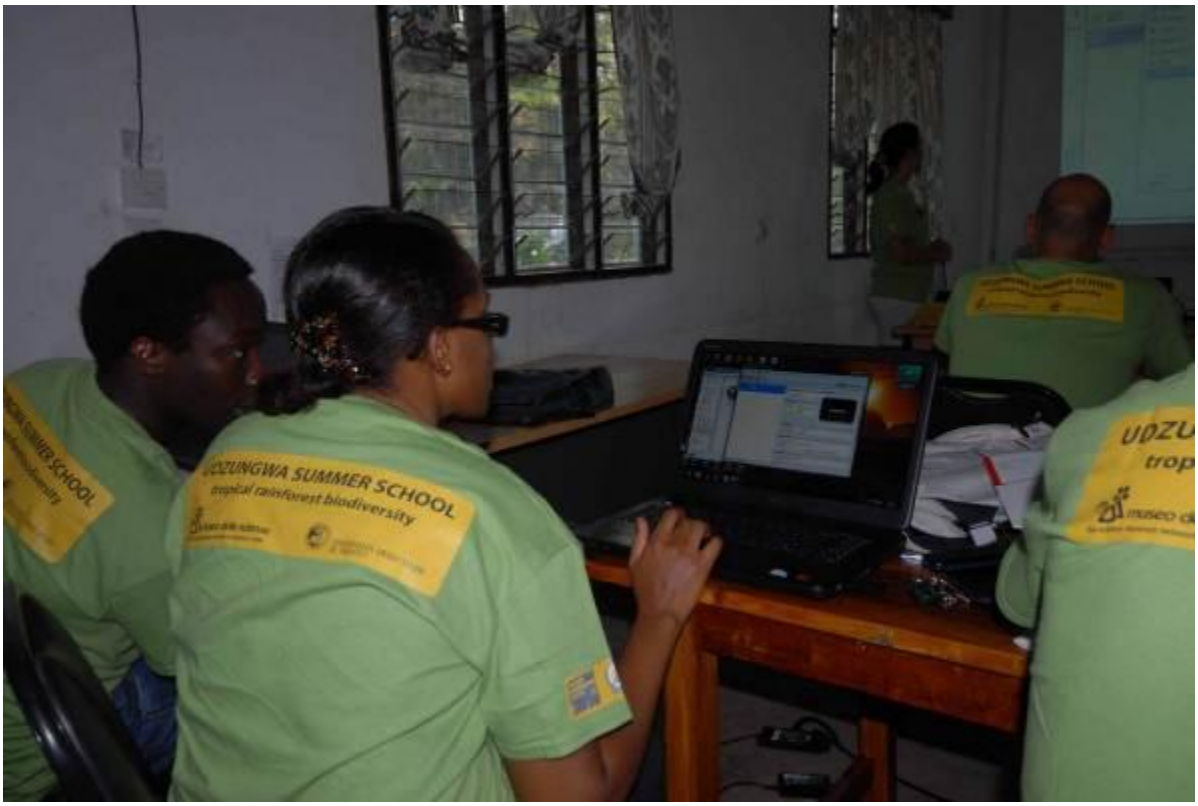
3. **Facilitate visiting researchers** and conservation agencies through providing accommodation, information, research facilities (Internet, computers, seminar room etc.).

In 2012 UEMC hosted 5 long-term researchers plus a number of guest researchers visiting on shorter term basis, adding up to a total number of around 150 researchers accommodated in the hostel and houses during the 6 years of activity. Overall, the resources raised from fees for accommodation in 2012 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 was from institutions conducting training at UEMC, notably Penn State University and Trento Museum/the University of Trento. UEMC continued to facilitate TEAM programme and Udzungwa Forest Project led by Dr. Marshall (Flamingo Land, UK) by hosting the staff and providing logistic support.

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

Capitalizing on the success of the first edition, UEMC hosted the **second edition of the summer school in 'GIS and field tools for assessing, monitoring and mapping'** organized by Trento Museum and the University of Trento. The school was attended by 13 international students and 2 Tanzanian students besides 5 staff from UMNP and UEMC, and it included a workshop on GIS for UMNP Ecology Department. Plans for a nation-wide training workshop for TANAPA forest park ecologists were not materialized and were postponed to the summer of 2013 when a dedicated training course is scheduled. Penn State University also repeated for the third time their field training programme.

In addition, UEMC facilitated the Udzungwa Elephant Project by hosting and collaborating to a number of training workshops held at UEMC. The first was a MIKE (Monitoring the Illegal Killing of Elephants) training workshop (2nd January 2012). MIKE is a way of collecting data systematically on poaching. The workshop was carried out specifically for the rangers, to introduce the MIKE program and ensure that data are collected correctly in the field when on patrol, using standard MIKE field forms. The other workshops were on use of GPS (31st January 2012) and GIS (5th and 6th February 2012). The workshop in the use of handheld GPS units was led by UEP's Athumani Mndeme and Arafat Mtui of UEMC. Five days later, a two-day intensive training workshop was held with senior Protection and Ecology staff of the Udzungwa Mountains National Park in the use of QGIS, led by Trevor and GIS expert Nick McWilliam (of Map Action and Anglia Ruskin University, Cambridge).



Staff of the National Park participating to the 2013 edition of the summer school on GIS and field tools for assessing monitoring and mapping biodiversity.

GPS training at the Udzungwa Ecological Monitoring Centre organized by UEP (left) and QGIS workshop with trainer Map Action's Nick McWilliam (right)

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

This programme continued and expanded in 2012 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 July 2009 (see UEMC 2010). In January 2011, refinement of the database and further GIS training was organized by Trevor Jones in collaboration with UEMC and support of Nick McWilliams, a GIS expert from Anglia Ruskin University in Cambridge and MapAction (UK). Training lasted 1 week and was aimed at improving park's staff capacity to handle spatial information (from patrols and monitoring activities) into GIS software. No further developments were done in 2012, however discussions with Dr. Msoffe head of TANAPA GIS Unit begun with a view of UEMC/UMNP becoming the southern parks' node for the new, park-wide GIS database being developed at TANAPA HQs.

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 present report it was decided not to include these data (which remains available on request), and hence present data from 2002-2012. 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.

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
	All observers		161	161	160	106

The updated data-set 2002-2012 for Mwanihana consists overall of 588 transect repetitions, for over 2300 km walked. This 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).

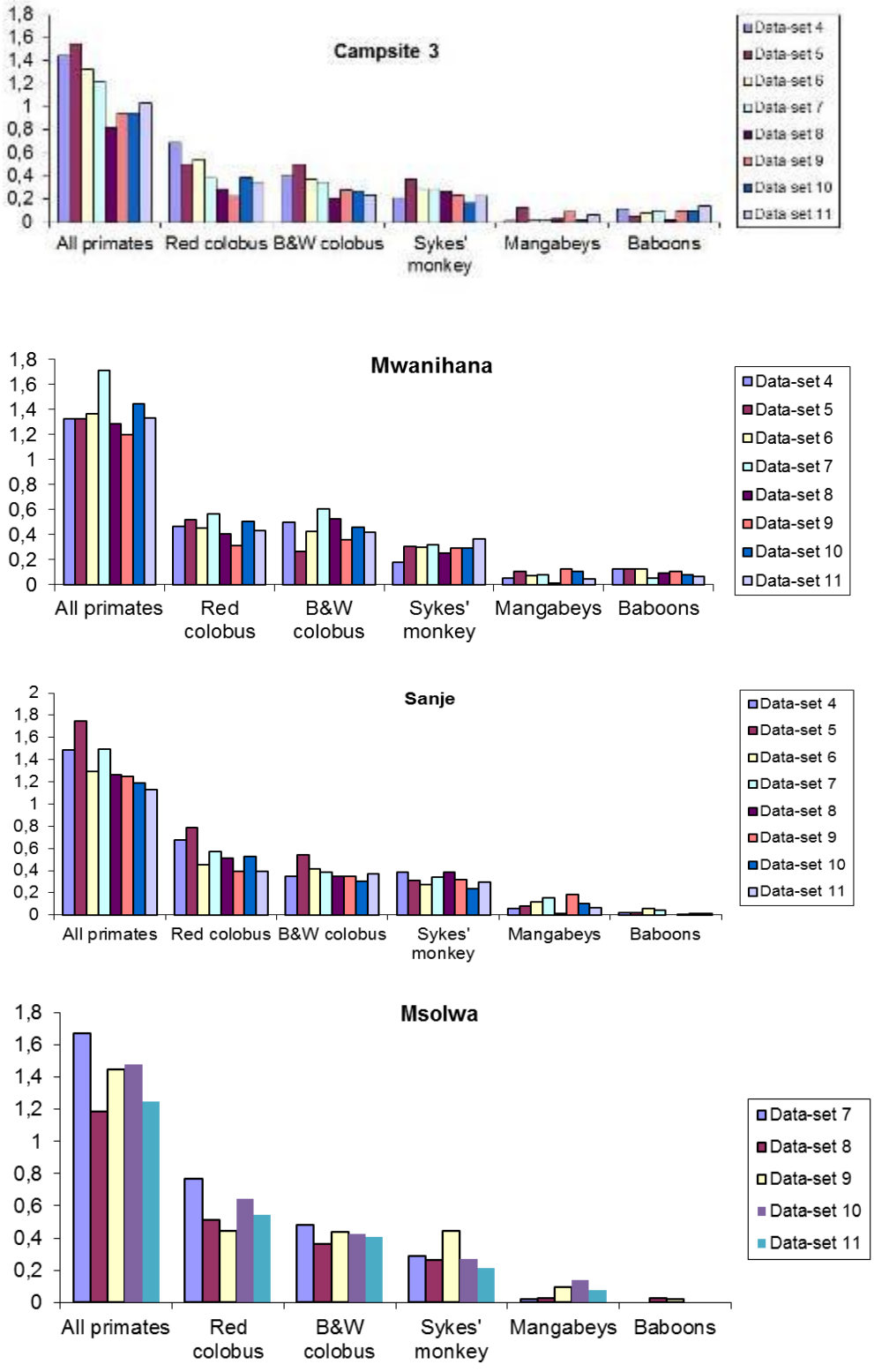


Fig. 1. Results of primates' encounter rate by observer for the 4 transects in Mwanihana forest.

Transect-specific results do not reveal striking trends of changes in abundance, as observed from earlier comparisons. Mwanihana appears the transect 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. Similar observations apply to results for Sanje transect. Indeed for these two transects, the reduced and more consistent data set used (that excludes data from before 2002), does maintain an apparent decrease trend for all primates, however none of the results for the 3 forest arboreal monkeys appear to contribute to this overall trend in any particular strength.

Statistical analysis - ANOVA and post-hoc comparisons (Table 3) – was performed on the pooled data-set. Robust and complete statistical analysis for the whole data-set is in progress for a scientific paper. ANOVA results indicate that for all primates and for the red colobus the inter-observer differences are significant, while for Angolan colobus and Sykes' monkeys they are not. Post-hoc comparisons for the former two species for which differences are significant, however, do not reveal the occurrence of any significant increase or decline with time.

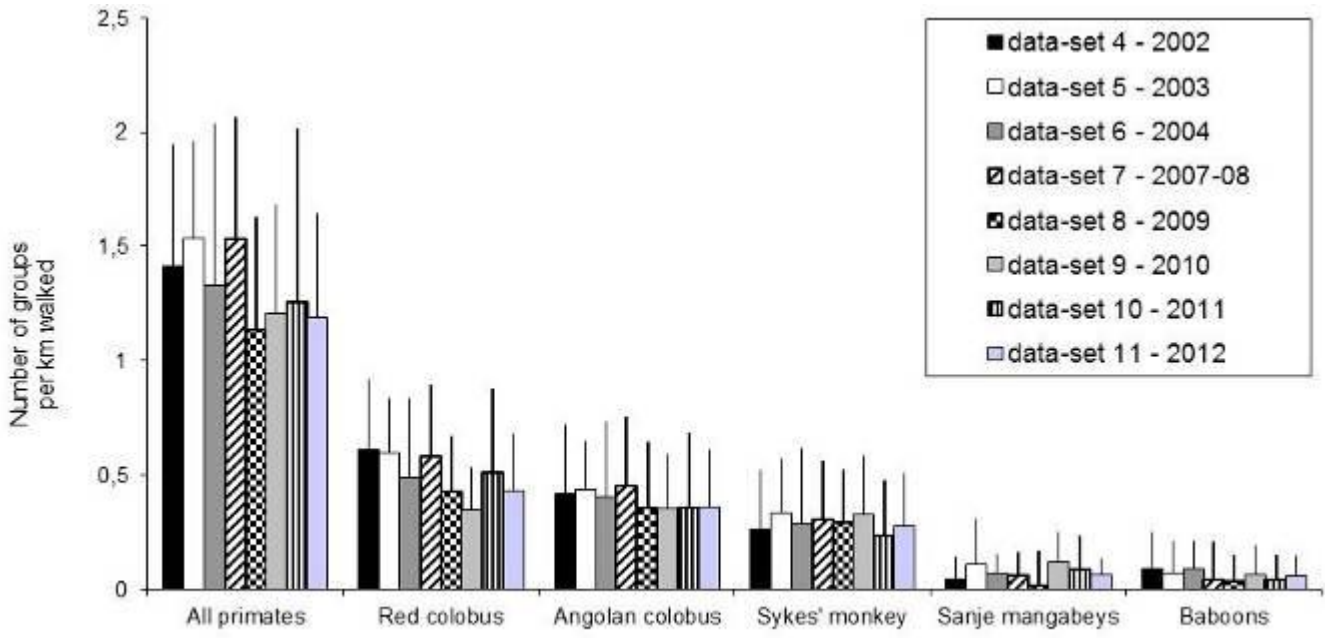


Fig. 2. Results of primates' encounter rate by observer for all transects pooled in Mwanihana forest.

Table 3. Results of ANOVA tests on primates' encounter rate by observer, with significant outcomes of post-hoc comparisons

	F statistic	P	Turkey's post-hoc comparisons
All primates	5.998	<0.001	Obs 5 vs 8,11 Obs 7 vs 8,9,10,11
Red colobus	9.140	<0.001	Obs 4 vs 8,9 Obs 5 vs 8,9,11 Obs 7 vs 8,9,11 Obs 9 vs 10
Angolan colobus	1.709	=0.104	None significant
Sykes' monkey	1.313	=0.241	None significant

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 2012 totalled 257 repetitions, equivalent to 915 km walked. 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.

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	ASM	February - December 2012	11	11	na	na	11	33
All			82	80	32	20	43	257

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 pattern of decreasing abundance with time continues to occur for the two colobine monkeys. For Mkaraji transect, data for the Sanje mangabeys also appear to show a decrease.

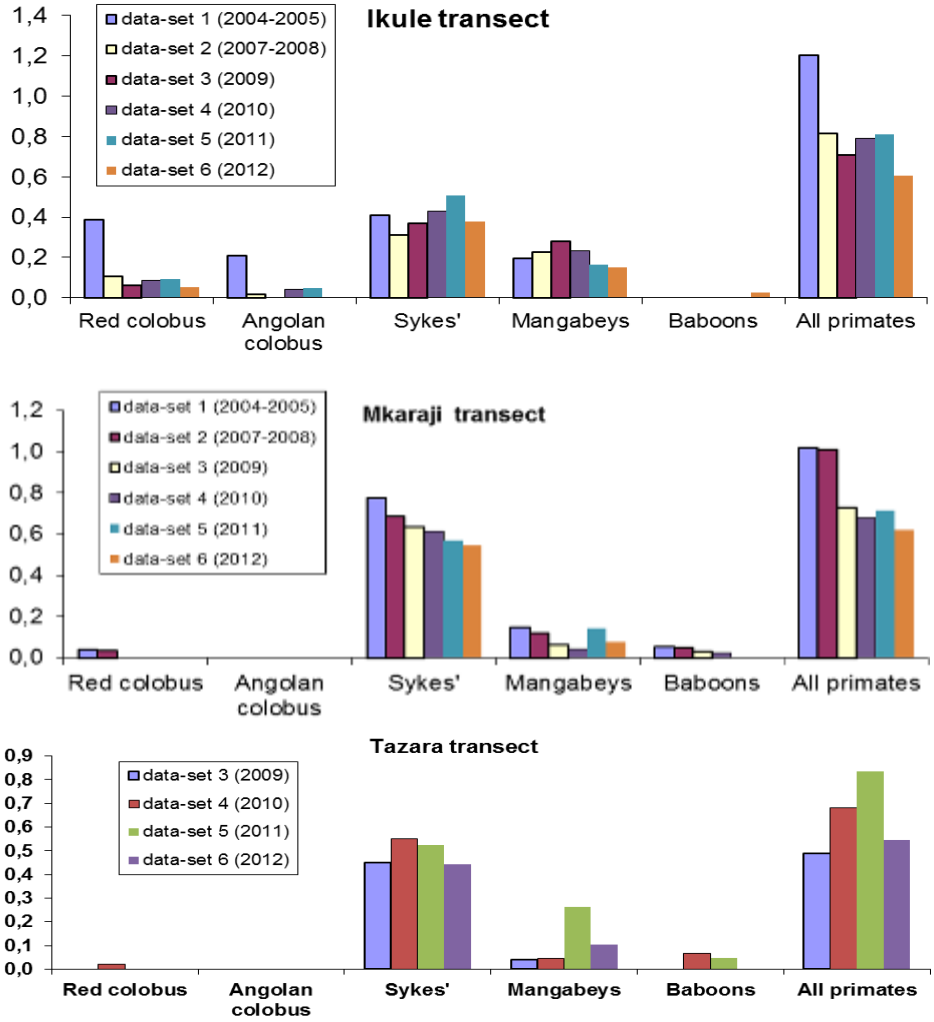


Fig. 3. Results of primates' encounter rate by observer and transect, for the 3 active transects in Uzungwa Scarp.

When all transects are pooled, the temporal trend is clear (see ANOVA results in Table 5): the differences are significant and significant post-hoc comparisons are directional, i.e. the first data-set is different from the subsequent. For both colobus monkeys, this is especially clear, with data-set 1 differing from all the subsequent (data-set 2-6). Differences for Sykes' monkeys are not significant. Although not tested statistically due to the poor suitability of the methods, results for Sanje mangabeys also do not seem to reveal any temporal trend.

Table 5. Results of ANOVA tests on primates' encounter rate by observer, with significant outcomes of post-hoc comparisons

	F statistic	P	Turkey's post-hoc comparisons
All primates	6.580	<0.001	Obs 1 vs 3,4,5,6
Red colobus	7.279	<0.001	Obs 1 vs 2,3,4,5,6
Angolan colobus	6.441	<0.001	Obs 1 vs 2,3,4,5,6
Sykes' monkey	1.134	=0.343	None significant

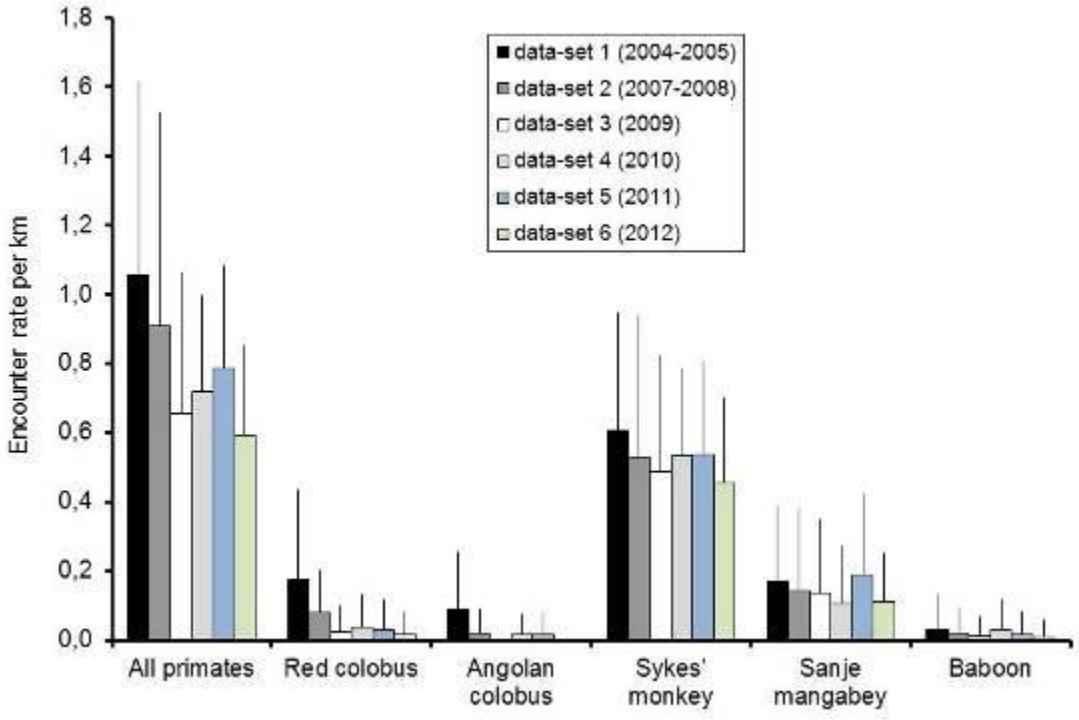


Fig. 4. Results of primates' encounter rate by observer for the pooled 3 active transects in Uzungwa Scarp.

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

Results of monitoring the red duiker 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. ANOVA tests show that for Mwanihana differences are significant ($F=2.936$, $p<0.001$) but post-hoc comparisons are only significant for data-sets 5 vs 8. For USFR, for which the data set is even smaller, differences are also significant ($F=2.915$, $p<0.02$) and post-hoc comparisons are significant for data-set pairs 1 vs 2 and 4 which indicate a declining trend followed by an increase in the last 2 years. These results need to be taken with particular caution as detectability of duikers in forests where they hunted such as USFR is particularly poor.

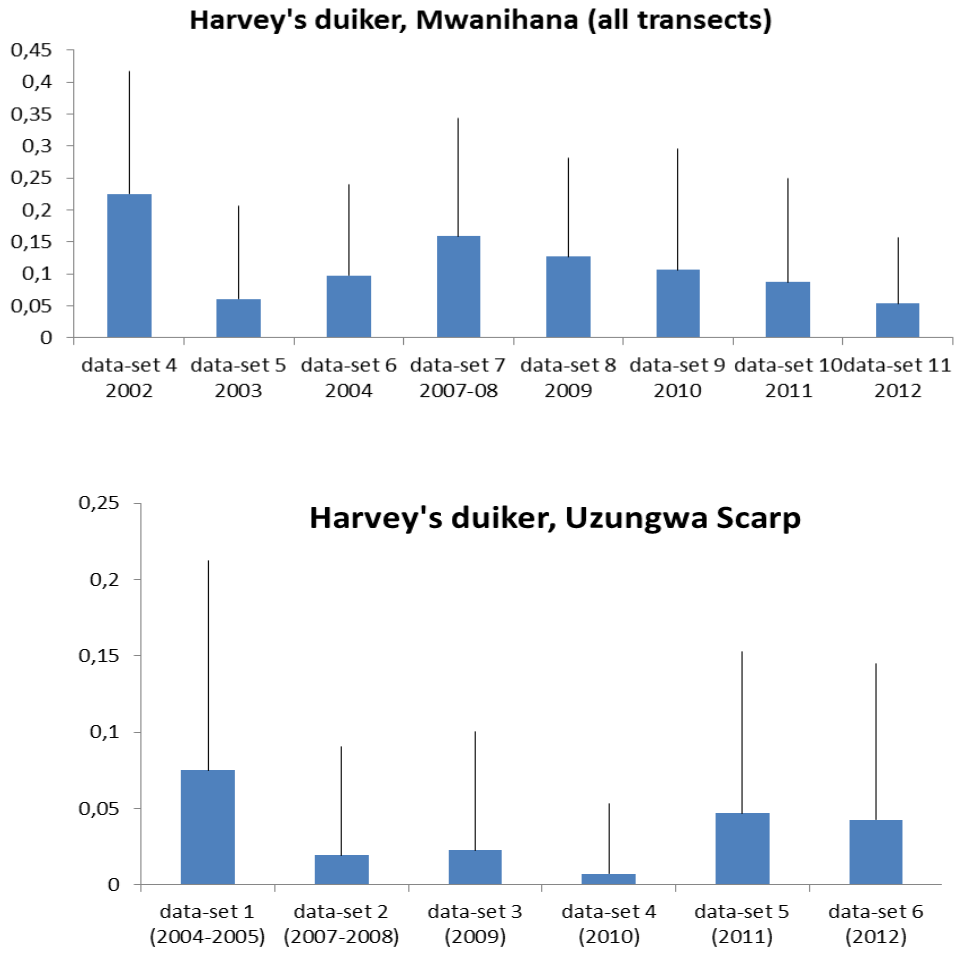


Fig. 5. Results of Harvey's duiker encounter rates for all transects by data-set in Mwanihana (above) and Uzungwa Scarp (below).

3.4. Interpretation of monitoring results

For primates, the increased data-set generally corroborates the conclusions in earlier reports, i.e. that populations appear to be relatively stable over time in Mwanihana forest, UMNP, while the declining trend in USFR persists and continues to be alarming. Hence, while the variation in relative abundance that emerged for Mwanihana should be considered natural and/or due to minor inter-observer differences, those emerged in USFR indicate a real declining trend. A detailed paper on these differences and the likely determinants has been published in 2012 (Rovero et al. 2012, *Biological Conservation* 146: 89-96), and used data from 2004-2009. The paper shows the relative effect of habitat degradation and hunting in determining the trends observed, with hunting mainly explaining the decline in population abundance of the colobines in USFR.

The key recommendations from these results are therefore similar to those previously stated, and particularly:

1. it is critical to continue and monitor with methodological consistency to previous efforts the primates of both forests;
2. conservation of these important primate populations depends on the good protection effort allocated to the forests where they occur. For USFR in particular, it is hoped that the proposed upgrading to Nature Reserve can be quickly done and can be associated to effective ground protection.

The results for Harvey's duiker are of less straightforward interpretation than for primates mainly because of their lower density and grater difficulties of counting them in the densely vegetated habitat. As a consequence, the standard errors associated to mean values of encounter rates are so large that assessing variations becomes difficult if not impossible. Results for Mwanihana do not indicate any particular trend, and for USFR there appears a sharp increase in relative abundance of 2011-2012 relative to previous years which is unclear and again based on very small number of counts. However, this duiker is also monitored in Mwanihana through the TEAM project, and multi-year analysis of data is planned to begin at the end of 2013 when 5 years of data will be available. It will be especially interesting to assess if the relative abundance and range of this common duiker has changed since the firewood collection banning in 2011.

4. Park-wide monitoring of large mammals

This programme begun in 2008 with transects establishment and training of rangers. As shown in the map in Figure 10, 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). Transects sample a variety of habitat types, from lowland deciduous and semi-deciduous forest (Ruipa and Lumemo) to woodland (Kidatu), wooded grassland, moist and dry forest (Udekwa and Mbatwa).

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, due to 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 to be established, 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.

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 fourth year of sampling. Three standardized monitoring protocols are implemented solely in Mwanihana forest: terrestrial vertebrates, vegetation and climate (see previous reports for more details).

Terrestrial vertebrates: 60 camera-trap points have been re-deployed through sampling 3 arrays of 20 camera-trap sites, sequentially. Twenty digital camera-traps (model Reconyx RM 45 Rapid Fire and Reconyx HP 500) have been used, each set to work for 30 days. The camera-trap were distributed at a density of 1 camera every 2 km2. Locations were pre-loaded in a GPS unit and actual points were located in the field by the field team. The final locations of the camera-traps were chosen upon the presence of wildlife trails and other signs. Sampling overall took place during July to November 2012.

A summary of sampling effort and results in terms of photographic events and list of species detected follows in Table 6 and 7.

Table 6. Sampling effort and summary results for TEAM's terrestrial vertebrate sampling during 2009-2012.

	2009	**2010**	**2011**	**2012**
Num of camera set	60	60	60	60
Num of cameras functional	58	59	59	60

Camera-trap days (24 h periods)	1818	1874	1829	1842
Mean camera-trap days per camera	31,3	31,8	31	30,7
Total number of events (1-hr interval)	1395	1766	1593	1523
Total mammal species recorded	27	28	27	23

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
Atilax paludinosus	Marsh mongoose	3	3	13	5
Bdeogale crassicauda	Bushy-tailed mongoose	130	308	295	318
Cephalophus harveyi	Harvey's duiker	367	250	271	379
Cephalophus spadix	Abbott's duiker	60	53	56	29
Cercocebus sanjei	Sanje mangabey	73	100	118	152
Cercopithecus mitis	Sykes' monkey	22	9	12	21
Civettictis civetta	African civet	1	NA	NA	NA
Colobus angolensis	Angolan colobus	1	2	1	2
Cricetomys gambianus	Giant pouched-rat	276	353	380	313
Crocuta crocuta	Spotted hyena	NA	4	3	NA
Dendrohyrax validus	Tree hyrax	23	42	36	50
Genetta servalina	Lowe's genet	18	64	54	59
Homo sapiens	Human	2	3	NA	1
Hystrix africaeaustralis	Hystrix	11	1	NA	2
Leptailurus serval	Serval cat	NA	NA	1	NA
Loxodonta africana	Savannah elephant	11	5	7	12
Mellivora capensis	Honey badger	7	6	7	13
Mungos mungo	Banded mongoose	2	7	1	NA
Nandinia binotata	African palm civet	2	7	9	11
Nesotragus moschatus	Suni	114	135	91	NA
Panthera pardus	Leopard	8	2	7	6
Papio cynocephalus	Yellow baboon	3	NA	2	NA
Paraxerus vexillarius	Tanganyika mountain squirrel	46	60	59	40
Petrodromus tetradactylus	Four-toad sengi	3	7	36	12
Philantomba monticola	Blue duiker	NA	1	NA	NA
Potamochoerus larvatus	Bushpig	18	23	16	22
Procolobus gordonorum	Udzungwa red colobus	5	2	8	NA
Rhynchocyon cirnei	Chequered sengi	4	4	8	NA
Rhynchocyon udzungwensis	Grey-faced sengi	45	88	95	61
Syncerus caffer	African buffalo	4	5	3	3
Thryonomys swinderianus	Cane rat	NA	NA	2	4
Tragelaphus scriptus	Bushbuck	NA	4	2	8
Species richness		**27**	**28**	**28**	**23**

With 23-28 species trapped, a relatively high portion of the mammalian community known for Udzungwa has been recorded in Mwanihana. 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 most frequently trapped are: giant-pouched rat bushy-tailed mongoose, Harvey's duiker, Sanje mangabey and grey-faced sengi or elephant-shrew).

In 2012 a consistent effort to analyse data begun. 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 follows [see also Rovero F., Collett C., Ricci S. Martin E., Spitale D. (2013). Distribution, occupancy and habitat associations of the grey-faced sengi (*Rhynchocyon udzungwensis*) as revealed by camera-traps. *Journal of Mammalogy* in press].

Fig. 6 shows the key results from the analysis. Occupancy (which is considered a proxy of abundance) was modelled throughout the portion of Mwanihana forest were the species occurs and the modelling accounted for environmental covariates of presence. Out of a number of covariates used (i.e. altitude, terrain slope, distance to the forest edge, distance to the eastern border of the park) the analysis found that giant sengis prefer areas with gentle slope and is more abundant towards the central and western portion of the forest relative to the eastern portion. This translates in greater abundance in the interior and intact, sub-montane and montane forest and probably also away from human disturbance at the park edges. The study concludes that camera-trapping is a highly efficient tool to model the presence and abundance of elusive mammals. Occupancy models such as this described have high ecological and management relevance, and they are currently being derived for a number of other species of the community.

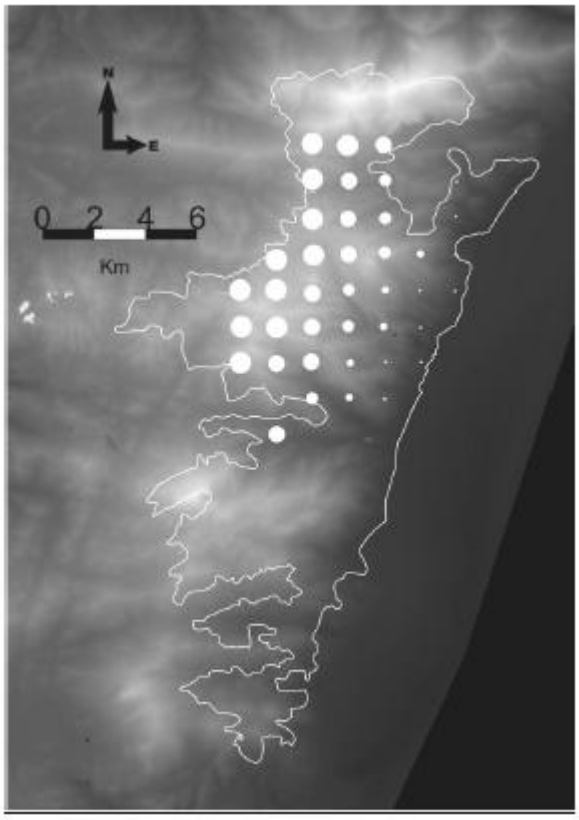


Figure 6. Map of Mwanihana forest, Udzungwa Mountains, Tanzania with locations of camera traps shown as dots of size proportional to the estimated occupancy of the grey-faced sengi. From Rovero et al. (2013).

Analysis of temporal changes in occupancy has not been performed yet, and plans are to begin addressing this question once the fifth year of data will be collected by the end of 2013.

Vegetation: all trees above 10 cm DBH in the 6 vegetation plots (each 1 ha) were remeasured in 2012. The plots are located at different altitudes in order to capture variations within Mwanihana forest. Sampling was conducted in October-November 2012.

A comparison of number of trees recorded per plot by 2011 and 2012 are shown in the Table below: the number of stems ranged between 446-722 (mean 584) and 469-710 (mean 589) for year 2011 and 2012 respectively. While the number of species ranged between 20-48 (mean 34) and 22-45 (mean 34) by year 2011 and 2012 respectively.

	Number of stems		**Number of species**	
Plot (name and altitude)	**Year 2011**	**Year 2012**	**Year 2011**	**Year 2012**
Plot 1 (Gologolo chini) 1127 m a.s.l	463	471	37	42
Plot 2 (Gologolo juu) 1795 m a.s.l	551	555	44	45
Plot 3 (Sanje chini) 778 m a.s.l	470	469	22	22

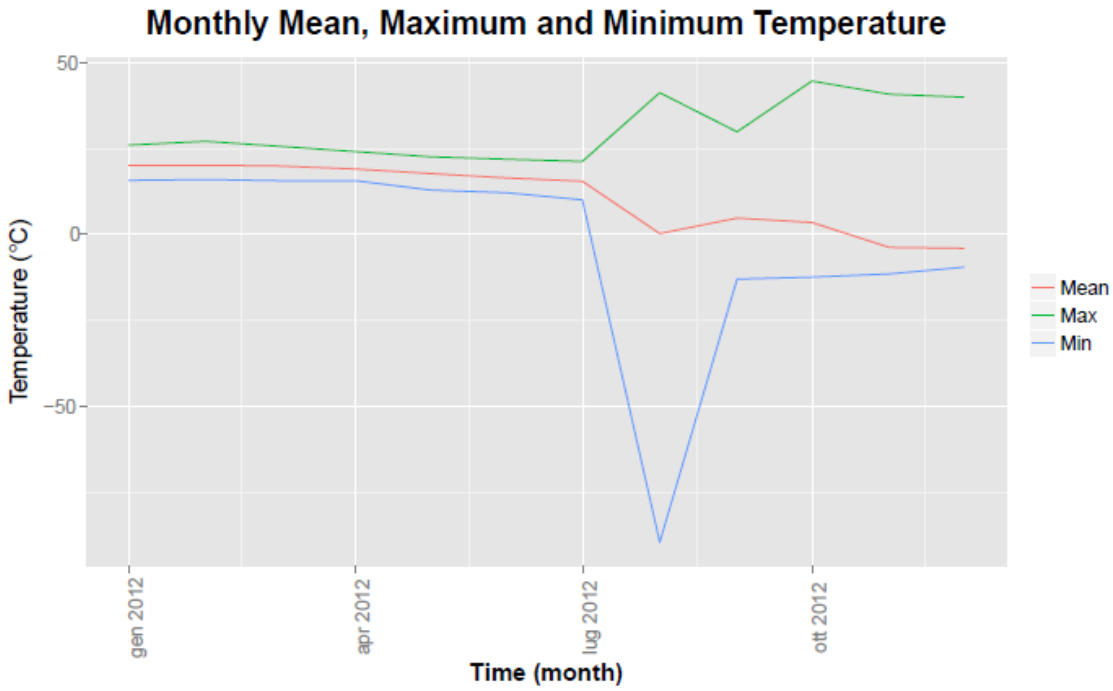
Plot 4 (Sanje juu) 1425 m a.s.l	722	710	54	55
Plot 5 (Campsite Chini) 781 m a.s.l	482	482	26	26
Plot 6 (Campsite juu) 1519 m a.s.l	610	609	43	41
Total	**3298**	**3296**	**129**	**128**

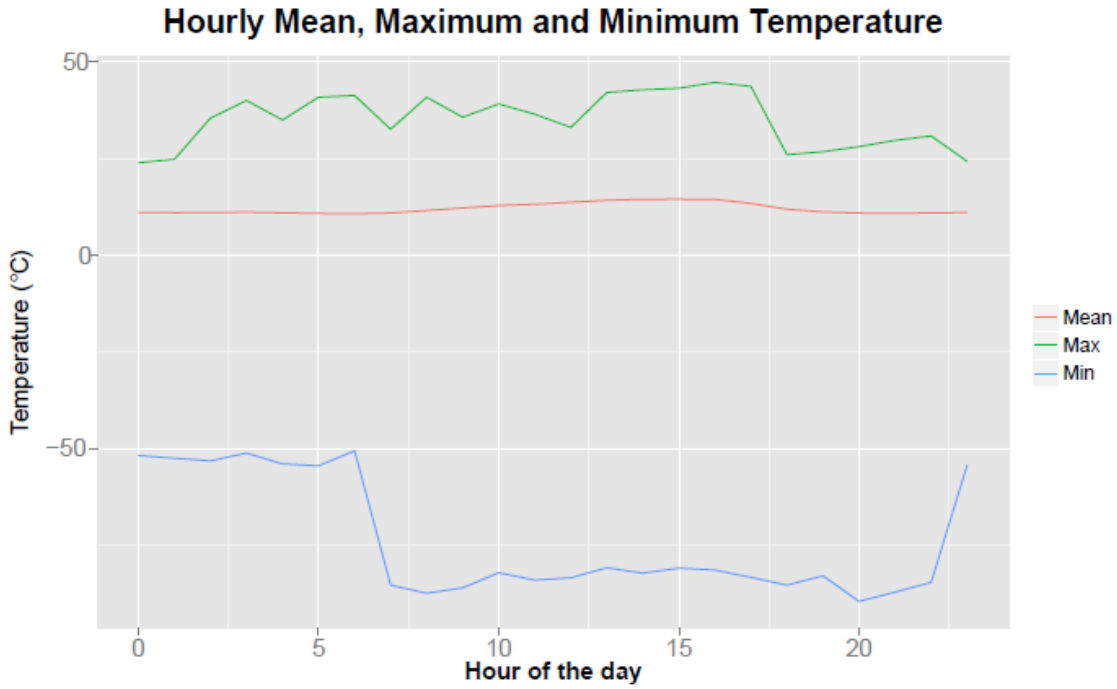
For 2012 data, DBH size classes distribution was also done and the results are shown below. As it was expected, majority of trees and lianas falls in the 10-20 cm DBH class, with the number of stems per class decreasing for larger size classes.

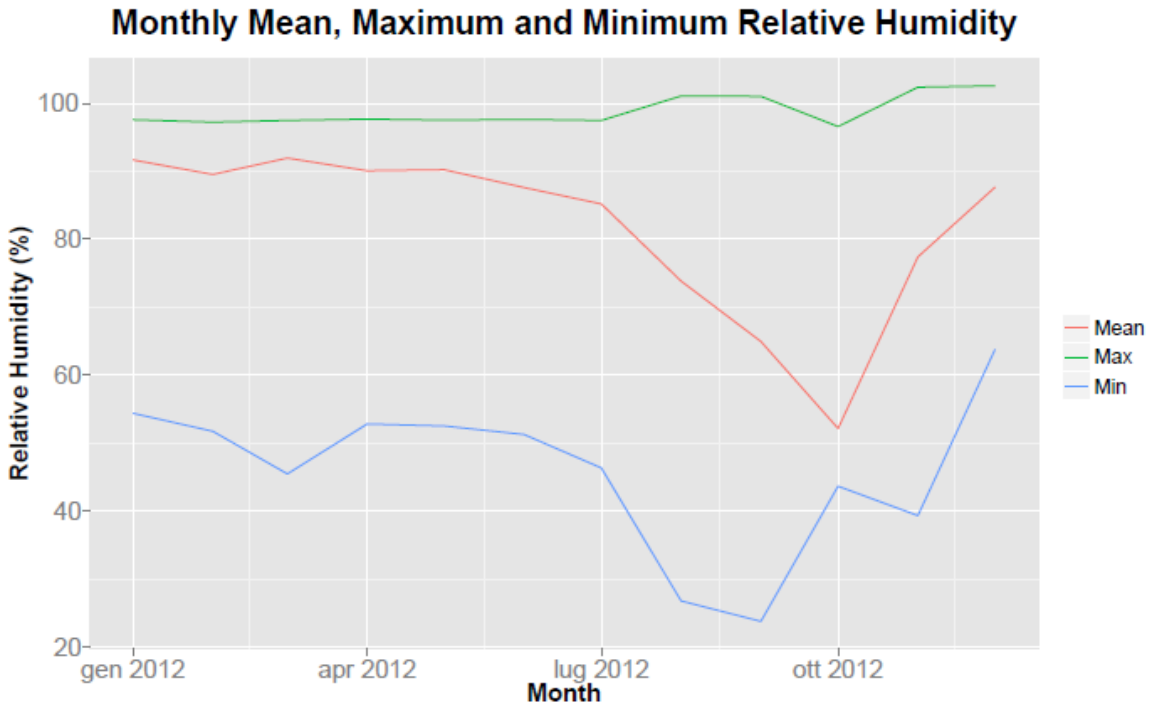
DBH class (cm)	Num. of stems						
	Plot 1	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**	**Plot 6**	**Total**
10=20	320	293	271	461	283	359	1987
20=30	35	99	88	129	111	122	584
30=40	36	57	44	39	42	50	268
40=50	32	43	23	24	21	39	182
50=60	13	25	10	22	12	10	92
60=70	8	12	12	15	3	4	54
70=80	6	6	8	7	5	8	40
80=90	4	7	6	1	2	9	29
90=100	5	4	3	5	0	1	18
>100	7	5	4	7	0	6	29

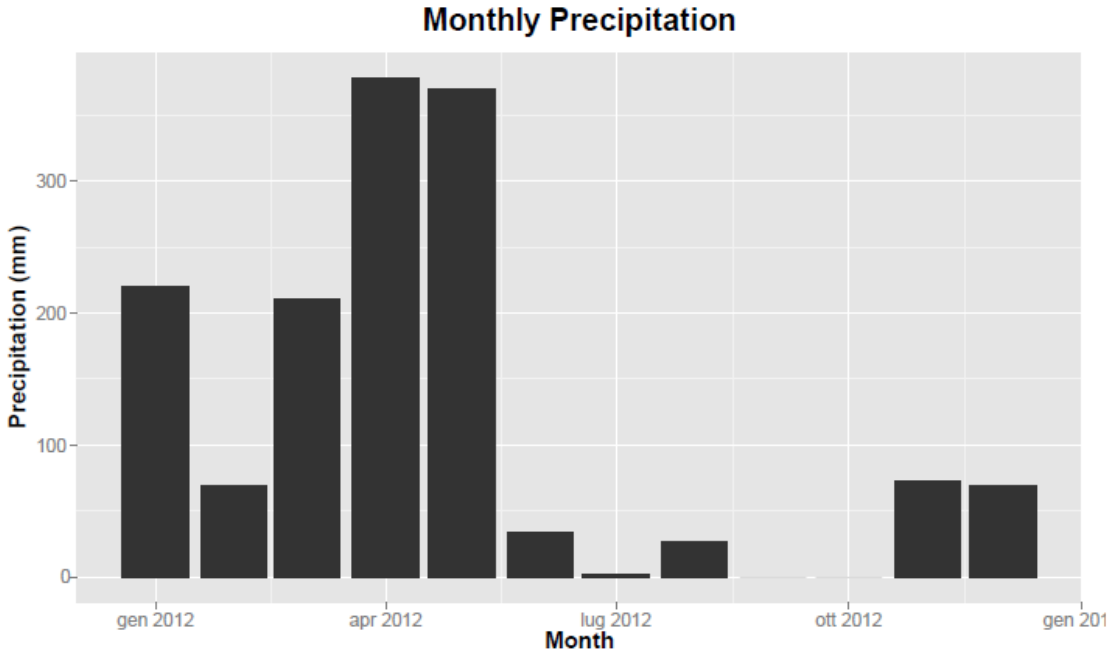
Climate monitoring: Through the use of an automatic weather station, TEAM project continued to collect data on four weather parameters namely rainfall, solar radiation, temperature and relative humidity. Once the data have been retrieved from the datalogger, they immediately become uploaded into TEAM 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, the main climate profiles generated for 2012 are provided, while additional data and information can be provided upon request.


Monthly Mean, Maximum and Minimum Temperature
50
0
−50
Temperature (°C)
gen 2012
apr 2012
lug 2012
ott 2012
Time (month)
Mean
Max
Min


Hourly Mean, Maximum and Minimum Temperature
50
0
−50
Temperature (°C)
0
5
10
15
20
Hour of the day
Mean
Max
Min


Monthly Mean, Maximum and Minimum Relative Humidity
Relative Humidity (%)
100
80
60
40
20
gen 2012
apr 2012
lug 2012
ott 2012
Month
Mean
Max
Min


Monthly Precipitation
Precipitation (mm)
300
200
100
0
gen 2012
apr 2012
lug 2012
ott 2012
gen 201
Month

6. School education and community conservation activities

Activities with schools ranged from lessons in class and visits to the park and cinema shows nights. 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 successful throughout 2012 and expanded to 13 more schools which included , Ichonde, Kisawasawa, Sanje, Kiberege, Darajani, Udzungwa, Tumaini, and Sonjo and 5 were secondary school (St. Mary secondary school, Bokela, Kisawasawa, Udzungwa, and Mang'ula: class lessons on environmental education were carried out regularly, and other activities included continuing school trees nurseries, tree planting around the schools, study tours, poster competitions and other games. The environmental programmes worked with standard 5 and 6 classes in each school, each class receiving one teaching period of 40 minutes per week. The average number of students per class was 150, so UEMC roughly reached 2700 students in 2012.

With the support of UMNP, UEMC has been taken one class from every school on a field trip to hike in the National Park. Also UEMC has been doing the same to take them to the plantation forest to see the differences between plantation and natural forests. Trips were greatly appreciated by the students, and they involved about 40 students and two school teachers each time.

Also UEMC in connection to Association Mazingira extended its programs to communities where 14 villages (Signali, Nkasu, Kiberege, Kisawasawa, Ichonde, Mgudeni, Mwaya, Mang'ula A,

Mang'ula B, Sole, Sonjo, Mkula, Sanje and Msufini, were visited and environmental education were provided.

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

- training to 14 villages (70 people) about establishment of tree nurseries;
- training to 42 farmers from 14 villages on agro-forestry;
- supplying gardening tree nursery tools to 14 villages;
- establishing 14 tree nurseries in these same villages;
- pivoting adoption of energy-saving stoves;
- facilitating the establishment of community groups, especially women, for implementing new activities. In particular, in 2013 a component of energy efficiency has been enhanced.

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

Related to this, Trento Museum has begun in 2012 planning for supporting the design and realization of a new Visitor Information Centre at the park office premises, as provided for by the new MoU for management of UEMC.

7. Activities planned for 2013 and strategic planning

UEMC plans to conduct the following activities in 2013:

- 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;
- in agreement with TANAPA's Ecological Monitoring Manager, conduct a 5-day training dedicated to ecologists from 7 forest National Parks, with a view to support standardization of monitoring protocols across forest parks; the training will be held during 19-23 August, 2013;
- conduct at the end of August 2013 the third edition of the summer school on field and GIS tools; at the time of writing this report, at least 15 international participants have registered;
- continue to support and facilitate the environmental education programme and the environmental cooperation activities by Association Mazingira, which during 2013 will include beginning to work with the park's Tourism Department to develop joined activities;
- related to this, Trento Musem through UEMC will propose an operational project and technical drawings for the establishment of the Visitor Information Centre at the park premises; the project will be submitted to TANAPA/UMNP for their input, recommendations and approval; fund-raising for implementation will ensue;
- continue and consolidate implementation of TEAM project, that will enter into its fifth year of monitoring.