



**Mathews Forest Range
Ecological Assessment
Summary Report
Namunyak Wildlife Conservancy
Samburu, Kenya June 2010**



Executive Summary

In general the species diversity and abundance was lower than any of the scientists expected. Tom Butynski, a primatologist, sums it up well: “As always seems to be the case in our surveys these days, we were more surprised by what we didn't find than by what we did find....and this raises all kinds of interesting questions.

There were, however, some new “records” found – butterflies, plants, frogs, birds that are known but have never been recorded in this area. These range extension records are an indicator of the lack of detailed biological inventory that has occurred to date in the Mathews. The forest has an endemic cycad which is found only in the Mathews. This cycad population is healthy with regeneration occurring in almost all sites.



Camera traps were set every night recording some incredible video of leopard, lion, hyena, elephant, genet, civet, bushbuck and porcupine. One of our camera traps was actually bitten (and destroyed) by a lion at our second forest camp.

The forest condition was quite diverse. The higher altitude forest (generally above 1800 meters) was in excellent condition with magnificent afrocarpus and podocarpus trees standing 200 feet tall with a closed canopy. In the lower forest and transitional zones with scrub vegetation there was more human impact from livestock grazing and honey harvesting in the forest than we expected. There is significant traditional honey harvesting which kills bee colonies. Livestock grazing and cutting tree branches for fodder for livestock (leaves) has had a serious impact on the condition of forest habitat in many areas. The understory is filled with thick vegetation – pioneer species that respond to gaps in the forest from cutting of branches and continued grazing pressure. The main threats to the forest are honey harvesting, livestock grazing and cutting fodder and fire.



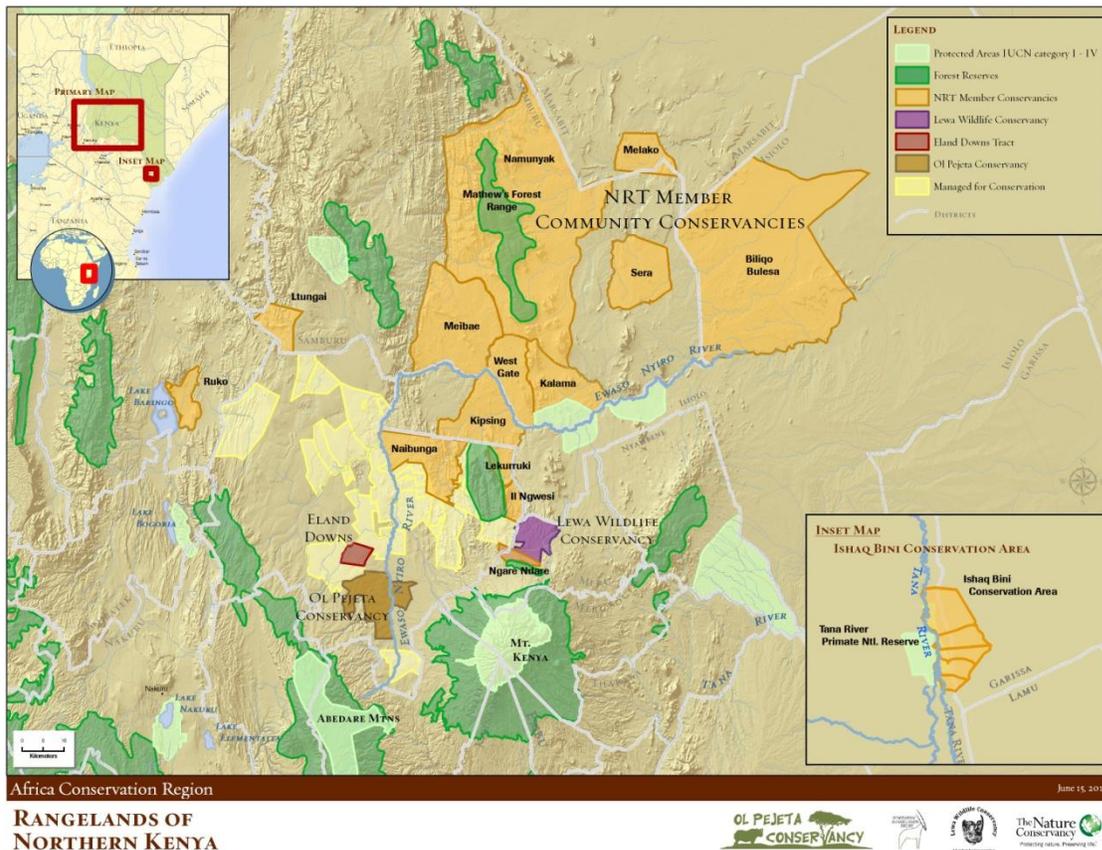
It has been a difficult few years with the drought - the elders who joined the assessment told stories of livestock numbers decreasing from around 200 per household to 40. But they all felt the ability to come into the forest and graze kept their livestock and thus them, alive. Clearly the future is about managing this balance between the needs of people and needs of the forest.

Future management recommendations include: continued monitoring, secure a co-management agreement with Kenya Forest Service, implement forest zoning and management plan to address grazing and fire, increase awareness and education of forest value and enterprise development – livestock, honey production, tourism. By implementing activities which support these key strategies, the Mathews Forest will continue to provide valuable ecosystem services for people and wildlife and be maintained as one of the most in-tact examples of the east african montane ecoregion.

Introduction

The Mathews Forest was originally gazetted in 1956 and declared a Kenya Forest Reserve in 1964. When gazetted the forest was recorded as approximately 97,400 ha (487,786 acres) of which 25% was closed canopy forest, 50% mixed forest and 25% was shrub or grassland. Results from this assessment agree with a previous Kenya Indigenous Forest Conservation Program (KIFCON) assessment in 1994 size the forested area of the Mathews Range at 32,085 hectares.

The Mathews is characterized by steep topography and granite outcrops that make most of the area inaccessible. The highest point of the Mathews Range is Warges Peak which stands at 2,688 meters above sea level. The forest is known for being in the best condition of all the sky island forests in northern Kenya. This is primarily due to its remote location, rugged steep terrain which precludes easy access and traditional compatible use of the forest.



The Mathew Forest is surrounded by Namunyak Wildlife Conservancy (a member of Northern Rangelands Trust) and provides many benefits to the Samburu pastoralists living in the region. The forest is the source of water, honey, medicinal plants, grazing and fodder for livestock and for these reasons; people do not live inside the forest. It is respected by the elders as a valuable resource which helps sustain life in the dry savanna below the forest.

In order to better manage this critical resource in the future, we wanted to find out more about its biodiversity and current ecological condition. What is the species diversity and abundance? What is the level of pressure? How degraded or intact is the forest? Is the condition uniform or are there hotspots of pressure? How do the Samburu view this resource and how best can we help them manage it for the long

term? What are the drivers of pressure? We narrowed these questions into 5 objectives of the ecological assessment.

Objectives of Ecological Assessment

1. To document biological diversity of Mathews Range
2. To document current habitat condition and define level of threat (degradation)
3. To identify key indicator species and areas in which to focus long-term community-based monitoring
4. To transfer that knowledge and the methods to measure biological diversity to Namunyak conservancy scouts
5. To document traditional use and cultural attachment to the forest and its resources

Research Teams

Team 1: Butterflies/Dragonflies/Insects - Dino Martins (Insect Committee of Nature Kenya)

Team 2: Primates/Birds/Mammals – Tom Butynski and Yvonne De Jong (Eastern Africa Primate Diversity and Conservation Program)

Team 3: Vegetation – Quentin Luke (Miami Botanic Gardens)

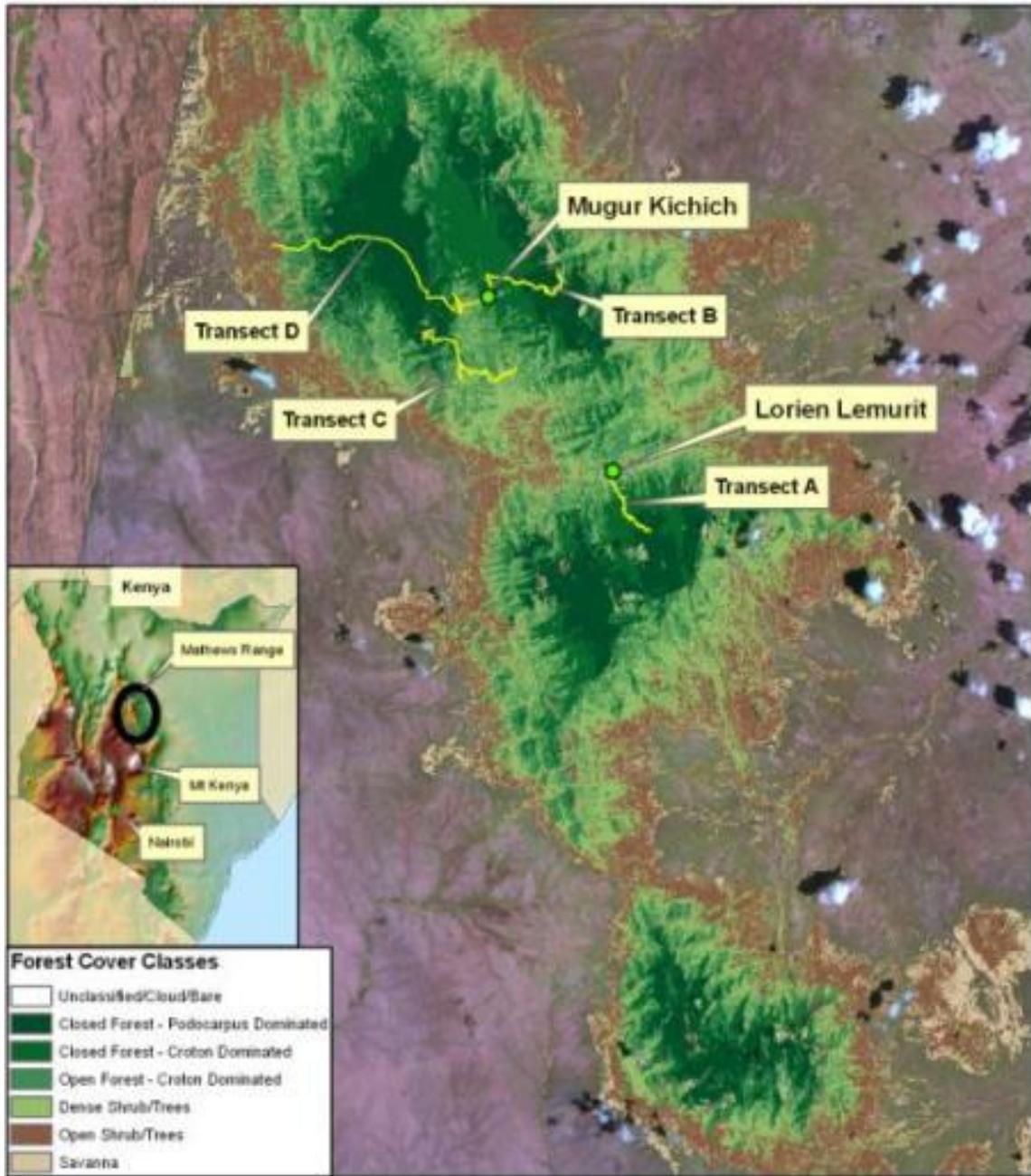
Team 4: Small mammals – Judy Mbau (National Museums of Kenya)

Team 5: Reptiles and Amphibians – Patrick Malonza (National Museums of Kenya)

Team 6: Vegetation and disturbance mapping – Tim Boucher and Matt Brown (The Nature Conservancy), Juliet King and Dominic Lesimirdana (Northern Rangelands Trust)

Methods

Each research team had a Namunyak elder and a Namunyak armed scout with them at all times to guide their way through the forest. While we tried to keep the numbers low we were about 35 people in camp every night. We had two base camps (Lorien Lemurit and Muger Kitich) that we used with several fly-camping excursions from each base camp. The assessment was 12 days long with approximately 6 nights in each camp.



Results

Summary results for each research team are presented below. Detailed reports from each research team are available.

Team 1: Butterflies and Dragonflies/Damselflies – Dino Martins

Butterflies

A total of 125 different butterfly species were observed during the survey. This figure represents about 15 % of the total Kenyan butterfly fauna. The butterflies observed came from five different families within the order Lepidoptera. This is a significant number of species for a remote and old range that is surrounded by arid conditions – yet other forests in Kenya have higher diversity (Shimba Hills with 35% of Kenya's diversity and Kakemega Forest with 35-40% of Kenyan species). Most of the forest-dependent species that are known to be restricted to relatively undisturbed forest were recorded in average numbers. For example, only two individuals of the Regal Swallowtail, the largest butterfly in Kenya, were seen during the survey. Other forest species that were seen in low numbers are the Kenya Bush Brown (rare Kenyan endemic) and the White-banded Swallowtail. This suggests that there are some areas of forest that experience high disturbance during droughts and that forest areas are regenerating post high usage during the 2009 drought.

A few forest-dependent species were seen in slightly better numbers, such as Trimen's False Acraea, which breeds on tall, forest trees in the family Sapotaceae. About 10-20 individuals were seen daily during the survey.

Dragonflies and Damselflies

A total of 17 different dragonfly and damselfly (Odonata) species were observed which is lower than expected. It was evident that the stream ecology had been highly impacted by the drought. This is likely to be both from reduced flow as well as high numbers of livestock using the streams and rivers resulting in lowered water quality (especially oxygenation), which is vital for the survival of the aquatic Odonata larvae.

It is expected that Odonata numbers and diversity will increase given the good rains and the ability of them to move from deeper isolated streams in the forest into the major streams and rivers. As long as the habitat remains intact and uncontaminated, these insects are fairly resilient. One species of dragonfly, the Globe Skimmer (a migratory species) was found away from rivers in glades and bush. This is an interesting species that has recently been found to migrate from India through the Maldives and Seychelles to East Africa. Given its abundance at the Matthew's Range this suggests that the forests and streams there are an important breeding site for this species.

Honey Bees

The main insect that was observed to be threatened within the forest is the honeybee. There appear to be two sub-species of the African honeybee present in the forest: *Apis mellifera scutellata* and *Apis mellifera monticola*. This in itself is very exciting as the subspecies *Apis mellifera monticola* is more typical of high altitudes on Mt Kenya, the Aberdares and Mt Elgon. It is a fairly gentle bee that has very large colonies and produces a lot of honey.

The main threat to honeybees is the destructive harvesting of wild colonies for honey. The nature of harvest involves burning/smoking out the bees, killing most of them in the process. This form of wild harvest is totally unsustainable and extremely unhealthy for both the honeybees and the forest. The losses from this practice include not just reduced wild honeybee genetic diversity, but also reduced seed-set and fruit production by native plants when honeybee numbers are reduced, as a result of reduced pollination. Damage to the forest also results from the fires that are started to smoke out bees. For example, on the walk from the first campsite to the higher forest over 20 trees damaged by this

practice were observed. Wild harvesting of honey is also a major cause of forest fires and at least two areas of forest damaged by this were observed during the survey.

In terms of honeybee foraging patterns, on the whole low numbers of honeybees were seen foraging from flowers like *Vernonia brachycalyx*, where one would typically expect to find large numbers of bees visiting.

Team 2: Primates/Birds/Mammals – Tom Butynski and Yvonne De Jong

Primate diversity and density (biomass) in the Mathews are low. However, according to elder Lpaasion Lesipih, the abundance of primates in the Mathews is higher today than 40 years ago. All primate groups encountered were afraid of humans, suggesting that the hunting of primates continues to be practiced.

Six species of primate are known to occur in the Namunyak Wildlife Conservancy; small-eared greater galago *Otolemur garnettii*, Somali galago *Galago gallarum*, Mt. Uarges guereza *Colobus guereza percivali*, de Brazza's monkey *Cercopithecus neglectus*, Hilgert's vervet monkey *Chlorocebus pygerythrus hilgerti*, and olive baboon *Papio anubis*. Of these six species, five occur in the Mathews Range Forest Reserve (small-eared greater galago, colobus guereza, de Brazza's monkey, hilgert's vervet monkey, and olive baboon) with the first three being 'forest-dependent' species.

With three forest-dependent primate species, the Mathews Range compares favorable with the other highland forests in Kenya that lie to the east of the Eastern Rift Valley, including those of Mt. Kenya (three species) and the Aberdares Range (three species). Except for olive baboon, all species of primate in the Mathews Range/Namunyak Conservancy are at low density relative to many other sites. The Senegal galago *Galago senegalensis* and the Sykes's monkey *Cercopithecus mitis*, two species expected to occur in the Mathews Forest Range were not recorded. The Sykes's monkey is almost certainly absent from the area. Additionally, the potto *Perodicticus potto* was not encountered in the Mathews Range.

One of the six primates in this region, colobus guereza, is represented by an endemic, 'Endangered', subspecies (*C. g. percivali*; IUCN 2010). The other five species are listed as 'Least Concern'.

Threats to the primates of the Mathews are habitat degradation due to human activities, including livestock grazing within the forest and along rivers, harvest of cattle fodder (by the cutting of trees and tree limbs) during the dry months, burning of forest and swamp vegetation, and hunting (especially of colobus guereza). Other threats include excessive drought and diseases.

This assessment is the first to record (1) small-eared greater galago in the Mathews Range, thereby extending its geographic range ca. 80 km to the north; (2) the presence of de Brazza's monkey more than 2 km away from a permanent water source; (3) groups of olive baboon that spend all of their time within the forests; (4) Somali galago that occupy degraded woodland bordering swamp and bushland; (5) the use of tree holes by Somali galago as resting sites and; (6) and Somali galago as high as 1250 m asl.

Fifty-one species of large- and medium-sized mammals were observed on, or reported for, Namunyak Conservancy. Of these, at least 29 species occur in the Mathews Range. Three of the 51 mammal species are on the Red List (IUCN 2010). as 'Endangered', two as 'Vulnerable', five as 'Near Threatened', and 39 as 'Least Concern'.

A total of 153 species of birds were encountered during this survey, 35 of which are forest dependent species. None of the 153 species is on the current IUCN Red List as threatened. Significant range extensions were made for red-fronted parrot *Poicephalus gularis* and woodland kingfisher *Halcyon senegalensis*.

Team 3: Vegetation – Quentin Luke

Previous studies reported a plant list of 902 species in the Mathews Forest Range. Quentin Luke brought that list to 1036 with 97 new records for the Mathews Range. Five plant species have Red Listing Status. Although most cycads have some threat status, the endemic cycad *Encephalartos tegulaneus* ssp. *tegulaneus* is presently rated as Least Concern (LC). Throughout the survey this attractive ‘dinosaur’ tree was encountered in large numbers and very healthy regeneration (seedlings) was noted. However, it is imperative that monitoring and protection is initiated. Some individuals seen were around 9m tall and, if only one leaf-scar ring is produced each year, would be over 600 years old.

High elevation vegetation was in fantastic condition, but much of the mid and lower forest vegetation has serious impact from grazing and fire with thick un-natural undergrowth. The severe drought in 2009 left plenty of evidence, in the area of the Mathews surveyed, of branch lopping to provide fodder for stock. Species targeted were mainly *Olea* spp., *Chionanthus* spp. and *Craibia laurentii*. Although it can be assumed that all the undergrowth in the mature forest was completely grazed (mainly *Commelina benghalensis*), the good rains earlier in 2010 meant that the health of the forest had more or less recovered.

The most serious impact observed was that of historical fire damage. Large areas of (presumably) once closed-canopy forest has been converted to impenetrable thickets of *Smilax* spp., *Triumfetta* spp. etc. It is this degradation of the vegetation that needs most attention. The main forest on the mountain tops was of superb condition and with a high degree of regeneration.

Team 4: Small mammals – Judy Mbau

Unexpectedly, both the diversity and relative abundance of small mammals in general was low. Similar mountain ecosystem like Nuu hills in Kitui (Malonza et al., 2006) high canopy forests like Mt. Elgon (Agwanda & Mbau., 2007), Maasai Mau forest (Mbau & Kanga., 2008) and Mt. Kenya (Musila, et al., 2009) registered a higher diversity of small mammals compared to the Mathews range. Most of the species caught have biogeographic affinity to the coastal fauna including Taita hills. High level of grazing pressure has been observed to have a negative impact on the species diversity and abundance of small mammals and is likely the cause of low diversity and abundance during this assessment.

Three species of fruit bats were caught from the high canopy forests of the second site. The presence of *Stenonycteris Lanosus* fruit eating bat and the Heart-nosed bat gives an insight into the importance of Mathews range for the conservation of bats in the country. The species are sparsely as well as irregularly distributed and their dependency on caves calls for their protection. The three species of fruit bats are ecologically important pollinators (Taylor, 2000) thus serve to enhance forest regeneration and re-forestation. Thus generally the presence of both fruit bats and insectivorous bats in the ecosystem serves to enhance important ecosystem services of pollination and insect control (Kalka & Kalko, 2006).

Team 5: Reptiles and Amphibians – Patrick Malonza

After a total of 114 (wetlands 55, Bush-lands 19, Forest 40) samples or time-limited searches a total of 23 species (7 frog, 13 lizard and 3 snake species) were recorded in the Mathews Range. Of these only 13 were found in the forest. In comparisons with other similar ecosystems the diversity is lower than that of the Taita Hills though the latter have been studied for a long period. Further herpetofauna study of the Mathews Forest is needed as the species accumulation curves did not plateau or reach asymptote meaning that more species could be detected with additional sampling.

Two range extensions in Kenya were found for the Jackson's Black tree snake *Thrasops jacksoni* and the Northern clawed Frog *Xenopus borealis*.

Of particular importance is the single chameleon recorded which seem to be a potential new species since its photographic appearance does not fit well to the already described species in the northern mountains range. East African montane forests have been found to act as refugia for chameleons consequently leading to their vicariant distribution in isolated mountains. These relict montane forests relatively provide stable environments which may lead to speciation.

Apart from the occasional burning down of trees by wild honey harvesters in the forest that can result to uncontrolled wild fires during the dry season, there was no observable and immediate threat to reptiles and amphibians in the forest. The inhabitants of this area are purely pastoralists and their livestock grazing seem currently compatible with herpetofauna survival.

Team 6: Vegetation and disturbance mapping – Tim Boucher, Dominic Lesimirdana, Juliet King, Matt Brown

The assessment found many impressive stands of intact forest at higher elevations (mainly above 2000 meters). Pristine tracts of *Podocarpus* dominated forest were found on both the middle and northern sections of the range. Although the southern section of the Mathews Range was not assessed (due to time limitations and previous detailed assessments), it could be seen from distant observation (through binoculars), that the southern section forest was intact as well.

At lower elevations (between 1500 meters and 1800 meters), the *Croton* dominated forest was pristine in parts, but extensively used for grazing for the majority of the area. Many trees had limbs cut off for fodder, but the trees not destroyed (only one species was used for fodder). Very thick understory growth occurred at this elevation, mainly caused by intense grazing and very heavy rains over an extended period (3 months) before the assessment.

For this analysis, we classed vegetation into three forest types, two shrub types, and a savanna class (the vast majority of the savanna was not delineated outside the range area). The vegetation classes are as follows: Closed Forest - *Podocarpus* Dominant; Closed Forest – *Croton* Dominant; Open Forest – *Croton* Dominant; Dense Shrub with Trees; Open Shrub with Trees; and Savanna. The forested vegetation was dominated by *croton* species. The breath-taking closed canopy *Podocarpus* forest was all at high elevations and showed little disturbance from timber harvesting, grazing or cutting of fodder.

Forest Cover Area

	hectares	percent
Closed Forest - <i>Podocarpus</i> Dominant	8,532	27%
Closed Forest - <i>Croton</i> Dominant	9,916	31%
Open Forest - <i>Croton</i> Dominant	13,637	43%
Total Forested Area	32,085	

Disturbance

In general, there is relatively little disturbance of the forest canopy compared to other small forested areas in Kenya. Understory disturbance is widespread and quite severe in times of drought. Grazing was noted at all elevations – including the highest parts of the range (including very small clearings used as livestock stockades (“Bomas”). This has lead to an extremely dense understory in places, with undesirable and unpalatable shrubs dominating. Grazing should be curtailed, or even be off limits in some of the higher,

more biodiverse places in the Mathews (especially in the northern section). Grazing should be especially limited along water courses – not only to protect the streams, but also to keep the water clean.

Forest Change

Comparison to older Landsat images (1986 and 2000) has shown that there is very little large scale change – no major amount of tree felling – either selective or clear cutting. The forest extent and boundaries seems to be relatively stable – perhaps unique when compared to other forested areas in Kenya.

Forest Condition / Threats

As discussed above, the forest is in good shape overall but has locations with severe degradation from lack of management. The major threats to the Mathews forest are lack of grazing and fire management. The forest is currently threatened by high levels of livestock grazing during the dry season when the surrounding areas cannot sustain the large herds of livestock and water is scarce. Uncontrolled fires caused mainly by honey harvesters are taking their toll on understory vegetation and dramatically changing the vegetation composition of this understory.

Additionally, the viability of bats is threatened by human use of caves, which are important roosting sites in the Mathews Forest Range. Additionally, there is some concern over poaching of wildlife – particularly hunting of the Colobus monkey.

Conservation Management Recommendations

There are several management recommendations that are offered in hopes of better preserving the biological diversity and ecological services of the Mathews Forest for current and future generations. These recommendations will be presented to Namunyak Wildlife Conservancy who will ultimately decide how they want to manage this resource in coordination with Kenya Forest Service.

1. **Co-management with Kenya Forest Service.** A clearly defined management agreement with the Kenya Forest Service to document and recognize Namunyak's stewardship / protection responsibility is needed. Without this management agreement, Namunyak scouts do not have enforcement authority when illegal activities are found.
2. **Zoning of the forest and implementation of a revised management plan.** Creating different management zones and management activities within the forest to allow grazing use and fodder cutting in a limited area and time during drought conditions will help protect the more sensitive areas. Planning more careful use of streams that are deemed to be sensitive and high in biodiversity and critical for reptile, amphibian and insects as well as ecosystem services for people in the long term. This approach can go hand-in-hand with water resources management and is very complimentary to sustainable use of the forests' water resources.
3. **Improve grazing management in grasslands and livestock program.** By improving grazing management in the grassland below the forest, the rangeland condition will improved which will lead to less pressure in the forest during dry times of the year. Improved grazing management in Namunyak could be incented by a livestock purchase program that NRT is piloting. A properly managed, sustainable, livestock production program with access to markets could help address issues of overgrazing and help rehabilitate critical rangelands in order to help produce sustainable livelihoods by increasing overall productivity.

4. **Fire management.** Prevent fires in the Mathews, or at least greatly reduce the incident of fire. This would (1) allow the forest to regenerate and support the most threatened of the species of this area, and (2) allow at least partial recovery of this vital watershed. The large areas of unproductive tangled thicket should be used in education programs to demonstrate the folly of the abuse of fire. Experimental rehabilitation of some of these thickets could be of immense economic benefit in the future.
5. **Invest in managed honey production.** Establishing of managed honeybee hives at suitable spots along the edges of the forest. Providing of hives will reduce pressure on the wild honeybees colonies, preserve their very precious wild honeybee genetic diversity and help supplement pollination services in areas where the hives are located leading to increased fitness of plant communities. This is both a threat reduction and income generation strategy.
6. **Continue longer-term monitoring of species.** This will provide valuable information on species trends, add to the diversity checklist, account for seasonal variability and also reveal any rare, endemic or threatened species within the forest. Additionally, continued monitoring will allow for the evaluation of conservation actions and help guide adjustments to these actions.
7. **Education and awareness of forest users.** Through the longer term monitoring of insects and the potential bee-keeping projects this could serve as a means to further understanding of the forest and highlight the importance of the forest and its many contributions both as a sanctuary for biodiversity and a component of sustainable human livelihoods. There is a lot of local knowledge and forest awareness that can be built on here. For example, some 'managed' honeybee hives were found in the forest where hollow trees were partially sealed with stones and the hives visited again and again to harvest honey. This could serve as an entry-point to building better beekeeping around the forest.
8. **Control Poaching.** Stop the hunting of *Colobus guereza*---an internationally recognized 'Endangered' subspecies. It might be possible to find alternative, sustainable, material ('fake fur') to replace the black-and-white pelt of this monkey as now used in traditional ceremonies. This attractive monkey, which people can view at some sites, should serve as the 'flagship' species for the Namunyak Conservancy.
9. **Ecotourism.** Expand the ecotourism program for the Namunyak Conservancy to include wilderness hiking and over-night camping in some of the more remote parts of the Mathews Range. Well-trained, 'natural history guides' would add to this 'wilderness experience'.
10. **Protect caves for bat roosting.** Local samburu communities need to be enlightened on the negative impacts of their long held traditional beliefs which force the Morans to make use of the caves. It will be important that the Moran are encouraged to use alternative areas for shelter and cooking activities other than using the caves. Some of the caves, other than being roosting sites, are well located along the tourist route and if well managed can serve to enhance tourism in the area. In addition, the conservation of bats in the area can be enhanced by use of bat boxes which serve as alternative roosts in the face of disturbance of their natural roosting sites.

Conclusion

The forest assessment was viewed as a success because we met our objectives and learned more about this forest resource— what it has, how it functions, the historic and current condition and use of the forest and some excellent ideas generated about how to monitor and manage it better for the long term. There was great value in doing this as a multi-disciplinary effort as teams could share ideas and concepts in a more fruitful way than if each one was conducting an inventory in isolation. Additionally the researchers had the opportunity to work side by side Namunyak scouts to expose them to inventory methods.

The Mathews Forest is in good condition but has significant impact from grazing and fire that will erode the viability of this system over time. While it is critical to maintain human use of this resource, it must be managed better in order to protect the services this forest provides for current and future generations.

Acknowledgements

Many thanks to Namunyak Conservancy for supporting this inventory with scouts, logistics and knowledge – particularly to Tom Lesarge, Namunyak Conservancy Manager – for his leadership and interest in the assessment. All the research teams completed their assignments with dedication and professionalism even though many of them spent their valuable time hacking through thick understory vegetation. The assessment could never have happened without the leadership and dedication of Dr. Juliet King. We are all indebted to her for coordinating daily logistics of food, transport, radio communications and local guides.

References

- Agwanda, B. 2001. A survey of Chiropteran (Bats) community of dry-land, Taita. Technical report, National Museums of Kenya.
- IUCN 2010. *The IUCN Redlist of Threatened Species*. Website: www.iucnredlist.org.
- Kalka, M. & Kalko E.K. 2006. Gleaning bats as underestimated predators of herbivorous insects: diet of *Micronycteris microtis* (Phyllostomidae) in Panama. *Journal of Tropical Ecology* **22**:1-10.
- Malonza, P.K., Muasya, A.M., Lange, C., Webala, P. Mulwa, R.K., Wasonga, D.V., Mwachala, G., Malombe, I., Muasya, J., Kirika, P. & Malaki, P. (2006). Biodiversity assessment in dryland hilltops of Kitui and Mwingi districts. National Museums of Kenya
- Mbau J.S., & Kanga E. M.(2008). Mammals of Maasai Mau Forest ecosystem. In; Githiru M., Musila W., Kanga M.E., Malonza P., Warui C. Maasai Mau Forest Biodiversity assessment Technical Report. Kenya Forest Working Group, Nairobi. Published in Nairobi Kenya in 2008 by Kenya Forest Working Group.
- Musila W., Githiru M., Kanga M.E., Warui C., Malonza P., Njoroge P., Gikungu M., Mbau J., Nyingi D., Malombe I., Kibet S., & Nyaga J. 2009. Mt Kenya Forest Biodiversity Assessment, Technical Report. Kenya Forest Working Group, Nairobi. Published in Nairobi Kenya in 2009 by Kenya Wildlife Service.
- Taylor, P.J. 2000. Bats of Southern Africa; Guide to Biology, Identification, and Conservation. University of Natal Press, South Africa.