CEPF SMALL GRANT FINAL PROJECT COMPLETION REPORT

I. BASIC DATA

Organization Legal Name: Miami University, Department of Geography

Project Title (as stated in the grant agreement): Ethnobotanical Knowledge for Adaptive Collaborative Management at Mt. Kasigau, Kenya

Implementation Partners for This Project:

Project Dates (as stated in the grant agreement): May 1, 2005 – August 31, 2007

Date of Report (month/year): September 2007

II. OPENING REMARKS

Provide any opening remarks that may assist in the review of this report.

I am providing comments on this form as a supplement to the final report submitted on the project. The project report is attached, along with a copy of the final budget and one appendix.

III. NARRATIVE QUESTIONS

1. What was the initial objective of this project?

My study investigated indigenous knowledge of plant resources around Mt. Kasigau, Kenya, a Key Biodiversity Area (#89) in the Eastern Arc. The study objective contributed directly to Strategic Funding Direction 3, "Improve knowledge of the biodiversity hotspot," under Investment Priority 3.5 to "compile and document indigenous knowledge" on the diversity, distribution, and conservation status of timber and non timber woody plant resources. I addressed two primary objectives:

1. Document the diversity and distribution of valued timber and non-timber plant resources to local populations at Mt. Kasigau;
2. Identify local perspectives on the opportunities and constraints for the sustainable use of valued plant resources.

2. Did the objectives of your project change during implementation? If so, please explain why and how.
My objectives did not change and included the collection of ecological and ethnobotanical data on wild woody plants in bushland, montane woodland, and evergreen forest on the mountain.

3. How was your project successful in achieving the expected objectives?
The project built directly on earlier ethnoecological research on the mountain and gained much knowledge on the woody flora (338 wild woody plants in 74 families and 208 genera), Kasigau Taita names (for 252 plants) and plant uses (205 species in 59 families

and 132 genera). Additionally, I now have ecological data on the composition and structure of woody plants from a total of 55 plots distributed in bushland, woodland and evergreen forest that provide important data on the distribution and relative abundances of valued woody plant resources. Please see the report for a more detailed description of the research findings.

4. Did your team experience any disappointments or failures during implementation? If so, please explain and comment on how the team addressed these disappointments and/or failures.
I remained overwhelmed by the hospitality and assistance I received from the community residents at Mt. Kasigau and staff at the East African herbarium. I also was grateful for the collaborative assistance provided by Roy Gereau. I regret that the time I had to spend in the field was limited, because I realize that the seasonal changes do influence greatly the relationships the Kasigau Taita have with plant resources. The December trip in 2006 was a great contribution to the success of the project. I also wish I would have had time to attend the workshops and conferences that were held to discuss monitoring methods and important findings from the research. The listserve certainly helped to convey that information.

5. Describe any positive or negative lessons learned from this project that would be useful to share with other organizations interested in implementing a similar project.
By coupling the ecological research with conversations about plants and their uses, I learned much about the historical ecology of the region. The history of landscape utilization practices and the reasons for changes in those practices are very significant to the current distribution of forest resources, their diversity patterns, and conservation status.

6. Describe any follow-up activities related to this project.
I am currently focusing on the publication of the research findings and compiling results from the research that can be shared with the local communities. I submitted one paper to the Journal of East African Natural History on the ethnobotany, prepared a poster on the altitudinal gradient in plant resources, and published papers on earlier research funded by National Geographic Society. When I began the project, I had compiled with a graduate student, botanical consultants, and the village residents, a guide to woody plants. During the CEPF project, we were able to edit the descriptions and photos provided in the book, and I plan to incorporate this information in a revised copy. I will be looking for funding to support the distribution of a revised guide, possibly by May 2008.

7. Please provide any additional information to assist CEPF in understanding any other aspects of your completed project.
Please see the attached research report where I describe some conservation implications of the research.

IV. ADDITIONAL FUNDING

Provide details of any additional donors who supported this project and any funding secured for the project as a result of the CEPF grant or success of the project.

Donor	Type of Funding*	Amount	Notes

Additional funding should be reported using the following categories:

- ***A*** *Project co-financing (Other donors contribute to the direct costs of this CEPF project)*
- ***B*** *Complementary funding (Other donors contribute to partner organizations that are working on a project linked with this CEPF project*
- ***C*** *Grantee and Partner leveraging (Other donors contribute to your organization or a partner organization as a direct result of successes with this CEPF project.)*
- ***D*** *Regional/Portfolio leveraging (Other donors make large investments in a region because of CEPF investment or successes related to this project.)*

V. ADDITIONAL COMMENTS AND RECOMMENDATIONS

VI. INFORMATION SHARING

CEPF is committed to transparent operations and to helping civil society groups share experiences, lessons learned and results. One way we do this is by making programmatic project documents available on our Web site, www.cepf.net, and by marketing these in our newsletter and other communications.

These documents are accessed frequently by other CEPF grantees, potential partners, and the wider conservation community.

Please include your full contact details below:

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Final Report
Critical Ecosystem Partnership Fund for the Eastern Arc and Coastal Forests

Ethnobotanical Knowledge for Adaptive Collaborative Management at Mt. Kasigau, Kenya
Conducted in Affiliation with the East African Herbarium, National Museums of Kenya
Approved by the Kenya Ministry of Education, Science and Technology, 31 May 2005,
MOEST 23/001/17C 24

Kimberly E. Medley
Department of Geography
Miami University, Oxford, Ohio USA

Project Duration: May 2005- August 2007

Project Description

I report on a study that investigated indigenous knowledge of plant resources around Mt. Kasigau, Kenya, a Key Biodiversity Area (#89) in the Eastern Arc. My study contributes to Strategic Funding Direction 3, "Improve knowledge of the biodiversity hotspot," under Investment Priority 3.5 to "compile and document indigenous knowledge" on the diversity, distribution, and conservation status of timber and non timber woody plant resources (CEPF 2003). I focus on the taxonomy and ethnobotany of 'wild' woody plants that occur naturally (i.e., were not planted) on the landscape and my analyses integrate measures of species richness and ecological structure along an altitudinal gradient that includes the lowland bushland vegetation (at mostly <650 m), montane woodland (650-1000 m), and evergreen forest (>1000 m). The study provides a unique opportunity to view "natural resources through the eyes of resource users" in a way that links "scientific and folk knowledge" (see Cunningham 2001, pp. xiii-xv) and thereby encourages adaptive collaborative management as an interactive planning approach that involves local communities and their knowledge about a place as important stakeholders in resource conservation (Little 1994, Buck et al. 2001).

A Participatory Research Approach

During the project period, I made two visits to the site from the end of May to early July in 2005 and 2006, and one field visit in December 2006. I employed participatory research techniques that focused on shared learning, built collaborative relationships between the researchers and the researched and validated local knowledge for adaptive management plans (Slocum et al. 1998; Cunningham 2001). Most plant surveys were conducted while walking to and working in ecological sample plots where we measured large trees greater than 10 cm diameter at breast height (dbh, 0.1 ha plots) and understory small trees, shrubs, and woody vines that were >1 m ht and <10 cm dbh (200 m^2 plots). Under the CEPF grant, 35 plots were added to the 20 already established in the bushland and on the mountain (Figure 1; Appendix). Village residents at Mt. Kasigau and botanical consultants at the East African Herbarium were critical to the success of the project. First, I worked with one key informant (Mr. Zaphania Mwandoe) and a field assistant (Moses Mwamodo) from Jora village throughout the research. They recorded with me the local names and uses of plants and confirmed agreements and disagreements among local experts in the different villages. Second, I hired at least one local expert and assistant from each of the villages in order to share and compare local knowledge about plant resources and gain collaborative skills on the collection of the ecological data. Third, I walked several transects with village experts and assistants from all the villages and a botanist from the East African Herbarium in order to compare local and scientific names for plants and confirm the vouchers collected for the study. Fourth, I conducted home surveys, semi-structured interviews, and participatory observations with village residents on the extraction, use, and sales of woody plant resources in order to explore their relative values. Fifth, I facilitated landscape/resource mapping exercises in Bungule and Kiteghe villages, following methods similar to those used to compile the maps for Jora and Makwasinyi (Kalibo & Medley in press), and elaborated on the naming of resource locations with the local experts and field assistants. These techniques were used to 'triangulate' findings from multiple methods as a way of confirming the names

and uses of plants (Medley & Kalibo 2005) and they also provided many opportunities for shared learning about plants and the landscape evaluation of woody plant resources at Mt. Kasigau (Medley & Kalibo 2007). The study began with a draft field guide to "Some Kasigau Woody Plants and Their Uses" that provided an important tool to explain and discuss the research, and guided the collection of plant vouchers and photos showing woody plant resources representative of the five village locations. We worked together on the compilation of plant knowledge that would effectively revise the guide.

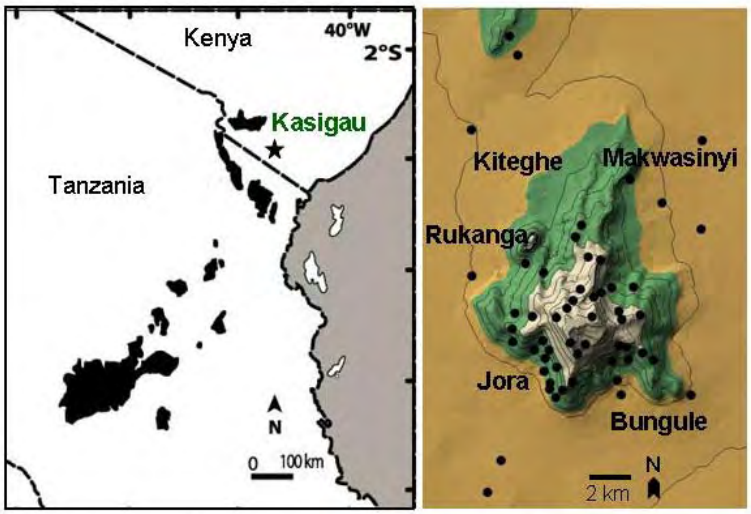

Figure 1. Location of Mt. Kasigau in the Eastern Arc and the ecological plots in bushland (<650 m, brown), montane woodland (650-1000 m, green), and evergreen forest (>1000 m, gray).

1. Document the diversity and distribution of valued timber and non-timber plant resources to local populations at Mt. Kasigau.

I submitted 460 numbered plant collections and many unnumbered vouchers and photos that were checked by botanical experts at the East African Herbarium (EA) and compared with other collections from Mt. Kasigau and the region (K7). These collections added to and extensively edited my earlier research at the mountain. My study focused particularly on the collection and confirmations of 'woody' plants as defined by Beentje (1994) in *Kenya Trees, Shrubs, and Lianas*, and the classification of 'wild' plants provided by Cunningham (2001). The ethnobotanical survey includes large trees (>10 cm diameter at breast height), small trees, shrubs/scandent shrubs (or woody herbs), and woody vines that were not planted where they occurred on the landscape (Medley & Kalibo submitted).

We now list 338 wild woody plants in 74 families and 208 genera identified during the ethnobotanical survey at Mount Kasigau (Medley & Wafula submitted). Several families, including Rubiaceae (31 spp. in 24 genera), Euphorbiaceae (26 spp. in 13 genera), Mimosaceae (20 spp. in 5 genera) and Burseraceae (10 species in 2 genera), and genera like *Acacia* (12 spp.), *Commiphora* (9 spp.), *Euphorbia* (9 spp.), *Grewia* (8 spp.), *Maerua* (7 spp.), and *Ficus* (8 spp.) are particularly diverse. Most of the plants (140 spp. in 41 families and 87 genera) occurred as trees, obtaining diameters of at least 10 cm dbh, but we also report a diversity of small trees (73 spp. in 33 families and 61 genera), shrubs and scandents (99 spp. in 36 families and 71 genera) and woody vines (26 spp. in 18 families and 23 genera). All but five of the plants reported from our survey of bushland, montane woodland, and evergreen forests are indigenous. Approximately 13% of the species on the list are identified as rare in the survey by Gereau et al. (2007).

The checklist includes plants that were observed on the transect walks, measured in the ecological plots, and mentioned during the participatory exercises conducted with local informants who could simultaneously describe whether the plant had a name or use. Local experts and village residents named

74% (252) of the wild woody plants and described uses for 205 (61%) plant species in 59 families and 132 genera. Kasigau Taita names for plants on the mountain are almost always different from those recorded for the Taita Hills (cf. Mbuthia 2003) and recorded during a one-day field visit to Sagala. For a few plants, they also vary among the villages on the mountain. For example, *Terminalia spinosa* is called muango and *Grewia forbesii* is called mwomubolo by residents in Makwasinyi and Kiteghe but these plants are called msaghano and mdonga, respectively, by residents from the other villages. Kishapughu was consistently provided by informants in Kiteghe as the name for *Psydrax schimperiana* subsp. *schimperiana* and ndido for *Apodytes dimidiata* var. *dimidiata*; the names were written down and accepted by the local experts from the other villages who had no names for the plants. Kasigau Taita names ("What is this plant called?") and their interpretation of plant names ("Why is the plant called this?) provide important insight on the local morphology and/or the taxonomy, local use, and local value of plants.

Plants with uses occurred as trees (107 species), small trees (29), shrubs/scandents (56), and woody vines (13). The checklist describes extractive material uses for food (77 plant species, 87 different uses), fodder (64, 66), construction (78, 96), technology (106, 183), remedy (80, 149) or fuel (66, 82) and non-extractive ecosystem services (63, 95). For these plants, we recorded a sum of 757 different uses and 533 use categories. About 70% of the plants were recorded with more than one use and about 6% of the plants had 10 or more uses. Most of the plants with uses occur in the montane woodland (85 species, 247 uses), most of the uses for plants occur in bushland (70 species, 337 uses), and many plants with uses occur between these two locations (34 species, 150 uses). Plants typically found in evergreen forest made up less than 7% of the plants with uses and less than 3% of the total uses recorded for the plants.

The relative occurrences of woody plants among the 55 ecological plots can be used to describe the ecological structure of plant resources at Mt. Kasigau (Figure 2). In these plots, I documented a total of 238 woody plants, measured as large trees (143 species) or small trees, shrubs, or woody vines (206 species, 95 are unique to the understory). Combining unique species occurrences for the two structural layers, average plot diversity is 20 (s.d. 6.1) with a high of 39 woody plant species for one evergreen woodland plot. At both structural layers highest species richness occurs in the montane woodland, showing a nonlinear trend with elevation, but much variation occurs within this zone between 650-1000 m. Changes in basal area for large trees and density for both structural layers show an increase with elevation toward high stature forest, but again the structural diversity among plots in the woodland zone is profound. Tree basal areas are high where *Commiphora baluensis* occurs in the lower montane woodland, and in the nearly monodominant stands of *Newtonia buchananii* in evergreen forest just above 1000 m; species richness is very high in evergreen woodland concavities at about 900-1000 m; and density is high at the canopy layer in the cloud forest just below the mountain's summit and in the understory of some woodland localities. Species richness and ecological stature, while corresponding to an altitudinal change in overall forest physiognomy (from deciduous woodland to evergreen forest) also show much variation within altitudinal zones that is explained by local topography such as differences between slope concavities and convexities and the history of human land use at those locations (Medley 2006). These plot data begin to show the very high diversity of forest community types around and on Mt. Kasigau that contribute to the biological significance of this mountain. Doctoral research by Christine Mutiti (2006; 2007; Ph.D. candidate at Miami University) focuses on vegetation diversity in the bushland and how remote sensing data may be used to further elucidate these patterns.

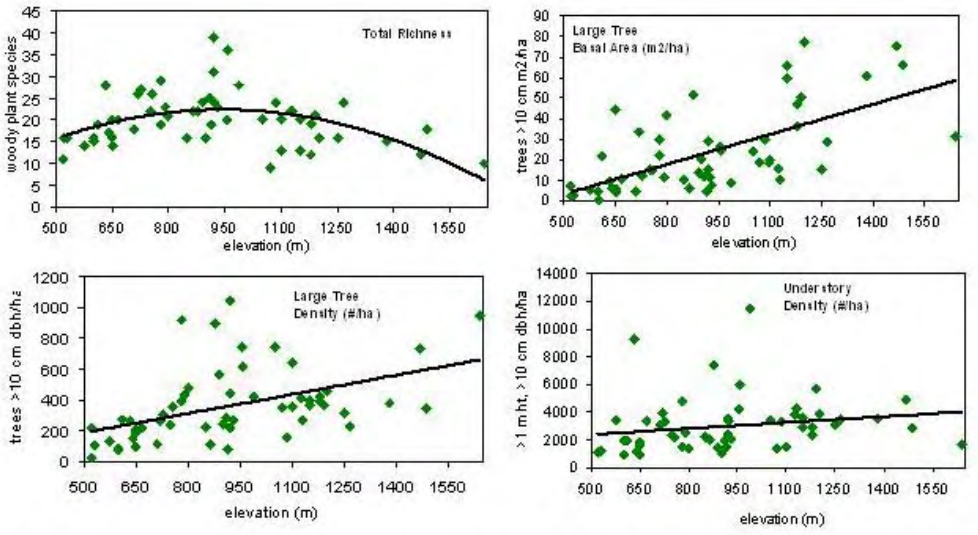

Figure 2. Ecological structure of the sample plots at Mt. Kasigau.

Among the 55 plots, the number of woody plants with uses (combining unique species measured as large trees and in the understory) averaged 14 (s.d. = 8) and the mean number of uses is 65 (s.d.= 45; Figure 3). Recognized resources at both structural layers are highest at the mountain's base between the bushland and montane woodland. Resource diversity correlates mostly with species richness (r^2=0.60 for all woody plants; r^2=0.85 for large trees; Figure 3, Medley 2007), but the positive relationship with richness is weakened by the occurrence of some trees in the woodland and bushland that have a large number of uses (e.g., *Zanthoxylum chalybeum* with 16 uses; over 10 uses for some of the *Acacia* spp.) and the very low occurrence of uses identified for trees in the evergreen forest. Resource extraction levels are currently highest in the bushland, but the diversity of trees with uses and the occurrences of woody plants for particular uses are very high in some montane woodland patches (Figure 4). These sites are characterized by physical-environmental conditions that support high species richness and also human-historical conditions, like the location of old settlements that hypothesize a past reliance on plants at these locations. These spatially-explicit data can be used to locate and monitor the occurrences of certain trees of high value as they are distributed across the region.

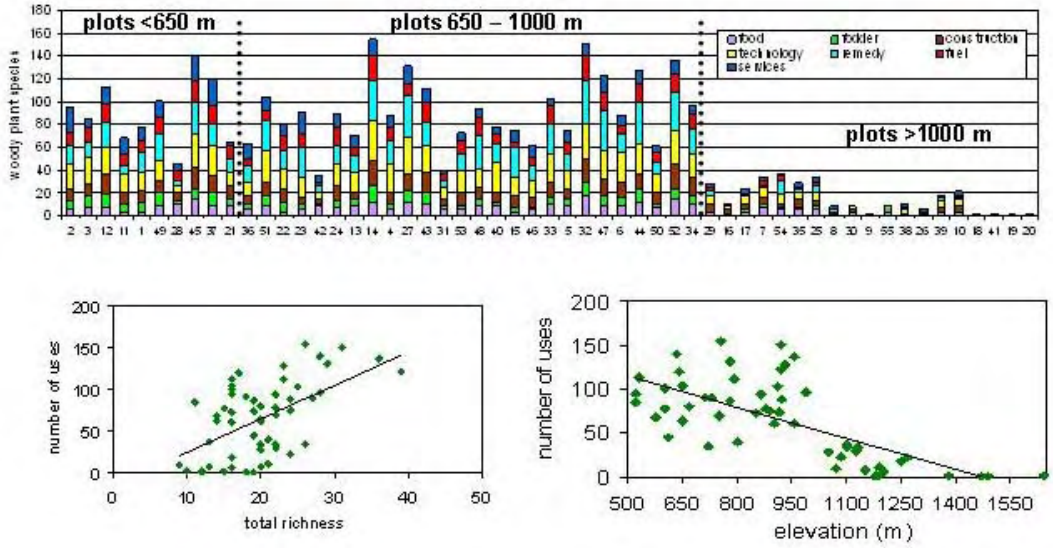

Figure 3. Resource diversity in the sample plots. Linear relationships are plotted between the total number of uses reported for large trees and unique woody plants in the understory and total species richness for the two structural layers (r^2= 0.29) and elevation (r^2= 0.47).

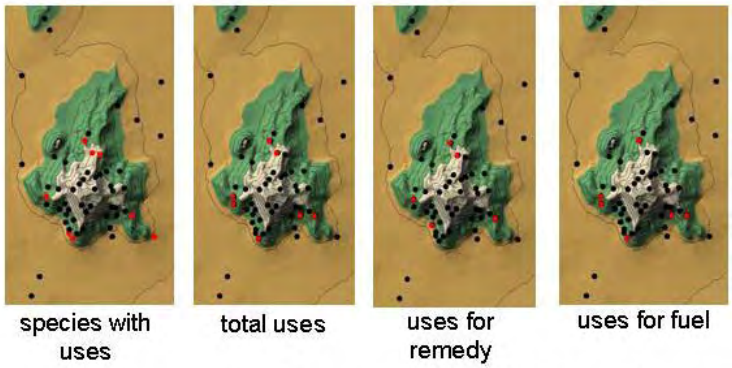

Figure 4. Resource patches for large trees (>10 cm dbh) at Mt. Kasigau (from Medley 2007). The maps show in red the ecological plots with the highest number of species with uses (12-20), greatest number of total uses (60-118), and the greatest number of uses for remedy (16-33) and fuel (10-19).

2. Identify local perspectives on the opportunities and constraints for the sustainable use of valued plant resources.

The ethnobotanical survey conducted under objective one compiled both qualitative and quantitative data on the relative values of woody plants at Mt. Kasigau. Table 1 lists the trees recorded with ten or more uses. Species that show a high consensus among the residents for many different uses are accordingly valued by the local communities. For example species like *Zanthoxylum chalybeum* and *Grewia* spp. are often heavily coppiced by stem cuttings but at the same time protected across the mountain and around their homes and farms. *Acacia nilotica* and also *A. mellifera* are highly valued for fuel wood, and *Sclerocarya birrea* and *Adansonia digitata* have many different uses that support their conservation around the homes and farms where they occur. *Manilkara sulcata* and *Grewia* spp. are particularly selected for their fruits and also provide strong wood for construction.

Table 1. List of woody plant resources with at least 10 recorded uses. When local uses are not generally confirmed by experts from the villages, they are identified by the village where the uses were seen or heard for Makwasinyi (mkw), Kiteghe (kit), Rukanga (ruk), Jora (j), or Bungule (bun). All plant vouchers were collected by Kim Medley (KEM) and confirmed at the East African Herbarium (Medley & Kalibo submitted).

Zanthoxyllum chalybeum Engl. var. *chalybeum* [Rutaceae]- t(st); bushland/montane woodland; KEM 495. **Genjeka-** fruits are edible, leaves for tea; leaves eaten by goats; straight poles for building; three-pronged stirrers for porridge (j), inner bark provides ropes for tying (j); large spoons; roots are boiled and liquid taken to relieve body pains, boils, and malaria; fruits are directly chewed and the liquid swallowed to cure malaria (mkw), roots and leaves are boiled and the liquid taken to cure and prevent sore throats (mkw), its roots and those of mkigondo (*Cassia abbreviata*) plus lemon juice, leaves of mdomoko (*Grewia tephrodermis*) and shambalaka (*Cissus rotundfolia*) are boiled with water and the mixture sprinkled on a patient by a herbalist to alleviate pains from ulcers (j), tea from the flowers and leaves relieves muscular pains (mkw), inner bark is chewed to alleviate diarrhea (j); firewood, but produces a lot of smoke and flying fireballs.

Grewia plagiophylla K. Schum. (formerly *Grewia mollis* Juss.) [Tiliaceae]- st(sh); bushland/montane woodland; KEM 697, KEM 513, KEM 811, KEM 1021. **Mdomoko, Mndomoko mbaa-** fruits edible; leaves eaten by goats; straight stems as cross poles; walking sticks, hoe handles, small slender stems used to make stirrers; leaves when squeezed give out foam that is used for washing utensils where there is no soap (j), small stems are chewed as a toothbrush (j); inner bark can be tied to a fresh cut to aid in blood clotting (mkw), bark is soaked in water and the liquid taken to cure diarrhea (mkw), liquid from boiled roots is drank by girls/women to reduce excess bleeding during menses (j), leaves used to prevent paralysis; firewood; leaves used in traditional ceremonies (mkw).

Acacia nilotica (L.) Willd. ex Delile [Mimosaceae]- t; bushland; KEM 433. **Mchemeri-** bark is sometimes boiled for tea; leaves and fruits eaten by goats- branches cut and dropped when in fruit; poles for construction but not permanent; branches used for fencing; sticky sap from fruits acts as a glue; spines used to remove foreign objects; its roots and those of mshaughi (*Manilkara sulcata*) and ndashi ya ng'ombe (*Combretum hereoense*) are boiled and the liquid taken to cure stomach upsets and problems related with the spleen (mkw), chewing the leaves alleviates coughing (mkw), chewing the inner bark helps to alleviate chest pains; liquid from its bark and that of mporozi (*Albizia anthelmintica*) kill internal worms in cattle; seeds boiled with tea help alleviate stomach

ulcers (mkw), bark boiled for kidney problems; charcoal, firewood; nectar for bees.

Adansonia digitata L. [Bombacaceae]- t; bushland; KEM pr. **Mlamba** [tree], Kilamba [fruit]- fruits edible, fruits used as a flavoring in porridge; leaves for goats; leaves believed to cure epilepsy (mkw), liquid from boiled bark cures body swellings (j); cures kidney stones (kit); symbolizes peace near the home, attracts rain, leaves used as manure in farms, giant diameter allows animal skins to be pegged on it for drying or supporting structures as a wall; shade in fields encourages the growth of wild greens.

Sclerocarya birrea (A. Rich.) Hochst. subsp. *caffra* (Sond.) Kokwaro [Anacardiaceae]- t; bushland; KEM 953. **Mnyeshavua** [mnyesha= to attract; vua= rain]- after seeds are eaten by goats and passed out, they are cracked and eaten by children (j); ripe fruits can be squeezed to produce juice; pound seeds and fry as an oil (j); fruits and leaves for goats, support for a latrine; brown dye from boiled bark decorates woven bags, large trunks are used to make pounding basins, wheels; liquid from boiled roots relieves toothaches (mkw); a poor firewood (j); nectar from flowers (j), flowering shows rainy season, want to have it near the farms but it kills crops growing under it.

Terminalia spinosa Engl.[Combretaceae]- t; bushland; KEM 840. **Msaghano, Muango** (mkw); leaves eaten by goats; straight, durable poles, fence posts; yokes, pounding sticks; yellow dye; chew the inner bark for sore throat (very bitter); firewood, charcoal; flowers provide nectar for bees, shade.

Grewia tephrodermis K. Schum. [Tiliaceae]- sh(st); bushland/montane woodland; KEM 421, KEM 539, KEM 752- **Mdomoko, Mndomoko (mtini)-** fruits edible; leaves eaten by goats; cross poles for building; flattened as a planting stick or a wedge, can bend easily for furniture, walking sticks, small branches used as a toothbrush; roots are chewed to cure stomach upsets and reduce diarrhea, inner bark is tied on a wound to stop bleeding; firewood; nectar for bees.

Melia volkensii Guerke [Meliaceae]-t; bushland; montane woodland; KEM pr. **Mkurumbutu**- leaves and fruits heavily eaten by goats; choice for sawn timber, straight poles/posts; doors, frames; supportive structure for firewood (j); choice for furniture, large dead trunks for beehives, pounding basins, local instruments like a guitar (j), small branches for utensils, sticky sap for glue (j).

Manilkara mochisia (Baker) Dubard [Sapotaceae]-t; bushland; KEM 952. **Mnao**- fruits [nao] are very sweet; leaves eaten by goats; straight poles for bulding; pounding sticks, hollowed trunks for beehives; stems used for pronged stirrers; roots boiled and drank to cure fever; firewood but produces fireballs, charcoal; live fence, left for shade, flowers give nectar

Manilkara sulcata (Engl.) Dubard [Sapotaceae]- t(st); montane woodland; KEM 942. **Mshaughi**- fruits [shaughi] are edible and very sugary; leaves eaten by goats; strong straight poles, large stems are split for posts; durable pounding sticks; eating raw fruits is believed to reduce diarrhea, roots are boiled and taken to relieve ulcers and stomach upsets (mkw), burnt ash helps to cure foot and mouth disease in cattle (j); firewood; nectar for bees (kit), shade for bees (kit).

Grewia villosa Willd [Tiliaceae]- sh; bushland; KEM pr. **Mshoshoti**- fruits edible; leaves eaten by goats; cross poles for building; slender stems for arrows; liquid from boiled roots cures body swellings, roots with those of mdongu (*Solanum incanum*) and mweja (*Sterculia africana*) are boiled and drank by girls/women to reduce excessive bleeding during menses, roots boiled in water and taken to cure stomach ache; firewood- useful for quick meals, charcoal; nectar for bees.

Acacia mellifera (Vahl) Benth. subsp. *mellifera* [Mimosaceae]- t; bushland; KEM pr. **Iti** (**Iti ya ngunge**- the strong one)- leaves and fruits eaten by goats; straight poles for building; bark boiled to produce a yellow dye for woven baskets (j); branches used for fencing because of the curved thorns; leaves chewed to help sore throats; chew inner bark for coughs; excellent firewood, charcoal; flowers provide nectar; some wasps make honey in the stems, “kimanga cha mbuche” (j).

Working with the village assistants and representatives from some of the women’s groups, I also used home surveys, participant observations, and semi-structured interviews to assess the relative value of different woody plant resources. These data were combined with ethnobotanical data compiled by Kalibo in 2002 and myself over four years of field research in the area (Medley & Kalibo submitted). The use of plants for construction or technology depends on the strength of the wood, its resistance to rot, how easily it can be cut and carved, and its aesthetic appeal. In a survey of 10 homes (that were under construction in the villages, the most common roof supports came from *Melia volkensii* (mkurumbutu as cut timber), *Manilkara mochisia, Terminalia spinosa* and *Terminalia prunoides,* the most common posts included *Terminalia prunoides* (often split from large stems), *Terminalia spinosa* and *Acacia bussei,* and the most common cross poles came from *Grewia tephrodermis* or *G. plagiophylla* (sometimes split) and *Combretum exalatum* or *C. hereoense.* The frames for each of these homes, however, included about 10 to 20 different tree species and cumulatively used over 40 tree species. The application of different trees for a particular use was also noted for many of the household products like the pounding basins (5 spp.), pounding sticks (11), toothbrushes (9), glue (17), and woven bags (9 spp for fibers; 8 spp. for dyes). A

few trees, like *Diospyros mespiliformis* and *Newtonia hildebrandtii* could only be collected as small posts because they were too hard to work with using the local tools. The Kasigau Taita do not make wood carvings but they recognize the value of trees like *Dalbergia melanoxylon* (sometimes used to make combs) and *Olea europea* subsp. *cuspidata* for that purpose. While the local experts collaborating on the project, and the residents we talked with were able to rank plants for particular products, relative differences are weakened by the large number of plants that have good value. The Kasigau adapt resource extraction practices to what is available and the large number of species that are acceptable.

Resource values are also reflected in the woody plant products that are marketed and sold among Kasigau Taita in the villages and to outside dealers. During the field research Medley & Kalibo (submitted) identified 34 plant products in 26 plant species that were being marketed. Sawn timber (e.g., as boards 1.8 m x 30.5 cm x 1.8 m) from *Melia volkensii* (200-360 Ksh), and *Commiphora baluensis* (180 Ksh) were sold to local carpenters for the construction of cabinets (at about 1500 Ksh), beds (1110 Ksh), as roof rafters (split to 5.2 cm x 5.1 cm at about 25 Ksh per 30.5 cm), or used for doors and window frames. One carpenter in Rukanga stated that he might buy 6-8 boards per week to meet his orders. For homes or fences under construction, we saw posts (e.g., *Terminalia prunoides* at 60-80 Ksh per post cut and delivered) and cross poles (e.g., *Combretum exalatum*, *Grewia tephrodermis* at 2 Ksh per piece) for sale. Local sales also occur among residents for technological products like pounding sticks (50-100 Ksh from *Dobera glabra* or *Cassia abbreviata*), pounding basins (200+ Ksh), tool handles (50-80 Ksh from *Albizia anthelmintica*), chairs from bent stems (250 Ksh for one made from *Cordia sinensis*), spoons (20 Ksh for a spoon from *Melia volkensii*), and brooms (20 Ksh for *Xerophyta spicata*).

Material exchanges, and accordingly the extraction levels, are much higher, when outside dealers come in to buy particular products. This is particularly shown by the recent promotion since 2000 of woven bags prepared by Kasigau Taita women. These bags are sold to tourists visiting the region and now to markets in other locations in Kenya and outside the country at prices between 100-1000+ Ksh. Whereas sisal, produced locally or bought from nearby Buguta, is cultivated for the production of these bags, the extraction levels of local plant products for dyes and additional fibers have gone up, respectively. The bushland region along the MacKinnon road that goes through Bungule was heavily impacted in the past by the export of high quality charcoal (particularly in the 1970s) and continues to be a threat with the development of better roads around the mountain. We observed one dealer who comes periodically to export timber from the region (*Melia volkensii* and *Commiphora baluensis*), and saw heavy extraction of *Oyris lanceolata* in June 2006 in response to an export market for “false sandlewood” that had developed over the past six months. These activities, while providing profits to a few individuals, greatly increase extraction levels in the region and the potential sustainable production of woody plant resources.

Research Outcomes and Conservation Planning

The research findings from this project underscore the importance of validating local knowledge about woody plant resources and incorporating local perspectives on diversity into Adaptive Collaborative Management (ACM) plans (Berkes et al., 2000; see Kalibo & Medley in press). The Kasigau Taita rely on "wild" woody plants as a type of "green social security" and can clearly document the distribution of these resources in relation to the mountain (Cunningham, 2001: 1). Below, I summarize some of the significant research findings as they relate to biodiversity conservation at Mt. Kasigau.

1. The floristic inventory, although limited in its focus to wild woody plants observed during the field surveys, highlights the contributions of Mt. Kasigau to the biological importance of the Eastern Arc Mountains. I report a mix of woody plants with Afromontane and Coastal floristic affinities (summarized in the first progress report), which is similar to that reported for the East Usambaras (Rodgers & Homewood 1982), and unique among the Eastern Arc regions in Kenya. The study highlights the need for comparative inventories of the flora and fauna in order to better understand the biogeographical relationships within this ancient mountain system.

2. Most of the plants vouchered during the study were named (74%) and used (61%) by the Kasigau Taita. The Kasigau Taita rely on these plants for their livelihoods, demonstrating the "utilitarian" aspects of plants to people (*cf.* Fleuret, 1980 for the Usambara mountains; Newmark, 2002 for the Eastern Arc) and the importance of including biological knowledge about utilization in conservation plans for the region (Medley & Wafula submitted). The high number of plants with uses, and even more importantly, the high number of plants that are "good" for the same uses form already established adaptive strategies that can better ensure the conservation of plant diversity.

3. Plant knowledge and accordingly resource extraction levels are very low in evergreen forest on Mt. Kasigau. Study participants show little conflict between their livelihoods and the protection of biodiversity [and water resources] in evergreen forest. Currently the greatest impacts in evergreen forest come from tourist visits (tree carvings and trail use) and research activities (former camps and experimental plots). Collaborative planning among stakeholders needs to ensure a sustainable supply of water from evergreen forest and respect the natural and cultural heritage of this zone as part of the biodiversity protection plan.

4. Most plants with uses occur in montane woodland (650-1000 m) and most uses for plants occur in bushland (<650 m). Resource extraction is greatest at the base of the mountain in a region that intersects with their homes and farms. Accordingly the extraction of 'wild' resources across this 'transitional zone' (see Kalibo & Medley in press) can be reduced by enriching and conserving the availability of woody plant resources across their homes and farms. Earlier research conducted in a sample of homes and farms around Jora and Makwasinyi clearly shows the potential for these areas to provide a high diversity of native and non-native woody plants. The conservation management of woody plant resources at the base of the mountain is viewed critical to the protection of biological resources on the mountain and in the surrounding bushland.

5. Rather than focusing on the designation of a protected zone, the findings from this research can be used to monitor and ensure the sustainability of extractive resources from priority locations within and across different vegetation and land-cover types. The Appendix shows the approximate gps locations of the ecological plots for which there are data on the composition and structure of woody plants and accordingly the occurrences of some rare trees. These data can contribute directly to any long-term monitoring plans proposed for the region. The local experts and field assistants that worked on the project are very familiar with the research and are in a strong position to guide subsequent studies in the region.

6. ACM has much to gain from understanding what kinds of extra-local forces influenced resource use by the Kasigau Taita as they moved up and down the mountain in the past, and currently influence their extraction of products for livelihood and commercial purposes. Several questions emerged during the field observations that confirm the complexity of human-resource relationships in the region. How is the utilization of bushland resources influenced by plans to conserve elephant populations in the wildife corridor? How does the influx of Somali pastoralists to the Kasigau ranch and accordingly the increase in fees at that location influence grazing practices on the trust lands? How has the improved road system influenced the export of woody plant resources from the region? Does the commercial extraction of timber and non-timber resources benefit the communities at Mt. Kasigau? What resource-based economies can be supported in the region? The last question relates to an exciting area of research in the region on the sustainability of different conservation enterprises.

7. Participatory resource maps (see Kalibo & Medley in press), local plant knowledge, and field observations validate a history of utilization and land rights up and down Mt. Kasigau that must be respected in any collaborative management plans. Equilibrium hypotheses of pristine montane forest do not match local interpretations; human-resource relations are embedded in the composition and structure of all vegetation types along the ecological gradient. The 'global'

conservation community needs to acknowledge and respect this history and empower local communities to guide the directives for adaptive collaborative planning in their home area (Medley & Kalibo 2007).

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Appendix: Ecological plot locations and descriptions.

plotcode	latitude (°S)	longitude (°E)	village	elev (m)	location notes	big tree (>10 cm dbh) richness	big tree density (#/ha)	big tree basal area (m^2/ha)	understory density (#/ha for woody plants > 1 m ht and < 10 cm dbh)	Species richness (woody plants)	Woody plants with uses	Sum of uses for all woody plants
1	3.796357	38.67784	Makwasinyi	600	Firewood collection site, especially for Combretum exalatum, south of road going west toward Kiteghe.	7	80	4.73	900	15	15	78
2	3.802709	38.68715	Makwasinyi	520	Located below farms in an area with *Acacia mellifera*.	7	220	7.32	1100	16	15	95
3	3.781324	38.68749	Makwasinyi	520	Black cotton soil between Makwasinyi and Kiteghe.	2	20	1.9	1050	11	10	85
4	3.8166	38.67103	Makwasinyi	780	Just above the old school site.	7	920	29.58	1500	19	16	87
5	3.816735	38.66586	Makwasinyi	915	Water intake, central village.	5	80	4.4	1450	19	16	74
6	3.82338	38.67267	Makwasinyi	922	Water tank along the pipe from the Kirongwe intake.	12	220	11.39	3350	24	20	88
7	3.83113	38.66925	Makwasinyi	1100	Evergreen *Trichlocladus*-dominated woodland on route to the pass with Bungule.	11	640	19.9	1450	20	13	34
8	3.822416	38.66752	Makwasinyi	1150	*Newtonia buchananii* forest above Kirongwe intake.	5	400	65.67	3550	20	5	8
9	3.824422	38.66813	Makwasinyi	1180	Pass between Makwasinyi (Kirongwe) and Bungule.	5	390	36.49	2400	12	2	2
10	3.830683	38.6677	Makwasinyi	1265	Big rock above the past between Makwasinyi (Kirongwe) and Bungule.	7	230	28.56	3450	24	9	22
11	3.86596	38.63612	Jora	575	Itoronyi, near the former Mwandoe cattle boma.	4	130	5.45	3400	14	12	68
12	3.858345	38.63931	Jora	530	Mlawasi, Firewood collection site with *Acacia nilotica* .	6	100	2.81	1200	16	16	113
13	3.833869	38.64994	Jora	750	Mwandoe old farm site on the mountain.	11	240	15.14	2350	22	16	70
14	3.829757	38.64223	Jora	755	Jora route to Kifagio (Viriwenyi).	11	360	14.66	2150	26	24	155
15	3.831787	38.64743	Jora	890	*Encephalartos kisambo* site.	13	560	13.49	1400	24	19	75
16	3.82958	38.64938	Jora	1070	Evergreen *Trichlocladus*-dominated woodland below the pass to Rukanga.	6	350	18.78	1400	9	4	10
17	3.823745	38.64689	Rukanga	1085	Water catchment for Rukanga and Jora in a stand of *Newtonia buchananii* .	4	160	30.06	3350	24	8	23
18	3.824081	38.65255	Rukanga	1380	Evergreen forest above Rukanga water catchment.	9	380	60.86	3500	15	2	2
19	3.83003	38.65592	Rukanga	1488	Evergreen (high montane) forest at the junction to the Jora summit.	9	340	66.12	2900	18	1	1
20	3.823751	38.6612	Makwasinyi	1640	Cloud forest just below Ngangala (Kasigau summit).	4	950	30.97	1700	10	1	2
21	3.84123	38.65103	Jora	650	Montane woodland going east toward Bungule, in a river concavity at Mwakuri.	14	210	44.28	900	20	17	64
22	3.83978	38.65107	Jora	668	Old farms on the slope to Mwakuri.	8	220	10.6	3350	20	17	80
23	3.83686	38.64971	Jora	710	Ndomokonyi, the old village on the mountain.	11	110	4.58	3050	18	18	91
24	3.84321	38.65247	Jora	728	Below a big rock on the route eastward to Bungule.	18	300	12.34	3350	27	23	90
25	3.83944	38.65643	Jora	1130	Near a large *Acacia robusta* (the rain tree), at the pass between Jora and Bungule.	10	270	10.14	4300	22	11	34
26	3.830433	38.65953	Bungule	1200	On a slope convexity along the route to Ingire.	9	460	77.3	3826	16	3	6
27	3.85432	38.6512	Jora	780	Kibotonyi, the rock above Ndomokonyi, on the route to the rain tree.	9	390	22.11	4800	29	26	131
28	3.84251	38.66806	Bungule	610	Tofino river at Bungule, above the first water intake; gps measure taken on the rock (Lwala lwa mbela) above the site and the community-constructed tourist banda.	7	270	21.48	1950	19	16	45
29	3.83604	38.65279	Jora	1050	Evergreen *Trichlocladus*-dominated woodland on the route to Ingire between the rock, Kisoghoko cha waka (where the gps measure was obtained, 882 m) and the lower pass with Bungule.	13	740	24.38	3450	20	9	28
30	3.83274	38.65774	Bungule	1150	Evergreen forest between the first and second pass on the route to Ingire (gps was obtained at the upper pass, 1270 m)	7	370	59.63	2900	13	5	8
31	3.834445	38.66585	Bungule	800	Along the river (first water intake) for Bungule, on the route to Kirongwe (above lwala lwa mbela) at an old village site (Kifumbo).	11	480	41.71	1350	21	15	40
32	3.804591	38.65716	Kiteghe	920	Deciduous woodland, west-facing along a spur ridge and the main trail to the summit (the old hotel road).	19	440	15.21	2400	31	27	151
33	3.80567	38.65867	Kiteghe	910	Deciduous woodland with *Dalbergia melanoxylon* , east-facing along the spur ridge and main trail to the summit (the old hotel road).	11	280	11.81	1950	25	21	103
34	3.801756	38.65867	Kiteghe	988	Along the east ridge with Makwasinyi, open woodland with a dense *Croton pseudopulchellus* understory, at the intersection to an old route up the mountain and the upper pass between Makwasinyi and Kiteghe.	15	420	8.81	11450	28	24	96
35	3.8199	38.6566	Kiteghe	1125	Just above the Kiteghe water catchment; gps measure taken at the stream.	11	410	15.62	3800	22	12	29

plotcode	latitude (°S)	longitude (°E)	village	elev (m)	location notes	big tree (>10 cm dbh) richness	big tree density (#/ha)	big tree basal area (m^2/ha)	understory density (#/ha for woody plants > 1 m ht and < 10 cm dbh)	Species richness (woody plants)	Woody plants with uses	Sum of uses for all woody plants
36	3.7563	38.64148	Kiteghe	650	Bushland site at the base of Amaka.	6	90	4.29	1600	14	14	63
37	3.76087	38.6434	Kiteghe	640	Below Amaka on an erosional site exposing lateritic soil.	8	150	6.01	1150	17	16	120
38	3.819073	38.66153	Makwasinyi	1190	Makwasinyi upper water catchment, just below pass with Kiteghe, plot at stream and along the trail to the stream.	7	370	50.33	5700	21	9	11
39	3.818042	38.66329	Kiteghe	1250	High pass between Kiteghe and Makwasinyi on the main trail to the summit; evidence of an old village site-- much before the resettlement (Kifumbo).	9	310	15.34	3050	16	7	18
40	3.81098	38.64526	Rukanga	878	Are, southwest facing slope below peak.	12	900	51.59	7400	22	19	78
41	3.821777	38.65511	Rukanga	1470	Ridge on route to the Rukanga summit; gps taken where the forest opens to rock at the summit.	8	733	75.32	4950	12	1	1
42	3.83907	38.66719	Bungule	720	Second water catchment for Bungule, along the river at a former settlement.	7	260	33.27	3900	26	16	35
43	3.834085	38.66985	Bungule	790	Montane woodland east of the main watershed (near lwala lwa mbela), convexity above a dry stream tributary.	12	430	11.55	2550	23	21	112
44	3.83419	38.67589	Bungule	930	Along the lower pass between Bungule and Tombolo, plot center is on a southeast facing ridge.	13	270	7.25	2050	23	21	128
45	3.842694	38.68473	Bungule	632	Firewood collection site beyond Mwarashua on the way to Kirongwe/Tombolo.	13	260	9.51	9300	28	25	140
46	3.841439	38.65413	Bungule	900	Just below the rock (mwandolo) between Bungule and Jora.	7	240	20.41	1100	16	16	61
47	3.826649	38.64211	Rukanga	920	Evergreen woodland plot just below viriwenyi; gps measure taken near the open rock at the pass between Rukanga and Jora.	21	1040	29.38	3500	39	29	122
48	3.823008	38.64278	Rukanga	865	Plot near the stream from the main water catchment for Rukanga- plot on the main trail that follows the water pipe, just below the old village and farm plots.	8	110	5.99	2000	22	19	94
49	3.813935	38.63239	Rukanga	600	Near the boundary with ilenyi; open bushland.	4	70	0.31	1900	16	14	101
50	3.813169	38.64948	Rukanga	955	Mwalalu on the pass between Rukanga and Kiteghe.	10	740	26.62	4250	20	17	61
51	3.77883	38.63227	Kiteghe	650	Kiteghe bushland on route from Gae; lateritic, sandy soil.	7	190	5.69	1800	16	13	104
52	3.809356	38.66019	Kiteghe	957	Siriri river, opposite side of the river (facing west) from the main route up the mountain-- actual plot is about 50 m toward the stream from the gps coordinates.	23	620	24.23	5950	36	32	137
53	3.79072	38.67019	Kiteghe	850	Just off Garama hill along the ridge to Lwala lwa Kiteghe between Makwasinyi and Kiteghe.	9	220	10.33	2250	16	15	73
54	3.81714	38.65837	Kiteghe	1100	Kiteghe old village site, along the terrace dug out for home sites.	9	360	18.46	1500	13	8	37
55	3.83255	38.67312	Bungule	1180	Maruma- at upper pass between Bungule and Kirongwe.	11	420	47.27	2950	19	4	0