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Expeditions Mozambique – Madagascar 2008-09

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Cabo Delgado Expedition 2009

Report on a reconnaissance visit to Lupangua Hill, Quissanga District, Cabo Delgado Province, Mozambique, with notes about *Micklethwaitia carvalhoi*

G. Philip Clarke, November 2010

This report acknowledges the tremendous contribution by the Prince Albert II Foundation of Monaco, the Total Foundation and the Stavros Niarchos foundation in funding the 'Our Planet Reviewed' expeditions to Cabo Delgado Province of northern Mozambique in 2008 and 2009. This area was at that time largely unexplored by biologists and considered to be of little biodiversity interest.

Through the generous funding from the above institutions, Pro-Natura International and the French Museum of Natural History, in partnership with the Instituto de Investigação Agrãria de Moçambique, have been able to identify and visit potential key sites in Cabo Delgado through a systematic methodology of first analysing satellite images, followed by a low-level aerial survey to verify findings, and finally by extensive ground visits to collect specimens.

The majority of biological exploration and research today is focussed on areas that are already known to be rich in endemism and diversity. The above institutions therefore took a considerable financial risk by funding research in an area that was almost blank on the scientific map, but which, as a consequence of these expeditions, is now known to be of global biodiversity importance.

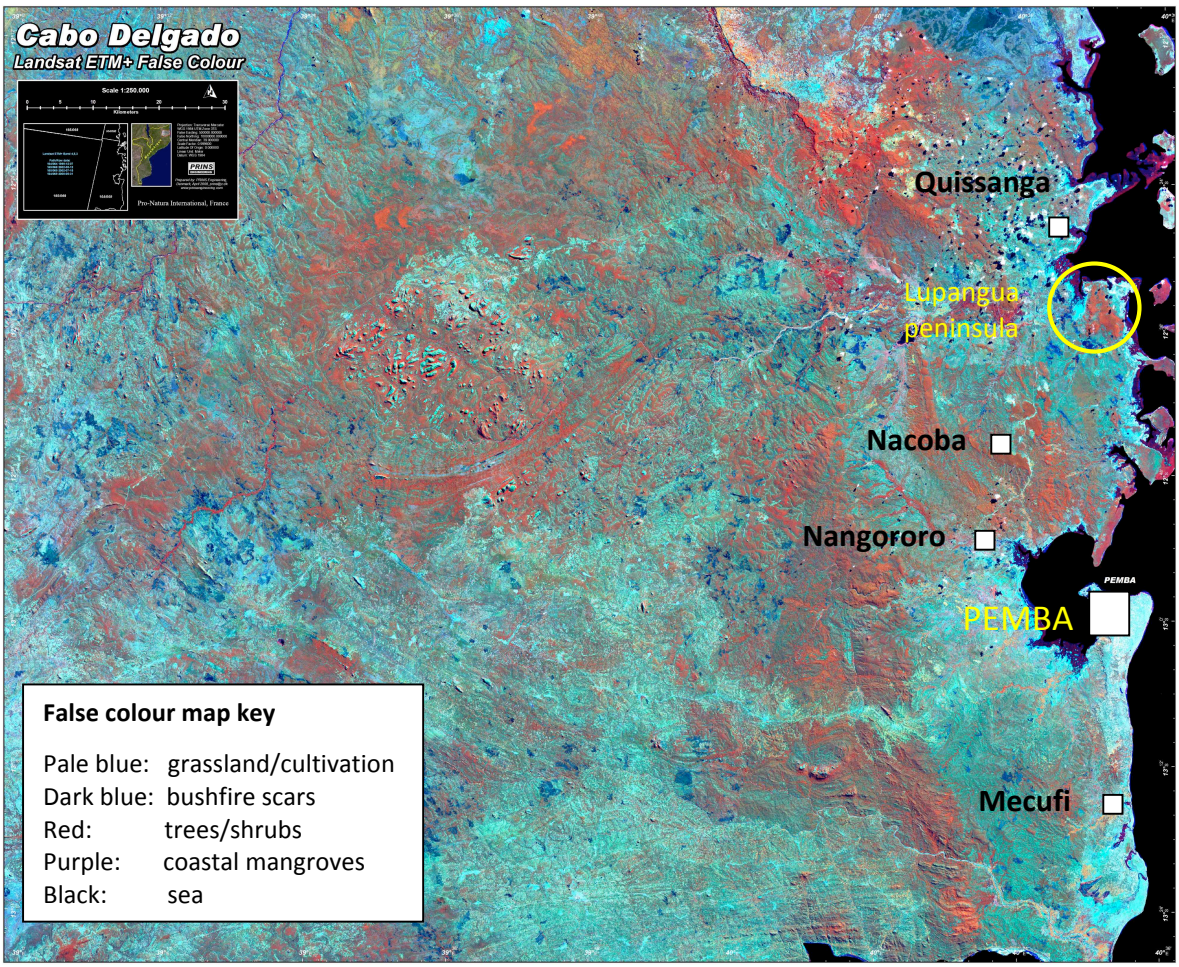
Without the support of the Prince Albert II foundation, the Total Foundation and the Stavros Niarchos foundation, it is unlikely that the forests on Lupangua Hill would have been visited by biologists for many years, by which time they may have been destroyed. This would have caused the loss of the most important remaining population of the endemic monotypic tree genus *Micklethwaitia*.

It is hoped that the results of this reconnaissance visit will place Lupangua on the global biodiversity map, and encourage further research and conservation efforts here.

Introduction

A brief reconnaissance visit was made to the Swahilian Coastal Forest (sensu Clarke 1998) located on the western ridge of the Lupangua Hills that are situated on the Lupangua Peninsula to the south of the coastal port of Quissanga in northern Mozambique. This area had never previously been visited by biologists, but was identified as a potential site of interest following the analysis of satellite images of Cabo Delgado Province during March 2008. Low altitude overflights of the area were conducted in April 2008, which confirmed the presence of thick and apparently little-disturbed forest here (Timberlake 2008).

The western ridge of hills on the Lupangua peninsula was visited by expedition leader Olivier Pascal, botanists Tom Müller and Phil Clarke, tree climber Frédéric Mathias, photographer Xavier Desmier, journalists Julian Blanc-Gras and Katia Clarens and artist/marine biologist Roger Swainston on the 22nd-23rd November 2009. Access to the target area was gained by boat from Quissanga, through the mangrove-lined creeks to the west of the Lupangua peninsula. A campsite was established at what turned out to be an ancient human occupation site/midden at 12°32'38"S, 40°29'17"E, containing large quantities of shellfish remains and earthenware potsherds. This site is on a raised shelf at about 10 m above the level of the surrounding salt flats, and may indicate the former shoreline before tectonic uplifting. No obvious water source was available in the vicinity.



False colour satellite photo of the area around Pemba in NE Mozambique, showing the location of the Lupangua peninsula (circled) and other sites mentioned in this report. Satellite analysis from 2000 © Prins Engineering.

Description of the area

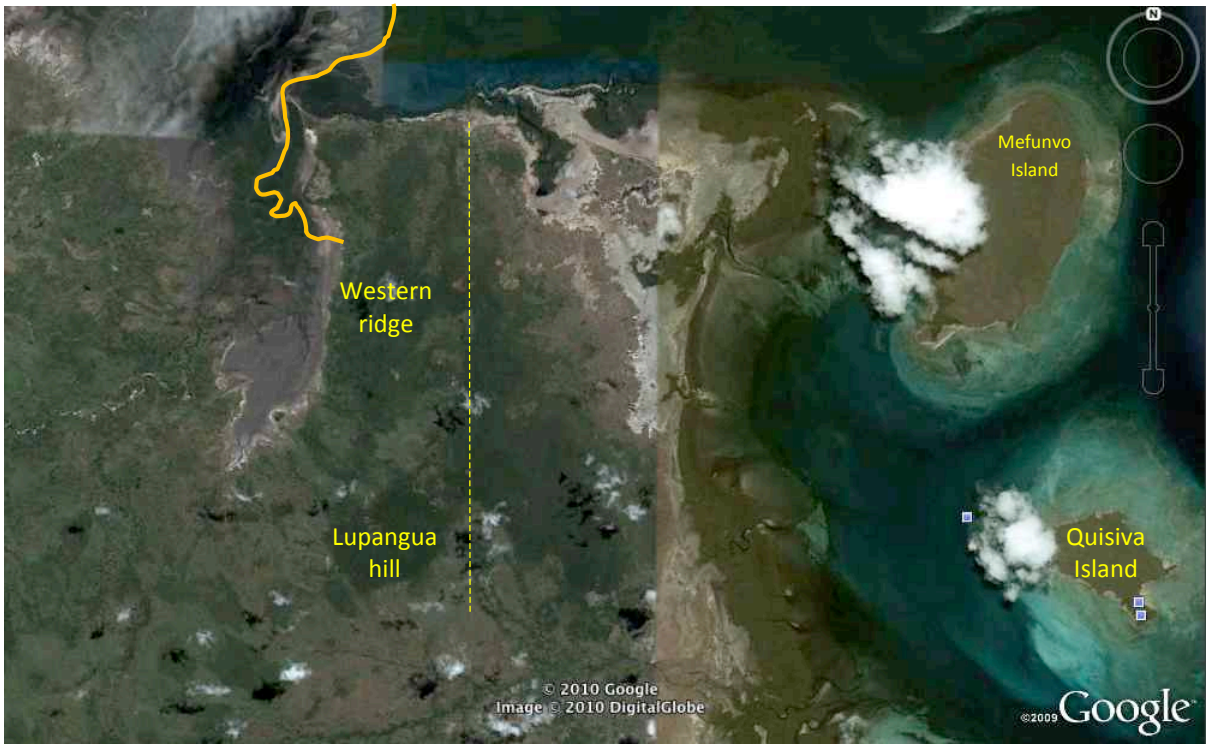
The Lupangua peninsula covers some 58 km^2 and is ringed on its western, northern and eastern sides by a wall of almost impenetratable mangrove forest. Salt flats are found inland of the mangroves, extending about a half km. Woodland is present on the outer margins of the peninsula close to the coast, and is replaced inland by about 25 km^2 of dry forest on the low hills and ridges. Forest also extends down to almost sea level in steep-sided seasonal drainage gullies where it is protected from fire.

The western ridge of the Lupangua hills is underlain by calcareous rocks set in heavy clay soils. The rocks are numerous, and are exposed all over the hill.

A few small non-permanent fishing settlements are found on the coast, and a large permanent village is located to the immediate south of the main Lupangua Hill. High resolution satellite images viewed on Google Earth (www.earth.google.com) indicate that agricultural activity takes place on the eastern and southern slopes of the Lupangua peninsula, which may be responsible for the historic conversion of forest to woodland via cultivation and fallow.

A single north-south cutline divides the peninsula, probably dating back to oil exploration during the early 1980s.

The whole of the Lupangua peninsula is contained within the Quirimbas National Park.



Lupangua peninsula from Google Earth satellite image, taken on the 25th April 2003 (at the end of the rainy season), showing the super-imposed route sailed to reach the western ridge of the Lupangua hills via the mangrove creek to the west of the peninsula (solid orange line) and the old oil cut-line (dashed line). The above image covers the area from 12°31'04"S to 12°37'47"S, and from 40°26'34"E to 40°37'39"E. The western ridge of the Lupangua hills reaches an elevation of 80 m while the main hill to the south reaches 130 m elevation.

Western ridge of the Lupangua Hills rising to about 65 m above sea level, viewed from salt flats at about 12°34'48"S, 40°29'20"E looking north by north-east (above) and from the air looking southwest (below). A band of woodland lines the salt flats, and is replaced upslope by Coastal Forest strongly dominated by *Micklethwaitia carvalhoi*. *Terminalia sambesiaca* is a frequent large tree in both vegetation types. Photos taken 23rd November 2009 (above), immediately after the first heavy showers marking the start of the rainy season, and at the end of the rainy season on the 27th April 2008 (below).

Woodland

A narrow fringe of woodland is present at the edge of the salt flats at the western base of the Lupangua hills, where *Terminalia sambesiaca* is a frequent component, together with *Acacia nigrescens* and *Acacia robusta ssp. usambarensis*. Other species include *Commiphora* sp., *Millettia stuhlmannii* and *Bauhinia tomentosa.*

In some areas this grades into scrub forest and in others directly into dry *Micklethwaitia carvalhoi*-dominated Swahilian Coastal Forest.

Spot 6 satellite images viewed on Google Earth (www.earth.google.com) indicate that woodland or wooded grassland covers about half of the Lupangua peninsula. Bush fires set by humans to control wild animals probably perpetuate the presence of woodland and prevent the succession to forest.

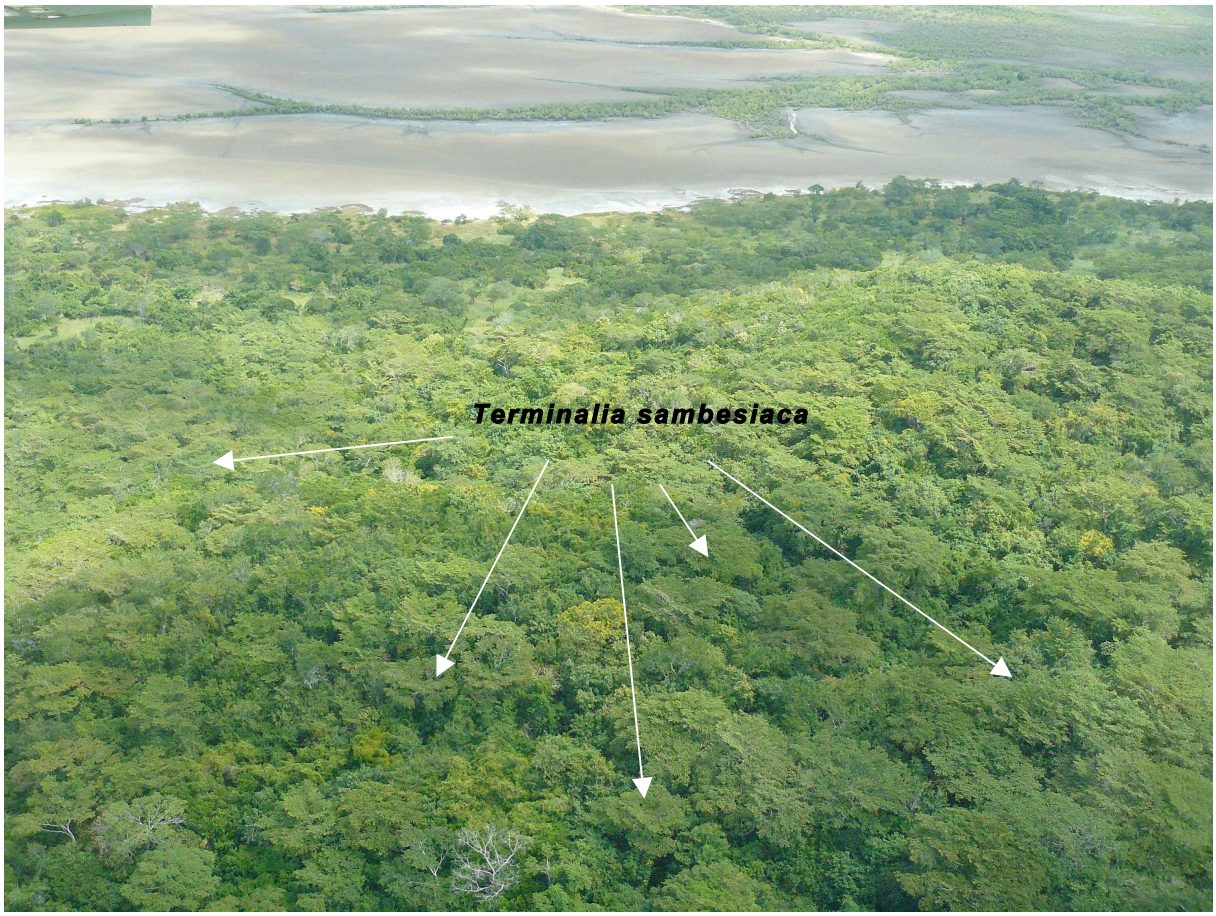
Spur of woodland dominated by *Terminalia sambesiaca*, on the western side of the western ridge of the Lupangua hills at 12°34'28"S, 40°29'45"E. Note the frequent exposed rocks littering the ground. View looking north, with the forested slopes of the western ridge of the Lupangua hills rising behind the trees to the background right. Photo taken 23rd November 2009, immediately after the first major showers marking the onset of the rainy season.

Scrub Forest

An area of deciduous scrub forest was visited at mid-slope at 12°33'53"S, 40°29'36"E, 23 m elevation. This comprised a diverse assemblage of canopy trees that include *Manilkara mochisia*, *Ochna* sp., *Monodora junodii*, *Terminalia sambesiaca*, *Euphorbia* sp., *Acacia robusta* ssp. *usambarensis* and *Dobera loranthifolia.*

The upper canopy to 8 m was very broken, with just 30% cover, while the lower canopy to about 3–4 m gave about 95% cover. This vegetation type is almost 100% deciduous, with almost all species just coming to leaf when visited at the end of the dry season in late November 2009.

Scrub forest is almost impossible to distinguish from true forest through satellite photos. Its existence on the Lupangua peninsula may be due to a thin soil layer over a rocky substrate.



Aerial view of the forest on the western ridge of the Lupangua hills (foreground), looking west towards salt flats and mangroves (upper part of picture). The rather distinctive fan-tailed branching of *Terminalia sambesiaca* is readily apparent from the air. Photo © Jonathan Timberlake, 27th April 2008, just after the end of the rainy season.

Micklethwaitia forest

Dry forest is present on the hill and ridge tops of the Lupangua peninsula. Three areas were visited, both of which were strongly dominated (70% up to 100% of canopy trees) by the extremely rare tree *Micklethwaitia carvalhoi*. This species is present over a comparatively wide range of micro habitats at Lupangua, ranging from flat hilltops to steep hillsides to the banks of narrow gulleys cutting through woodland (where it is probably able to survive bushfires due to the natural fire barriers created by rocky stream beds that are clear of leaf-litter, as well as by the wind breaks caused by the sudden topographical changes on the top of the banks). All of these sites appear to be well-drained.

Micklethwaitia is a monotypic genus known only from six sites in northern coastal Mozambique. This Caesalpinioid legume's nearest relatives are the genera *Cynometra* and *Scorodophloeus* (Lewis 1996; Lewis & Schrire 2004), to which it shares a similar ecology. The smooth, scaling bark and shape of *Micklethwaitia* looks much like a *Cynometra*, while guides from Quissanga gave *Micklethwaitia carvalhoi* the same local name 'Mpande' that is given to *Scorodophloeus fischerii* in Tanzania. Like *Micklethwaitia*, both *Scorodophloeus* and *Cynometra* produce almost monodominant stands of canopy trees, supported by a dominant layer of saplings in the shrub layer.

Scorodophloeus and *Cynometra* are exclusively lowland forest genera that are found in the forests of Central Africa as well as in the Coastal Forests of the Swahilian regional centre of endemism along the eastern African coast. The discovery of *Micklethwaitia* dominant forest at Lupangua places this forest firmly within the Eastern African Coastal Forest hotspot.

Saplings of the rare tree *Micklethwaitia carvalhoi* dominating the herb and small shrub layer of the forest on the western ridge of the Lupangua hills, 12°34'28"S, 40°29'53"E. Photo taken 23rd November 2009.

Well developed dry forest strongly dominated by *Micklethwaitia carvalhoi* on the western slope of the western ridge of the Lupangua hills near 12°34'28"S, 40°29'51"E. Most of the individuals in this view are of *Micklethwaitia*, and most are single-stemmed, with the exception of two mid-left that have coppice regenerated, possibly after being cut for construction poles. Photo taken 23rd November 2009, immediately after the first major showers marking the onset of the rainy season.

Dry *Micklethwaitia carvalhoi* forest near the summit of the western ridge of the Lupangua hills, 12°34'28"S, 40°29'53"E. Most of the canopy trees as well as the saplings in this view are of *Micklethwaitia*. Photo taken 23rd November 2009, immediately after the first major showers marking the onset of the rainy season.

A vegetation survey at 12°34'28"S, 40°29'54"E at 77 m elevation recorded an 8 m high canopy very strongly dominated by *Micklethwaitia carvalhoi*, with the same species together with *Monodora junodii* dominant in the small tree layer. Other canopy and smaller sub-canopy trees include the occasional *Terminalia sambesiaca*, *Euphorbia* sp., *Acacia robusta* ssp. *usambarensis*, *Acacia nigrescens*, *Erythrina* ?sp. nov., *Hildegardia migeodii* and *Albizia forbesii*.

GoogleEarth satellite images show that the forest at this location has an unusually smooth and even canopy, while other areas on the Lupangua hills have larger, wide-crowned trees that in the far north of the western ridge include a number of baobabs (*Adansonia digitata*). Much more research is therefore needed to properly characterise the forests at Lupangua.

Unknown forest type with large canopy emergents including *Terminalia sambesiaca*

Scrub forest at 12°33'53"S, 40°29'36"E

Micklethwaitia-dominated forest
12º33'58.5" S, 40º29'39" E

Terminalia sambesiaca – Acacia nigrescens & *A. robusta* woodland
12º34'27" S, 40º29'45" E

Micklethwaitia-dominated forest
12°34'28"S, 40°29'53"E.

Tongue of *Micklethwaitia*-dominated forest in seasonal drainage gulley

Detail of Lupangua from Google Earth satellite image, taken on the 25th April 2003 (at the end of the rainy season).

Strongly mono-dominant stand of *Micklethwaitia carvalhoi* on a steep slope at 12°34'28"S, 40°29'51"E. The absence of a shrub layer (above) is possibly due to an earlier incursion of fire that may have killed off saplings as well as the fallen tree in the foreground. Immediately behind the above view was an area where fire had removed the canopy trees (below, foreground; note burn scars on other trees below. Photos taken 23rd November 2009, immediately after the first major showers marking the onset of the rainy season.

Conservation importance: *Micklethwaitia* at Lupangua and elsewhere

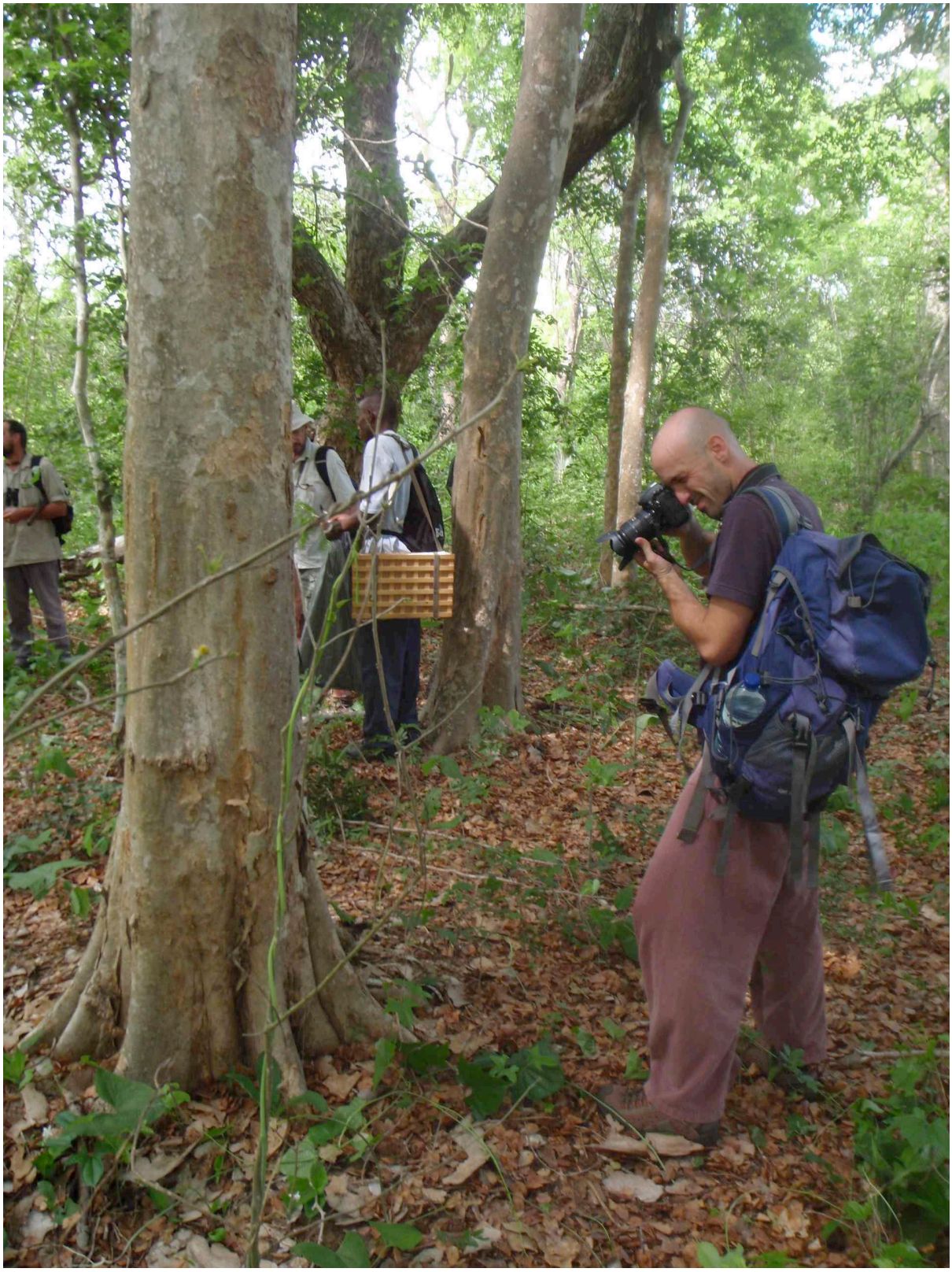
Micklethwaitia is a monotypic genus that was originally known only from a fragmentary specimen collected during 1884–1885 at "Mossuril (Mossoril) to Cabaceira (Cabbessira)" by de Carvalho, after whom the species is named (Lewis 1996). Just 8 km of coastal plain separates the small port of Mossuril from the coastal settlement at Cabeceira – from high-resolution satellite images taken in 2005 and 2006 (www.earth.google.com) it is clear that no forest remains in this area, which now comprises an open landscape with scattered trees. It is unlikely therefore that the highly forest-dependent *Micklethwaitia* still exists here.

The species was rediscovered in 1960 some 220 km north of the first collection, by Gomes e Sousa, who made 12 collections from the vicinity of Nangororo at 12°54' S, 40°22' E, on the coastal plain to the immediate west of Pemba bay at 30-60 m altitude "on red clay soils with quartzite" (Lewis 1996, but note that some of the cited grid locations are doubtful — one is out at sea, and another is over 20 km from Nangororo, even though this is given as the location). All of these collections were conducted between 1960 and 1964. Large areas of scrub forest are still present around Nangororo, despite its high population density and proximity to Pemba, so *Micklethwaitia* is probably still present here.

The Pro-Natura Mozambique 2008–2009 expeditions have located *Micklethwaitia carvalhoi* at three further locations: in the forests on the hill/plateau top near Nacoba at 12°47'89"S, 40°25'02"E on well-drained red soils where the tree is the most common present (up to about 30% of canopy trees at the single site visited); in an isolated patch of sacred forest in the Quiterajo Conservancy at 11°45'56"S, 40°16'06"E, where the tree is locally strongly dominant (up to 80% of canopy trees); and on the western ridge of the Lupangua hills where it is also strongly dominant, reaching up to 95% of canopy trees in some areas.

South African botanists John and Sandie Burrows, who have also taken part on the Pro-Natura International Mozambique 2008–2009 expeditions, note that *Micklethwaitia* is fairly common in the area around Pemba, but that it is being heavily cut down with mature trees now rare. Specimens were collected at Brenda's bushcamp on the slopes below Pemba airport at 13°00'24"S, 40°31'23"E, and on the road south of Pemba to Mecufi at 13°12'50"S, 40°33'02"E.

Heavily disturbed mixed dry forest near Nacoba at 12°47'89"S, 40°25'02"E. This forest has been heavily disturbed by logging, and from the air had a closed but extremely uneven canopy caused by the colonisation of lianas in the light gaps. *Micklethwaitia* accounted locally for up to 20% of canopy trees in some areas of the forest. Photo taken 29th April 2008, just after the end of the rainy season.



A large individual of *Micklethwaitia carvalhoi* reaching 16 m to the canopy in the Quiterajo Conservancy at 11°45'56"S, 40°16'06"E. The trees here were larger than those seen at Lupangua, possibly due to this site being on alluvial soils close to the edge of the Messalo River floodplain, compared to the drier, rocky substrate on the Lupangua hills. Photo taken 1st December 2008, immediately after the first major showers marking the onset of the rainy season.

The forests around Nacoba are situated on either side of a secondary road linking Ibo Island and Quissanga to Pemba, and are being rapidly cleared for farmland as the fertile red soils, regular transport and close proximity to market towns makes this an ideal site for farming foodcrops. Around Pemba the species is already heavily cut with few mature trees remaining.

The small stand of *Micklethwaitia* at Quiterajo numbers no more than about 50 canopy-height trees located on clay soils towards the base of a drainage line. Extensive exploration of the surrounding areas has not located other stands of *Micklethwaitia*, so it is likely that this particular stand has only survived due to the site being considered as sacred by the local people.

At Lupangua *Micklethwaitia* is found on pale coastal clay soils with frequent calcareous rocks that would make the area difficult to cultivate. Local guides reported that it is used as a source of poles for constructing houses, as its timber is hard and termite resistant. This was confirmed by the observation of trees had coppice regenerated from stumps.

A further threat to Micklethwaitia was observed at Lupangua on a steep slope on the edge of the forest where fire had intruded and burned through the base of a number of trees, causing them to topple over. This would suggest that *Micklethwaitia* has very little resistance to fire.

The large number of individuals present at Lupangua, together with its current low threat of agricultural clearance (and therefore reduced risk of fire) means that this site therefore contains the least threatened and potentially largest remaining population of *Micklethwaitia*.

Map showing the known current distribution of *Micklethwaitia carvalhoi* (solid triangles) as well as the original collecting locality from where it has probably become extinct (open triangle).

Species list

The following plant species were collected/recorded at Lupangua, and identified at the Royal Botanic Gardens, Kew, UK:

Family	Species	Habitat	Vouchner no.	Notes
Acanthaceae	*Neuracanthus africanus* ssp. *africanus*	Woodland/forest margin	Clarke 137	SE Africa
Acanthaceae	*Ruellia prostrata*	Woodland	Müller 4178	Widespread
Anacardiaceae	*Lannea cf. schweinfurthii*	Scrub forest	Müller 4161	Widespread
Annonaceae	*Monodora grandidieri*	Forest	Müller 4169	Swahilian endemic
Annonaceae	*Monodora junodii*	Forest	Müller 4187	Tanzania to Natal and inland
Anthericaceae	*Chlorophytum amplexicaule*	Forest	Clarke 139	First lowland collection of species otherwise restricted to Tanzania, Mozambique and Zambia.
Bignoniceae	*Markhamia zanzibarica*	Woodland	Müller 4185	Widespread
Capparaceae	*Capparis sepiaria* var *stuhlmannii*	Forest	Müller 4193	Widespread
Capparaceae	*Thilachium africanum*	Forest	Clarke L3	Widespread
Combretaceae	*Terminalia sambesiaca*	Woodland, forest	Müller 4177	Widespread
Fabaceae (Caesalpinioidae)	*Bauhinia tomentosa*	Woodland	Clarke 142	Widespread
Fabaceae (Caesalpinioidae)	*Micklethwaitia carvalhoi*	Forest	Müller 4168	**Dominant canopy tree. Swahilian endemic monotypic genus restricted to Cabo Delgado 5th location for species/genus**
Fabaceae (Mimosoidae)	*Acacia nigrescens*	Woodland, occasionally in forest	Müller 4175	Widespread
Fabaceae (Mimosoidae)	*Acacia robusta* ssp. *usambarensis*	Woodland, occasionally in forest	Müller 4179	Species widespread, subspecies restricted to eastern Africa
Fabaceae (Mimosoidae)	*Albizia forbesii*	Woodland, occasionally in forest	Müller 4189	Widespread
Fabaceae (Papilionoidae)	*Erythrina* ?sp. nov.	Forest	Clarke 140	**Possible new species based on identification of leaves. Might be same as another sterile specimen collected nearby at Quiterajo**
Fabaceae (Papilionoidae	*Millettia stuhlmannii*	Forest	Müller 4170	Widespread

Labiatae	*Orthosiphon thymiflorus*	Forested river gully	Clarke 138	Widespread
Labiatae	*Premna schliebenii*	Forest	Müller 4171	**Swahilian endemic, usually found in lowland Eastern Arc; 2nd collection in Mozambique**
Opiliaceae	*Opilia amentacea*	Woodland	Müller 4180	Widespread
Salvadoraceae	*Dobera loranthifolia*	Forest	Müller 4163	Swahilian
Salvadoraceae	*Salvadora persica*	Forest	Müller 4188	Widespread
Sapindaceae	*Allophyllus rubifolius* var. *alnifolius*	Woodland	Müller 4182	Widespread
Sapotaceae	*Manilkara mochisia*	Scrub forest	Müller 4167	Wide eastern African coast
Sterculiaceae	*Hildegardia migeodii*	Forest	Clarke 141	**Swahilian. New to Mozambique; southernmost record for species**
Sterculiaceae	*Sterculia africana*	Forest	Müller 4173	Widespread
Tecophiliaceae	*Kabuyea hostifolia*	Woodland/forest margin	Clarke 136	**Swahilian endemic monotypic genus; southernmost record for species/genus; 2nd location in Mozambique**
Tiliaceae	*Grewia microcarpa*	Forest	Müller 4192	Swahilian & Guineo-Congolian

Lupangua hills, looking southwest. The white tree crowns in the foreground are baobabs *Adansonia digitata*, which are often associated with rocky areas in dry forest along the eastern African coast. Photo taken on the 27th April 2008, just after the end of the rainy season. Photo © Olivier Pascal.

Possible new species of *Erythrina* found at 12°34’27”S, 40°29’52”E (6 m tall tree above left and right, with leaf shown below left), and at 12°34’27”S, 40°29’55”E (12 m tall tree below right) within dry forest strongly dominated by *Micklethwaitia carvalhoi* on the top of the western ridge of the Lupangua hills. These trees differ from *Erythrina sacleuxii* by having a pair of prickles on the petiole, and a much smoother bark.

Rough-barked *Erythrina sacleuxii* located in a small stand of sacred forest strongly dominated by *Micklethwaitia carvalhoi* near the village of Maputo in the Quiterajo conservancy at 11°45'56"S, 40°16'06"E. Contrast with the smooth-barked *Erythrina* found in the Lupangua forests in the images opposite. Note also the difference in the shape of the spine bosses. Photo taken 1st December 2008, immediately after the first major showers marking the onset of the rainy season.

Summary and Recommendations

Dry Coastal Forest of the Swahilian Regional Centre of Endemism / Eastern African Coastal Forests hotspot is present on the low hills of the Lupangua peninsula, about 40 km north of Pemba in northern Mozambique. This forest and associated vegetation are remarkable for being in near pristine condition, and yet are situated right beside the sea, where human activity elsewhere in Eastern Africa has destroyed much of the original vegetation of the coastal plain.

The Lupangua forests cover some 25 km^2 and include areas that are strongly dominated by the canopy tree *Micklethwaitia carvalhoi*. The genus *Micklethwaitia* is monotypic, and is now restricted to 6 locations in northern Mozambique. The Lupangua forests contain the most important surviving population of this species and genus.

A possible new species of coral tree *Erythrina* ?sp. nov was collected in *Micklethwaitia* dominated forest at Lupangua.

The Lupangua forests are contained within the Quirimbas National Park, where exploitation of natural resources by local residents is permitted. It is therefore recommended that additional measures be implemented to prevent the modification/destruction of the Lupangua forests, to preserve a unique forest in a unique location beside the sea.

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This report can be downloaded from www.coastalforests.org

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