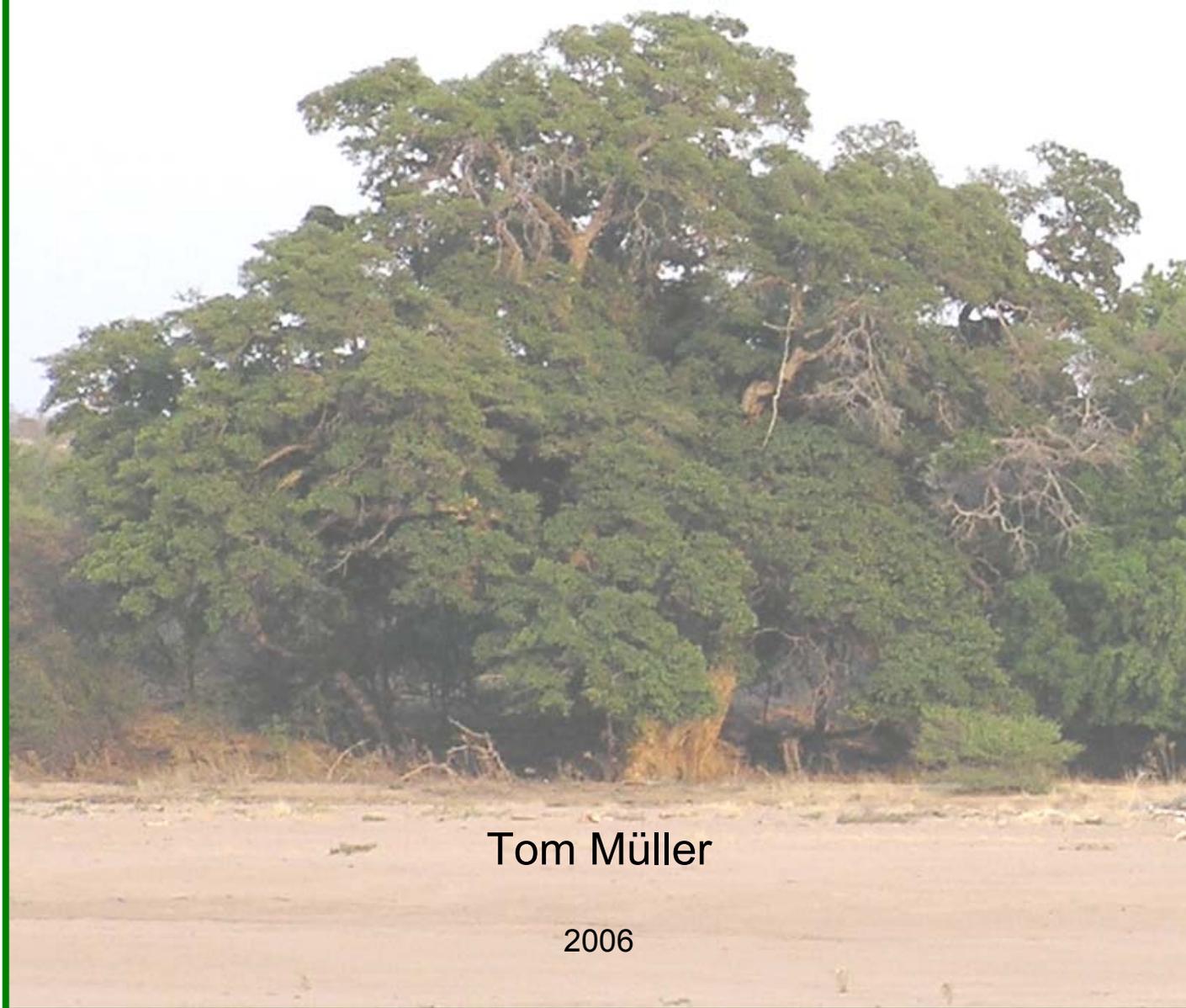




**THE
DISTRIBUTION, CLASSIFICATION AND
CONSERVATION OF RAINFORESTS IN
EASTERN ZIMBABWE**



Tom Müller

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Occasional Publications in Biodiversity No.19

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Originally prepared as a consultancy report for
the Zimbabwe Forestry Commission in June 1994

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SUMMARY

The distribution and a classification of the rainforest patches in Eastern Zimbabwe is presented, based on air photo interpretation and extensive field work. Twelve forest types are described based on their woody species composition. Altitude was found to be the major gradient.

The outlines of the forest patches are shown on 1:50,000 maps, and each patch or group of patches is numbered and described. Total forest area was found to be 107 km², the majority of this being in the Nyanga area.

Areas of particular interest for conservation are pointed out and conservation priorities outlined. Brief management recommendations are also given.

ACKNOWLEDGEMENTS

This report was originally done as a consultancy for the Research and Development Division of the Zimbabwe Forestry Commission in June 1994. It is the summary of two years of fieldwork, mostly carried out by the author in the 1970s as part of a wider study into rainforest distribution and composition in Eastern Zimbabwe carried out under the National Herbarium and Botanic Garden of Zimbabwe, Harare. The author wishes to acknowledge support given during that initial study by the Department of Research and Specialist Services of the Ministry of Agriculture. He also wishes to thank Jonathan Timberlake for help with the maps and preparation for publication.

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1. INTRODUCTION

The distribution of rainforest in the Eastern Districts of Zimbabwe is not fully known. There is also no classification available of the different rainforest types which can be recognised in accordance with environmental gradients. The Forestry Commission of Zimbabwe has therefore requested a consultancy which utilises existing unpublished information and personal field knowledge to classify and map the forests and also to make recommendations on conservation priorities. The resulting report is intended to serve as an initial base for biodiversity conservation of the rainforest biomes, and also to avoid the danger of removing forests without clear knowledge of their importance.

1.1 Terms of Reference

- a) Using existing annotated air photos, transfer interpreted extents of all indigenous moist forest patches in the Eastern Highlands of Zimbabwe onto 1:50,000 and 1:250,000 scale maps, and determine areas. Describe each area.
- b) Prepare a classification of the above forests based on species composition using existing field data, and allocate all forest patches shown to a forest type. Mention should also be made of those forests known to be excessively disturbed.
- c) Indicate which forest types and areas are of national or international priority for biodiversity conservation, after suitably excluding those known to be excessively disturbed.
- d) Describe in general terms what management practices should be employed or avoided in order to enhance conservation value of the various forest types.

2. RAINFOREST IN ZIMBABWE

Rainforest is extremely localised in Zimbabwe, and is found mainly on the windward slopes of mountains along the eastern border with Mozambique. It occurs between an altitude of 350 and 2100 m with a disjunct distribution, and consists of over 350 fragments stretching in a north-south direction for approximately 250 km. The individual forests range in size from less than one hectare to a few square kilometres. There are three main centres of rainforest development, which are (from north to south), the Nyanga mountains, the Vumba mountains and the mountains of the Chimanimani District. Smaller forests occur between the main centres and also in Chipinge District. Chirinda Forest makes up the southern end of the distribution. The total area covered by rainforest is approximately 107 km² (less than 0.028% of the country). If the steepness and undulating nature of the terrain on which forest is generally found is considered, the total area could be regarded as in the region of 120-150 km².

Where rainforest occurs, annual average rainfall is at least 1200 mm, with significant precipitation (mist and rain, or rain only) during the dry season. The main environmental variables which control the species distribution and determine the species composition of the various forest types are altitude, amount of available water (especially during the dry season), disturbance by man and, to a lesser extent, soil type, aspect and topography.

3. METHODS

3.1 Fieldwork

The information on which much of this report is based was gathered during field work which was carried out between 1976 and 1984. The work comprised a detailed investigation of 202 quarter hectare forest plots which were spread over the whole area where forest occurs. The positions of the plots was predetermined on air photos. In each sampling plot all the woody species with a diameter-at-breast height (dbh) of 8 cm and above were recorded. The species of the sapling and shrub layers and the ground cover were recorded using a Braun-Blanquet cover abundance rating. Epiphytes and bryophytes were also recorded. Soil samples were collected and all relevant environmental data were noted. The access routes to the sites often went through forest and these were used as transects along which the validity of newly developed hypotheses concerning species distribution in relation to environment was tested.

3.2 Analysis of Data

Analysis of the data was carried out with the aid of the computer programmes DECORANA (Detrended Correspondence Analysis; Ter Braak 1988) and TWINSpan (Two-Way Indicator Species Analysis; Hill 1979). However, no satisfactory analysis could be achieved by computer alone. The classification arrived at is essentially derived directly from the field sheets aided by computer-produced results and the experience gained from working in the forests.

3.3 Map Production and Calculation of Forest Area

All rainforest has been marked on air photos dating from 1965 and 1975, using field knowledge where appropriate. The outlines have been checked against the 1986 air photos and no significant changes have been noted, except for some small forests mainly in communal lands which are discussed later.

The forest distribution maps have been produced by transferring the forest outlines from the air photos on to 1:50,000 maps. The map which shows, schematically, the extent of rainforest in the eastern Districts has been produced by transferring the forest outlines by eye from the 1:50,000 maps on to the three relevant portions of 1:250,000 maps.

The extent of the area covered by rainforest was calculated from 1:50,000 maps by dot planimeter after transferring the forest outlines from 1:25,000 aerial photographs dating from 1965 to 1975. A rough estimate of the extent of each forest type has been made. Since forest type boundaries do not show up on aerial photographs it is impossible to make accurate estimates in cases where two or more types occur in one forest patch. Where the forest type changes with altitude, contour lines have been used as type boundaries for the purpose of the estimate. Where two or more types occur in the same altitudinal zone, the estimate is based on notes made on site visits during field work.

4. FOREST CLASSIFICATION

Altitude is the most important factor affecting the species composition of rainforest in Zimbabwe, and four major forest zones can be recognised based on it. Montane forest (above 1650 m), sub-montane forest (1350 to 1650 m), medium altitude forest (850 to 1350 m) and lowland forest (350 to 850 m). The altitudinal limits are approximate and vary considerably in accordance with aspect and relief. For instance, on warmer western and northern slopes species generally confined to lower altitudes are found higher up, and on slopes which allow for easy downward movement of cold air (long steep slopes) high altitude species are found further down the slopes than normal.

Using tree species composition as a criterion, the two upper zones can be divided into 10 forest types and the two lower zones are best considered as one type each. The majority of the forests, or portions of forests, can be classified with relative ease into recognisable and fairly homogeneous types. These, in turn, can be reconciled with the environment and repeat themselves in similar environmental situations. However, some forests do not fit well into the generally observed pattern and there seems to be no obvious environmental reason for these anomalies. There is evidence that many forests have been severely disturbed by man over several centuries which may be the reason for the difficulties in classification. The anomalies are described either as variants of the type which they most resemble or as intermediates between types where this seems appropriate.

4.1 Rainforest Types

The approximate extent of each forest type and its occurrence is summarised in Table 1.

4.1.1 MONTANE FOREST ZONE (above 1650 m)

Six montane forest types can be readily recognised.

4.1.1.1 *Syzygium masukuense* montane forest (Type 1, approximately 655 ha)

This is only found on the Nyangani massif, where it covers much of the area where forest can occur between 1700 to 2050 m. Where the forest is least disturbed, *Syzygium masukuense* accounts for up to two thirds or more of the total tree cover. Other common canopy trees are *Aphloia theiformis*, *Cassipourea malosana*, *Ilex mitis*, *Podocarpus latifolius*, *Prunus africana*, *Rapanea melanophloeos* and *Schefflera umbellifera*. No sub-canopy can be distinguished, but *Canthium oligocarpum*, *Diospyros whyteana*, *Dovyalis lucida*, *Erythrococca polyandra*, *Pavetta umtalensis*, *Peddiea africana* and *Psychotria zombamontana* are found as scattered small trees in the sapling layer. The shrub layer is dense and dominated by *Justicia betonica*, *Peddiea africana* and *Psychotria zombamontana*. Towards drier sites, *Syzygium masukuense* is less dominant and *Aphloia theiformis*, *Curtisia dentata*, *Ilex mitis*, *Macaranga mellifera*, *Maesa lanceolata*, *Rapanea melanophloeos* and *Schefflera umbellifera* more prominent. Lower down the slope the canopy is more mixed and species like *Cryptocarya transvaalensis*, *Faurea racemosa*, *Olea hochstetteri*, *Pterocelastrus echinatus* and *Tabernaemontana stapfiana* are more common. The canopy is 10 to 12 m in height with a few emergents up to 15 m, increasing to about 15 m in height with emergents up to 20 m towards the lower boundary.

4.1.1.2 *Afrocrania volkensii* montane forest (Type 2, approximately 375 ha)

This is a distinct forest type with a limited distribution on Nyangani mountain, where it is confined to wet boulder scree and the central portion of the high valleys, but is more extensive on mountains in the south-west of Chimanimani District where it occurs on gentle upper slopes or broad high valleys. A few small patches are found in the highest part of the Banti Forest Reserve. In the canopy *Afrocrania volkensii* can be dominant (Nyangani mountain) or co-dominant with *Ilex mitis* and *Olea hochstetteri* (Chimanimani District). Other common tree

species are *Ekebergia capensis*, *Kiggelaria africana*, and *Prunus africana* and *Calpurnia aurea*, *Canthium pauciflorum* subsp. *angustifolium*, *Diospyros whyteana*, *Halleria lucida* and *Trimeria grandiflora* are typical of the ill-defined second layer. *Peddiea africana*, *Psychotria zombamontana* and *Sclerochiton harveyanus* (Chimanimani District only) dominate the shrub layer. Canopy height is up to 30 m and the forests are relatively undisturbed.

4.1.1.3 *Widdringtonia nodiflora* forest (Type 3, approximately 40 ha)

This type of forest is limited in extent and distribution, occurring on the Nyanga mountains and on some mountains in the Chimanimani District, mainly between 1 700 and 2 100 m. It is principally confined to fringing streams in rainshadow areas where it is often affected by fire. This forest consists almost exclusively of *Widdringtonia nodiflora* or contains occasional specimens of *Curtisia dentata*, *Ilex mitis*, *Maesa lanceolata*, *Macaranga mellifera*, *Nuxia congesta*, *Rapanea melanophloeos* and *Schefflera umbellifera*. The height of the canopy rarely exceeds 10 m and stratification is poorly developed. At the end of its development this forest is more of a thicket consisting of scattered *Widdringtonia nodiflora* mixed with forest edge species such as *Buddleja salviifolia*, *Hypericum revolutum*, *Myrica pilulifera*, *Passerina montana*, *Erica hexandra*, *Stoebe vulgaris* and others. *Widdringtonia nodiflora* forest can hardly be considered rainforest proper in Zimbabwe and has only been mapped where it forms large stands and contains some other rainforest species.

4.1.1.4 *Ilex mitis* - *Schefflera umbellifera* - *Maesa lanceolata* montane forest (Type 4, approximately 695 ha)

This is a forest type confined to areas where conditions are probably too dry for either of the two *Syzygium* species to grow in abundance. It occurs mainly in small, often concave, patches or on ridges within and above the upper end of *Syzygium* dominated forest from about 1700 m to 2100 m (the upper end of rainforest development). Dominant canopy species are *Aphloia theiformis*, *Curtisia dentata*, *Faurea racemosa*, *Ilex mitis*, *Maesa lanceolata*, *Podocarpus latifolius*, *Rapanea melanophloeos* and *Schefflera umbellifera*. The forest type is extremely variable and could be considered an aggregate of sub-types. In different forests various of the above species are dominant or some may be absent. Other typical or occasional trees are *Cassipourea malosana*, *Ekebergia capensis*, *Halleria lucida*, *Kiggelaria africana*, *Macaranga mellifera*, *Syzygium guineense* subsp. *afromontanum* and *Tabernaemontana stapfiana*. *Diospyros whyteana*, *Dovyalis lucida*, *Erythroxylum emarginatum*, *Pittosporum viridiflorum* and *Trimeria grandifolia* are common smaller trees. The shrub layer is, on the whole, similar to that of *Syzygium*-dominated montane forest. Canopy height is variable, normally between 12 and 15 m, but can be up to 20 m with emergent specimens of 25 m. An interesting variant is the *Podocarpus latifolius* forest which occurs in the upper portion of the Banti Forest Reserve.

4.1.1.5 *Syzygium guineense* subsp. *afromontanum* montane forest (Type 5, approximately 2420 ha)

On the Nyangani massif this forest type is found at slightly lower altitudes than the *Syzygium masukuense* montane forest in the lower portion of the montane belt. Elsewhere it is the main montane forest type in areas where forest is relatively undisturbed and occurs up to about 1 900 m. On some slopes it can reach into the sub-montane belt as low down as 1 500 m.

Normally the dominant canopy tree species is *Syzygium guineense* subsp. *afromontanum*. *Aphloia theiformis*, *Cassipourea malosana*, *Cryptocarya transvaalensis*, *Olea hochstetteri*, *Pterocelastrus echinatus* and *Rapanea melanophloeos* are important associate species which can become co-dominant or even dominant in some areas. Other widespread trees are *Apodytes dimidiata*, *Bersama swynnertonii*, *Croton sylvaticus*, *Ekebergia capensis*, *Ilex mitis*, *Kiggelaria africana* and *Nuxia congesta*. *Curtisia dentata*, *Macaranga mellifera*, *Maesa lanceolata* and *Podocarpus latifolius* are often present and, together with *Aphloia theiformis* and *Rapanea melanophloeos*, increase towards drier sites and with increasing disturbance. The sub-canopy is well-developed and dominated by *Tabernaemontana stapfiana*, *Dovyalis lucida*, *Erythroxylum emarginatum*, *Eugenia nyassensis*, *Oxyanthus speciosus*, *Pavetta umtalensis*, *Rawsonia lucida*, *Xymalos*

monospora, *Chionanthus foveolatus* subsp. *major*, *Ochna holstii* and *Oricia bachmannii*. The latter three species can sometimes reach the canopy. *Justicia betonica*, *Peddiea africana*, *Psychotria zombamontana* and *Sclerochiton harveyanus* normally dominate the well-developed shrub layer. Canopy height increases with decreasing altitude from about 12 to 20 m, or even 25 m, with emergent trees up to 30 m.

4.1.1.6 Regenerating montane forest (Type 6, approximately 1935 ha)

This forest type is particularly common in the Nyanga and Vumba mountains where large areas of rainforest are in different stages of recovery from having been cleared during past times. All stages in between, from near-pristine *Syzygium* forest to forest which has been cleared as recently as 100 years ago, can be found. The dominant tree species is normally *Macaranga mellifera*, with *Aphloia theiformis*, *Maesa lanceolata* and *Schefflera umbellifera* often co-dominant. *Polyscias fulva* and *Allophylus abyssinica* can sometimes be fairly common, especially in the lower part of the montane belt. *Aphloia theiformis* dominates the sub-canopy, often together with *Xymalos monospora*. Most of the tree species which occur in the montane belt can be found in small numbers in regenerating forest. The shrub layer is generally similar to that in mature montane forest. The presence of *Cassinopsis tinifolia*, *Hypericum revolutum* and *Myrica pilulifera* indicate young regenerating forest. The canopy consists of even-aged stands of trees and can be between 15 and 20 m in height with emergent specimens up to 25 m.

4.1.2 SUB-MONTANE FOREST ZONE (1350 to 1650 m).

This can be considered an ecotonal belt of forest consisting of a mixture of montane and medium altitude tree species, with the proportion of medium altitude species increasing with decreasing altitude to about 50% or more in the lower parts. Four forest types can be distinguished in this zone, but intermediates occur.

4.1.2.1 Mixed sub-montane forest (Type 7, approximately 2130 ha)

This is the most mesic forest type in this zone, and can reach as high as 1750 m on the Chimanimani mountains, but more often the upper limit is between 1600 and 1650 m. On the Vumba mountains mixed sub-montane forest is found immediately beneath the *Syzygium guineense* subsp. *afromontanum* montane forest, but *S. g.* subsp. *afromontanum* is practically absent. Elsewhere it is an important component of the canopy cover right down to the lower parts. Generally the canopy is fairly mixed. Common species are *Cassipourea malosana*, *Nuxia congesta*, *Oricia bachmannii*, *Podocarpus latifolius*, *Rapanea melanophloeos* and *Syzygium guineense* subsp. *afromontanum* from the montane zone, *Cassipourea gummiflua*, *Chrysophyllum gorungosanum*, *Craibia brevicaudata* subsp. *baptistarum*, *Ficus chirindensis*, *F. craterostoma*, *F. scassellatii* and *Strombosia scheffleri* from the medium altitude zone. A tree found in all four zones, *Croton sylvaticus* is often prominent, and *Ekebergia capensis*, also found at all levels, is sometimes present. *Bersama swynnertonii* and *Margaritaria discoidea* var. *nitida* are occasional tree species which are mainly confined to this forest type. The sub-canopy is also composed of montane and medium altitude species. *Aphloia theiformis*, *Diospyros whyteana*, *Erythroxylum emarginatum*, *Ochna holstii*, *Oricia bachmannii*, *Oxyanthus speciosus*, *Tabernaemontana stapfiana* and *Xymalos monospora* are montane species, and *Cola greenwayi*, *Englerodendron magalismontanum*, *Garcinia kingaensis*, *Heinsenia diervilleoides*, *Myrianthus holstii*, *Rawsonia lucida*, *Rothmannia urcelliformis* and *Vangueria esculenta* are typical of medium altitude. The composition of the sub-canopy varies considerably, and up to four or five of any of the above species can be co-dominant. The most common species in the well developed shrub layer are *Justicia betonica*, *Psychotria zombamontana*, *Peddiea africana* and *Sclerochiton harveyanus*. Often there is a great variety of species in the shrub layer and up to 50 species have been recorded in the shrub layer of a 0.25 ha stand. Canopy height is from 25 to 35 m and emergents can reach 40 m. In a mature forest of this type species richness for trees reaches its peak for Zimbabwe. In a 0.25 ha stand 41 species with more than 8 cm dbh were recorded.

4.1.2.2 *Craibia brevicaudata* forest (Type 8, approximately 35 ha)

This forest type is fairly rare and is only found between 1400 and 1600 m and confined to granite boulder screes. The canopy consists almost entirely of *Craibia brevicaudata* subsp. *baptistarum*, with *Ficus chirindensis* and *F. scassellatii* as typical associates. *Cassipourea malosana*, *C. gummiflua*, *Croton sylvaticus* and the pioneer trees *Albizia schimperiana*, *Macaranga mellifera* and *Polyscias fulva* are occasionally present. *Craibia brevicaudata* subsp. *baptistarum* is also dominant in the sub-canopy, with *Dracaena steudneri*, *Rothmannia urcelliformis*, *Teclea nobilis* common and *Ritchiea albersii*, *Tabernaemontana stapfiana* and *Xymalos monospora* occasionally present. The shrub layer is patchy and irregular and is mainly developed where there are pockets of soil between boulders. The species composition is varied with *Dracaena fragrans*, *Metarungia pubinervia*, *Peddiea africana* sometimes common, but often a variety of young trees and climbers make up a substantial part of the shrub cover. Canopy height is 20 to 25 m, sometimes up to 30 m, with emergent fig trees up to 35 m.

4.1.2.3 *Albizia*-dominated regenerating forest (Type 9, approximately 380 ha)

Regenerating forest changes physiognomically below 1600 m due to the appearance of *Albizia gummifera* and *A. schimperiana* as dominant canopy trees. *A. schimperiana* is common on drier sites and *A. gummifera* common where there is more moisture. Sometimes these two species are mixed in various proportions. Other typical canopy trees are *Celtis africana*, *Croton sylvaticus*, *Polyscias fulva*, *Rauvolfia caffra* and *Sapium ellipticum*. *Macaranga mellifera* is still very common, either in the canopy or, more often, forming a high subcanopy immediately beneath the *Albizia* crowns. Common smaller trees are *Teclea nobilis* and *Xymalos monospora*. In the upper parts of the zone *Aphloia theiformis* can still be common, and lower down *Tarenna pavettoides* subsp. *affinis* is sometimes plentiful. In the early stages of regeneration *Trema orientalis* is often present. The shrub layer is well developed and similar to mixed sub-montane forest. The canopy height of an *Albizia*-dominated forest can be up to 40 m high with emergent *Albizias* up to nearly 50 m. This type of regenerating forest also occurs right through the medium altitude zone, down to about 1000 m.

4.1.2.4 *Albizia schimperiana* forest (Type 10, approximately 110 ha)

This is the driest type of rainforest before miombo woodland takes over. The transition to miombo is sudden and sharp. The dominant canopy species is usually *Albizia schimperiana*. As moisture increases, *A. gummifera* becomes more common, sometimes even dominant. Other characteristic trees are *Allophylus abyssinicus*, *Celtis africana*, *Ekebergia capensis*, *Ficus sur*, *Prunus africana* and, occasionally, *Croton sylvaticus*. *Curtisia dentata*, *Maesa lanceolata* and *Schefflera umbellifera* can be common in the upper part of the zone. Typical lower story trees are *Dracaena steudneri*, *Kiggelaria africana*, *Ochna holstii*, *Pittosporum viridiflorum*, *Teclea nobilis*, *Trimeria grandifolia* and *Xymalos monospora*. Towards the drier end of this forest type, forest-edge species such as *Calodendrum capense*, *Erythrina lysistemon*, *Fagaropsis angolensis*, *Ficus thonningii*, *Olinia vanguerioides*, *Scolopia zeyheri*, *Schrebera alata* and *Terminalia gazensis* become increasingly common and can reach the canopy. Here the canopy can be quite mixed with *Albizia schimperiana* less prominent. Smaller trees typical of the dry end of forest development are *Bridelia micrantha*, *Canthium inerme*, *Cussonia spicata*, *Dais cotinifolia* and *Rhus lucida*. The shrub layer can be similar to that in mixed sub-montane forest at the wetter end, and rather patchy and diverse at the drier end, where it consists of a mixture of young trees, forest-edge shrubs, twiners, young climbers and typical forest shrubs.

Canopy height is similar to the *Albizia*-dominated regenerating forest, but can be as low as 20 or 25 m where the *Albizias* are absent, and then the odd *Albizia schimperiana* emerges conspicuously.

4.1.3 MEDIUM ALTITUDE FOREST ZONE (850 to 1350 m).

In this zone there is a continuum from the wetter to drier stands, but they are sufficiently related to describe them as one unit. As already mentioned the regenerating forest is similar to that found in the zone above, except that *Cordia africana* and *Harungana madagascariensis* are additional species.

4.1.3.1 Medium altitude forest (Type 11, approximately 1370 ha)

By far the best example of medium altitude forest in Zimbabwe is Chirinda Forest in Chipinge District. Just over 600 ha in extent, it is a magnificent forest in a near pristine state, and contains the full array of species typical of medium altitude in Zimbabwe. Elsewhere, the species assemblage is reduced and medium altitude forest consists of relatively few small patches which are remnants of larger forests, mainly on the slopes of the Nyanga mountains. Apart from this, there are some naturally small fragments which correspond to moist environments of limited extent and are relatively inaccessible. In Chirinda Forest the dominant canopy species are *Chrysophyllum gorungosanum*, *Craibia brevicaudata* subsp. *baptistarum* and *Trichilia dregeana*. Elsewhere, in addition to these, *Newtonia buchananii* can be the dominant species, sometimes together with *Maranthes goetzeniana*. Other common canopy species are *Celtis gomphophylla*, *Croton sylvaticus*, *Diospyros abyssinica*, *Drypetes gerrardii*, *Ficus chirindensis*, *F. scassellatii*, *Khaya anthotheca* (*K. nyasica*), *Lovoa swynnertonii* (only at Chirinda) and *Strombosia scheffleri*.

The sub-canopy consists essentially of *Cassipourea malosana*, *Cola greenwayi*, *Celtis mildbraedii* (only Chirinda Forest), *Diospyros ferrea*, *Drypetes gerrardii*, *Englerodendron magalismontanum*, *Heinsenia diervilleoides*, *Myrianthus holstii*, *Orcia bachmanii*, *Pleiocarpa pycnantha*, *Rawsonia lucida*, *Rothmannia urcelliformis*, *Strychnos mellodora* (only in Chirinda Forest and satellites), *Strychnos usambarensis*, *Suregada procera*, *Trilepisium madagascariense* and *Vangueria esculenta*. *Tabernaemontana ventricosa* is a common small tree or shrub typical of medium altitude and lowland forest. *Chrysophyllum viridifolium* is occasionally present, sometimes even reaching the canopy. In the Nyanga area, *Englerodendron magalismontanum* is often the dominant sub-canopy tree. The shrub layer is dense and varied but often dominated by *Dracaena fragrans*. Canopy height is 50 to 55 m in Chirinda Forest with emergent trees to nearly 60 m. Elsewhere it is 40 to 45 m with emergent trees up to 50 m.

4.1.4 LOWLAND FOREST ZONE (350 to 850 m).

Very little rainforest remains in this zone and what there is is sufficiently similar to describe as one type.

4.1.4.1 Lowland forest (Type 12, approximately 490 ha)

Extremely small fragments of lowland forest exist in the Pungwe Valley and a little more than 2 km² in the Rusitu Valley. The dominant tree species in the canopy is *Newtonia buchananii*, while the other common trees are *Maranthes goetzeniana* and *Xylopia aethiopica*, with *Erythrophleum suaveolens* and *Khaya anthotheca* (*K. nyasica*) locally frequent. Occasional rare species are *Ficus bubu*, *F. exasperata*, *F. vallis-choudae* and *Milicia excelsa*. *Funtumia africana* often forms a high sub-canopy immediately beneath the *Newtonia* crowns. Other common sub-canopy trees are *Aporrhiza nitida*, *Blighia unijugata*, *Millettia stuhlmannii*, *Pachystela brevipes* and *Trilepisium madagascariense*. *Uapaca lissopyrena*, an unusual tree with stilt roots, is common in wet places and along small streams. The sapling layer contains a number of small trees, the most common ones are *Aidia micrantha*, *Englerodendron magalismontanum*, *Craterispermum schweinfurthii*, *Dracaena mannii* and *Tarenna pavettoides* subsp. *affinis*. The shrub layer is well developed and varied, dominated by young lianes and the offspring of tree species, especially *Funtumia*. The bamboo-like *Olyra latifolia* and the sub-shrub *Pseuderanthemum subviscosum* are common throughout. Locally abundant shrubs include *Afrosalsalisia kassneri*, *Drypetes arguta*, *Rinorea convallarioides*, *R. ferruginea*, *Tabernaemontana ventricosa*, *Tricalysia pallens* and *Vepris drummondii*. Where rivers or large

streams run through the forest, *Breonadia salicina*, *Cleistanthus apelatus*, *Khaya anthotheca* (*K. nyasica*), *Mascarenhasia arborescens*, *Rauvolfia caffra* and *Uapaca lissopyrena* commonly occur. An occasional member of this habitat is *Syzygium owariense*. Canopy height is in the region of 50 m.

Table 1. Extent of moist forest (hectares) in the Eastern Highlands.

Map sheet	Forest	Total	1	2	3	4	5	6	7	8	9	10	11	12
Troutbeck 1832 B2 & 1833 A1	Nyangui	10			10									
	Kwaraguza	55				55								
	Memba	170					135	35						
	E Nyanga	55							55					
	TOTAL	290			10	55	135	35	55					
Nyanga 1833 A3 & 1832 B4	Nyazengu	1365	205				400	350	400				10	
	Nyanga Block	2850	400	150		150	900	430	700				120	
	Nyanga Grassland	80			10	70								
	Pungwe Gorge N	620	50				280	220	50		10		10	
	Pungwe Gorge S	385				15	80	270			10		10	
	Pungwe Gorge E	725					100		565				60	
	Lower Pungwe valley	35												35
	Mtarazi Falls	255				10	30	150	5			30	30	
	TOTAL	6315	655	150	10	245	1790	1420	1720		20	30	240	35
Stapleford 1832 D2	Mtarazi Falls	5										5		
	Hope	15						15						
	John Meikle Res. Stn.	185					55	25	80		10		15	
	TOTAL	205					55	40	80		10	5	15	
Mutare 1832 D3	Imbeza	25							15		10			
Sheba 1832 D4	Lambton	50					10	30		5	5			
Zimunya 1932 B1	Cloudlands	235				20	50	75		10	80			
	Castle Beacon	135					40	50	20	5	15	5		
	TOTAL	370				20	90	125	20	15	95	5		
Vumba 1932 B2	Excelsior	195					70	80	20		20	5		
	Castleburn	150					60	35	40		15			
	Witchwood	180								5	125		50	
	Nyabanda	80											80	
	TOTAL	605					130	115	60	5	160	5	130	
Banti 1932 B4	Banti	200		15		70	40	40	35					
	Engwa/Chetora	105		10		95								
	Tambara	25				25								
	Grass Fell West	120				40	40	40						
	TOTAL	450		25		230	80	80	35					
Cashel 1932 D2	Steyns Stroom	120					40	70	10					
	Summervale	35			20	15								
	Martin Forest Res.	70				30	20	20						
	TOTAL	225			20	45	60	90	10					
Mukambiru 1932 D3	Gwendingwe	290		200		50						40		
	Mutema C.L.	40									5		35	
	TOTAL	330		200		50					5	40	35	
Chimanimani 1932 D4 & 1933 C1/C3	Greenmount	25										25		
	N Chimanimani	90				20	20		40	10				
	Central Chimanimani	75				5			70					

Map sheet	Forest	Total	1	2	3	4	5	6	7	8	9	10	11	12
	S Chimanimani	20												20
	Hayfield/Haroni	35												35
	Glencoe + Mermaids Grotto N	140				25	50		25		15		25	
	TOTAL	385				50	70		135	10	15	25	25	55
Chipinge 2032 B1	Glendalough	5											5	
	Moodies Rest	60											60	
	Dordrecht	25											20	5
	TOTAL	90											85	5
Junction Gate 2032 B2 & 2033 A1	Roslyn	10											10	
	Mermaids Grotto S	60									60			
	mid-Rusitu valley	20											10	10
	Haroni/Rusitu	385												385
	TOTAL	475									60		20	395
Mount Selinda 2032 B3	Chako	15											15	
	Chirinda/Chipete	800											800	
	TOTAL	815											815	
Tamandayi 2032 B4	Rattleshoek	5											5	
	GRAND TOTAL	10,635	655	375	40	695	2420	1935	2130	35	380	110	1370	490

Regenerating forest at this altitude consists of *Albizia adianthifolia*, *Anthocleista grandiflora*, *Harungana madagascariensis*, *Macaranga capensis*, *Trema orientalis* and, sometimes, *Cordia africana* and *Sapium ellipticum*. However, regenerating forest does not often grow up to canopy height as in the higher zones. Some of the hardwoods like *Newtonia* and *Xylopia aethiopica* grow through the *Harungana* and *Trema* when these are 10 m or less in height. There are a number of isolated small forest patches below 900 m altitude in the Rusitu Valley which differ somewhat from the main forest block. Some of them are dominated by *Newtonia buchananii* but others contain a mixture of low-altitude trees, forest-edge species and sometimes trees that are normally more common at medium altitudes. Trees which often occur in these forests, but by no means in all of them, are *Albizia gummifera*, *Bersama abyssinica*, *Blighia unijugata*, *Celtis africana*, *Ficus exasperata*, *Filicium decipiens*, *Glenniea africana*, *Sapium ellipticum*, *Trichilia dregeana*, *Xylopia parviflora* and *Zanha golungensis*.

5. DISTRIBUTION OF FORESTS

The extent of rainforest in eastern Zimbabwe is shown schematically on a map which consists of stuck together portions of the Mutare, Chimanimani and Chipinge 1:250,000 maps (see Appendix A). The outlines of the forests as transferred from the air photos are shown on over 40 sections of 1:50,000 maps and are contained in Appendix B.

The forests or group of forests have been numbered consecutively on the relevant 1:50 000 maps with the numbers running from north to south and east to west. The following text refers to the numbers on the maps giving a brief account on the forest types, state of degradation (only applicable in a few cases of Type 11 and 12 forests), points of special interest and conservation priorities if the forest are on private or Communal Land.

Troutbeck Sheet (1832 B2 & 1833 A1)

1. Most likely Type 3, but has not been investigated. One of the forests is on Forest Land, the other just outside on Rukotso on State Land.
2. Mature and well developed Type 4 especially in the eastern most portion. Some Type 6 is also present.
3. This should be mainly Type 5 and possibly Type 6. It has not been investigated, but *Olea hochstetteri* and *Syzygium guineense* subsp. *afromontanum* are clearly visible from the air.
4. From the altitude it can be assumed that most of these forests are Type 7, with the possibilities that Types 8 and 9 are also present. It has so far not been investigated. These forests occur on private land and are probably worthy of legal protection.

Inyanga Sheet (1832 B4 & 1833 A3)

5. This is Type 3 with some Type 4 species also present.
6. Consists of Types 1 and 6, above 1700 m, Type 5 below, and Type 7 in the lowest parts (mainly below 1550 m).
7. The smaller patches above the escarpment are mainly Types 4 and 6. The forest which stretches from the top to the Pungwe River consists of Types 1 and 6 on top, Type 5 on the mid-slopes and Type 7 below, with a mixture of Types 9 and 11 close to the Pungwe River.
8. Nine small patches of Type 10 or 11. These have not been investigated.
9. This is mainly Type 6 with some Type 5 in the less disturbed parts.
10. Mainly Type 6 with some Type 7 in the lower parts.
11. This is a well preserved and relatively pristine medium altitude forest (Type 11) situated below Mutarazi Falls. Over much of it *Aningeria adolfi-friedericii* is the dominant canopy tree, a species which, within Zimbabwe, is found only in this area.
12. These are Type 10 forests which also contain some, smaller, specimens of *Aningeria adolfi-friedericii*.
13. Mainly Type 4 forests with some Type 6 and 1 also present.

14. This is the largest block of rainforest in Zimbabwe. The upper portion consists mainly of Type 1 interspersed with Type 6, and Type 2 on boulder scree between the two escarpments on the south-eastern slope of Nyangani. Below this, there are extensive Type 5 and then Type 7 forests, and where the forest reaches below 1350 m there are smaller pockets of Type 11.
15. These are remnants of the large medium altitude forests (Type 11) which were cleared to make room for the tea plantations. Much of it is regenerating forest and contains elements of the lower form of Type 9.
16. Another larger block of rainforest which shows similar catenas down the slopes as number 15, but only down to Type 7. It also contains extensive Type 6 nodules. In the uppermost forest, SSW of Tuckers Gap is a very good example of Type 2 on a boulder scree.
17. These are most probably Type 9 forests, but have not been investigated.
18. These are the extensive forests which cover the southern end of the Nyazengu ridge. There is Type 5 on top, grading into some very good examples of Type 7, with some Type 11 at the very bottom.
19. A cluster of small Type 11 forests dominated by *Newtonia buchananii*.
20. Most likely Type 9 with some Type 11, but have not been properly investigated.
21. Although the altitude is relatively high, this is one of the last few Type 12 forests in the Pungwe Valley.
22. The Rumbisi Hill forest, consists only of *Newtonia buchananii* and *Aidia micrantha*, the latter forming a relatively low sub-canopy.
23. Mainly regenerating Type 11 with some smaller more mature patches in the upper central part of the forest.
24. A small relatively mature Type 11 forest which is on private land and merits protection as a Botanical Reserve.
25. Two very small Type 12 forests surrounded by tea plantations. At present protected by the Tea Estate, but worth gazettement as a Botanical Reserve.
26. Regenerating Type 12 forest, consisting mainly of *Albizia adianthifolia*, *Macaranga capensis* and young *Newtonia buchananii*.
27. The Pungwe Bridge forest was degazetted as a Botanical Reserve in the early 1980s. Although severely degraded it is by no means beyond recovery and merits to be gazetted again as Reserve since it is one of the very few remaining Type 12 forests in the Pungwe valley.

Stapleford Sheet (1832 D2)

28. This is a low altitude form of Type 10 with some *Aningeria adolfi-friedericii* present, mainly in the sub-canopy.
29. Consists essentially of Type 6.
30. The upper region of this fairly large forest consists mainly of Type 6 interspersed with Type 5. Further down the slope there is mainly Type 7, some of which contains numerous *Podocarpus latifolius*, especially in the sub-canopy, and Type 8 on a boulder scree. One

of the best examples of Type 9 is found about halfway down the slope, consisting mainly of very large specimens of *Albizia gummifera*. Towards the bottom end of the slope Type 7 forest grades into a small patch of Type 11. This is a very interesting forest situated mainly on the south-eastern slope of a steep-sided valley beneath Mt. Rupere next to John Meikle Forest Research Station. It contains six different forest types and many interesting species. In the Type 7 forest of the middle slope there are numerous specimens of *Bersama swynnertonii*, an otherwise rare tree. From the Type 6 forest of the upper slopes comes the only record of *Tricalysia acocantheroides* for Zimbabwe.

31. This is one of the best developed and preserved Type 5 forests seen in Zimbabwe. It covers the top and the upper eastern slopes of Mt. Chinyamariro and belongs to a private forest estate. This forest merits gazetting as a Botanical Reserve.
32. A Type 11 forest situated at the foot of a cliff. At the forest edge are numerous specimens of the endangered *Encephalartos manikensis*.
33. This is most likely Type 7 grading into Type 11 towards the lower end, but has not been investigated.

Except for No. 31, all forests marked on this sheet are on Forest Land.

Mutare Sheet (1832 D3)

34. A mixture of Types 7 and 9 due to disturbance. This is on private land, and if it is still there, should be gazetted a Botanical Reserve.

Sheba Sheet (1832 D4)

35. Consists mainly of Type 6 with some Type 5 interspersed, and Type 9 below 1500 m.
36. Mainly Type 9 mixed with small patches of Type 8.

Zimunya Sheet (1932 B1)

37. The north-eastern side of the mountain is covered with Type 9. The original forest was cleared before 1940. There is some Type 8 on a boulder scree beneath the steepest part of the slope. On top and on the south-eastern slopes there is a mixture of Types 5 and 6.
38. There is Type 4 on top of the ridge, especially along the forest edges and in the smaller patches. On the main slope there are mainly Types 5 and 6.
39. Type 5 forest along a valley with some patches of Type 6.
40. Patches of Type 6.
41. A Type 10 forest in the lower portion, with Type 8 above.
42. Relatively well preserved Type 5 with small holdings and settlement in-between.
43. Types 5 and 6 in the upper parts and essentially Type 9 lower down with pockets of Type 7 in the less disturbed areas. Nos. 41 and 43 contain unusual vegetation, they are on private land and worthy of legal protection.

Vumba Sheet (1932 B2)

44. A mixture of Types 9 and 10.
45. Essentially Types 5 and 6 with transition into Type 7 in the lowest parts.
46. A mixture of Types 5 and 6 with some Types 7 and 9 in the lower portion of the valley.
47. Small patches of Type 9, probably the regenerating remnants of a large Type 11 forest which once covered a good portion of the area.
48. This is the well known Bunga Forest. The hilltop and the upper slopes are covered with Type 5, interspersed with some pockets of Type 6. The lower slopes at the southern end are very good examples of Type 7 with a high number of different woody species. Most of Bunga Forest is protected in a National Park. The best portion of Type 7 is however on private land and should be gazetted a Botanical Reserve.
49. A very interesting Type 11 forest surrounded by *Brachystegia spiciformis* woodland. It is on private land and should, together with some of the surrounding woodland, be gazetted as a Botanical Reserve.
50. These are two Type 9 forests, with small groups of trees from the original Type 7 left. Because of the Type 7 elements the eastern one contains, it is worthy of legal protection.
51. A very good example of Type 8, which merits legal protection.
52. These are fairly extensive Type 9 forests. The original forest was cleared earlier this century.
53. A very small Type 11 forest surrounded by fields. The last remnant of a much larger forest which had to give way to agricultural development.
54. *Newtonia buchananii* and *Trilepisium madagascariense*-dominated Type 11 forest.
55. Type 11 forest which has not been investigated.
56. Mixed species Type 11 forest with similarities to Chirinda Forest.
57. Type 11 forest which has not been investigated.
58. *Newtonia buchananii* and *Trilepisium madagascariense*-dominated Type 11. The only known locality for *Monanthotaxis buchananii* in Zimbabwe.
59. Mixed species type 11. The only known locality for *Pancovia golungensis* in Zimbabwe.

The few medium altitude forest patches found on the slope down to the Burma Valley are all on private land and without exception worthy of being declared Botanical Reserves (Nos. 53 to 59).

Banti Sheet (1932 B4)

60. Mainly Type 4 with patches of Type 2 on concave slopes.
61. Type 4 on the upper slopes with *Podocarpus latifolius* the dominant canopy species over much of the area. *Schefflera umbellifera* is dominant on ridges and towards the upper edge of the forest where there is less moisture available. There is Type 5 interspersed with Type 6 on the mid-slopes, and some well developed Type 7 and small patches of Type 8 in the

lowest portion. *Afrocrania volkensii* is found along the streams almost to the end of the forest.

62. This could be Type 7, but has not been investigated.
63. Probably Type 4 forest with Type 2 along the streams, but has not been properly investigated.
64. Most likely Type 4 or possibly Type 3, but has not been investigated.
65. Could be Type 6 with some Type 4 or 5. Visited by the author 20 years ago without a thorough investigation being made.

Except for No. 63 and the two northernmost forest of 64, all forests on this sheet are on Forest Land.

Cashel Sheet (1932 D2)

66. Could be Types 5, 6, or 7. Has not been investigated.
67. Most likely Type 3, otherwise Type 4. Has not been investigated.
68. Could be Type 4, 5 or 6. Has not been investigated.

Nos. 66 and 67 are on Forest Land, No. 68 is on private land.

Makambiru Sheet (1932 D3)

69. These two patches have not been investigated, but could be similar to No. 71 or a form of Type 9.
70. This is essentially a Type 11 forest, although its altitude is between 1300 and 1480 m, which is rather high. It has, however, some species typical of Type 7 and *Newtonia*, often present in Type 11 outliers, is practically absent (one small shrub recorded). The *Chrysophyllum gorungosanum*-dominated forest is usually rich in species, but badly degraded in places. Much of the understory has been removed, probably to use as poles. It is the only place in Zimbabwe, apart from one seedling found on a fire break on Mt. Pene in a pine plantation, where *Ocotea kenyensis* has been recorded (two specimens in the shrub layer).
71. A Type 11 forest dominated by *Newtonia buchananii*. Most of it was already cleared by advancing settlements in 1984 and it is not known how much exists to day.

It is hoped that it is not too late to protect what still remains of these very interesting forests in Mutema Communal Land (Nos. 69, 70 and 71).

72. A small patch of Type 10.
73. Type 2 forest, the only locality in Zimbabwe where large specimens of *Scolopia mundii* have been recorded.
74. Along the margins of the valley there is Type 4, the inner portion is covered with Type 2. There are many large specimens of *Afrocrania volkensii*, *Ekebergia capensis*, *Ilex mitis* and *Olea hochstetteri*.

75. These forests are like No. 74 in their upper parts, in the middle and lower portions there is a rather mixed Type 10 (below 1550 m) consisting of some *Albizia schimperiana* with a variety of forest-margin species, among which are some very large specimens of *Scolopia zeyheri*.
76. These have not been investigated, but are probably similar to No. 75. The forests marked on this sheet are very unusual and different from other forests in Zimbabwe. All except the ones marked No. 76 are on Forest Land and it is assumed that they will receive adequate protection. The No. 76 forests are on private land (Rookwood and Cecilton) and should be investigated with view to gazetting them Botanical Reserves.

Chimanimani Sheet (1932 D4 & 1933 C1/C3)

77. This is a Type 10 forest, and *Albizia gummifera* is the most common canopy tree. It is on private land and should be legally protected.
78. Most of the valley consists of Type 9 which is about 45 years old. There were settlements along the valley which were removed during the late 1940s. The northern upper portion of the forest consists of relatively untouched Type 11.
79. This is Type 5 merging into Type 7 downwards.
80. This relatively large forest covers the south eastern slopes of Mt. Pene. On the uppermost slopes there is Type 4 grading soon into well developed and mature Type 5, generally dominated by *Syzygium guineense* subsp. *afromontanum*. In some areas *Olea hochstetteri* is co-dominant or even dominant. Lower down the slopes Type 5 gives way to well preserved Type 7. *Schefflera umbellifera* is the dominant tree as far down as 1450 m on a long ridge near the eastern margin of the forest. Near the main streams on the mid-slopes are large stands of the otherwise rare *Cyathea capensis* tree fern.

Nos. 78 to 80 are on Forest Land.

81. A species-rich forest which is a mixture of Types 5 and 7, with some small patches of Type 8.
82. Several small Type 4 forests but containing some species typical of Types 5 and 7.
83. A very well developed and undisturbed Type 7 forest on the steep slopes of a hidden valley and dominated by large specimens of *Chrysophyllum gorungosanum*.
84. Probably similar to No. 82, but has not been investigated.
85. This is most likely a form of Type 12 or otherwise similar to No. 87, but has not been investigated. The westernmost of these two forest patches is on Forest Land.
86. A Type 12 forest with some riverine forest species close to the stream. Looks like a remnant of a larger forest which probably covered much of the bottom part and some of the less steep slopes of the lower Haroni valley. There are many disjunct patches of regenerating forest scattered around the area.
87. Looks physiognomically much like rainforest but contains many forest-margin species. No particular tree is dominant in the canopy and the forest does not resemble the normal Type 12. Probably represents the dry end of the lowland rainforest spectrum.
88. A Type 12 forest on a steep and dissected slope above the Rusitu River. There are some riverine forest species present and *Brachystegia spiciformis* was recorded about 50 m inside the forest edge.

Chipinge Sheet (2032 B1)

89. Probably similar to No. 71 but has not been investigated. It could be an interesting forest.
90. Probably Type 11, but has not been investigated.
91. This is a partly degraded Type 11 forest consisting of patches of regenerating forest and areas of well-preserved mature forest.
92. A rather disjunct Type 11 forest which has been reduced to a few patches of closed canopy. There are indications that this was once a dry form of Type 11 containing a fair proportion of marginal forest species.
93. A mixed Type 11 forest in a well preserved state with a high density of *Cleistanthus apetalus* and *Englerodendron magalismontanum* in the sub-canopy. *C. apetalus* is normally found in Type 12 forest mainly near rivers and streams.
94. A small Type 12 forest on a steep slope with scattered boulders, dominated by *Khaya anthotheca* and *Craibia brevicaudata*. The otherwise rare *Glennia africana* is the most common sub-canopy tree.
95. A small atypical Type 12 forest on a dolerite outcrop which protrudes from the main slope to the Rusitu river. The dominant canopy tree is *Trichilia dregeana*, with *Zanha golungensis* and *Ficus thonningii* also common. The main sub-canopy species is *Trilepisium madagascariense*, followed by *Blighia unijugata* and *Teclea nobilis*.
96. A very small regenerating Type 12 forest dominated by marginal forest species such as *Celtis africana*, *Xylopia parviflora*, *Zanha golungensis* and the pioneer species *Albizia adianthifolia*. *Dracaena mannii* and *Bersama abyssinica* subsp. *nyassae* are the most common smaller trees.

Forests Nos. 89 and 90 are on Communal Land, Nos. 91 and 92 on private land and Nos. 92 to 95 are on a ARDA Estate. All of them are worth gazetting as Botanical Reserves.

Junction Gate Sheet (2032 B2 & 2033 A1)

97. Essentially a regenerating Type 11 forest with a very patchy canopy. *Craibia brevicaudata* and *Croton sylvaticus* are the main large trees and *C. brevicaudata*, *Englerodendron magalismontanum*, *Myrianthus holstii* and *Trilepisium madagascariense* the most common smaller trees.
98. Small Type 11 forest consisting mainly of *Newtonia buchananii* with *Trilepisium madagascariense* beneath. There are only small patches of continuous canopy and most of the forest is fairly degraded. Grades into woodland above and on either side.
99. Two small Type 11 forests on a flattish shelf above the last slope to the Rusitu river consisting mainly of large specimens of *Trichilia dregeana* with pioneer and marginal forest species.
100. This is a most interesting and species-rich ecotonal forest with features of Types 11 and 12. The flattish western portion has only a few canopy trees left, mainly *Newtonia buchananii*. The steeper slopes to a stream beneath have patches of relatively well preserved original forest species. From here comes the only record of *Acridocarpus natalitius* and *Combretum umbricola* for Zimbabwe.
101. Four small, probably marginal, Type 12 forests which have not been investigated. The two westerns one are on private land, the others on Communal Land.

102. A mosaic of Type 12 with some riverine forest species and regenerating forest. People were moved out of this area after it was declared part of Chimanimani National Park. Most of the disturbed forest is regenerating extremely well. The western-most portion is on private land.
103. This is the Rusitu Botanical Reserve, a remnant of a much larger forest, and is threatened by agricultural development. However efforts are being made at present to mark out the reserve clearly and to give it better protection. It is the only locality for *Rinorea arborea* in Zimbabwe and also contains the very rare *Coffea salvatrix* and *Ficus vallis-choudae*. Up the slope the forest grades into *Brachystegia* woodland.
104. Mainly regenerating Type 12 forest with only a few groups of the original trees left.
105. This is the Haroni/Makurupini Forest, the largest and best preserved Type 12 forest left in Zimbabwe. Uphill into the Chimanimani mountains it borders on *Brachystegia microphylla* woodland. The hills to the east in Mozambique are covered with *Brachystegia spiciformis* woodland. Most of the forest is well developed and shows a mature age structure. There are, however, areas with younger forest as well as two patches of regenerating forest which were cleared in the 1970s. This is the only locality in Zimbabwe for *Afrosersalisia kassneri*, *Combretum coriifolium*, *Dichapetalum madagascariense*, *Eugenia woodii*, *Ficus bubu*, *Memecylon sansibaricum* var. *buchananii*, *Rinorea ilicifolia*, *Rourea minor* *Sclerochiton caerulea*, *Trichoscypha ulugurensis*, *Voacanga africana* and *V. thouarsii* - all woody species. It is also one of only two localities for *Milicia excelsa*, a well-known timber tree. Beside this, it contains several fern, orchid and herbaceous species found nowhere else in Zimbabwe.
106. This is the Haroni Botanical Reserve, which has been very much reduced over the last 10 years, and although legally protected is in danger of total extinction.

The forests numbered 97, 98, 99 and 100 are either on private land (100) or on an ARDA estate. All should be given legal protection. The four small forests numbered 101 are on Communal Land and need to be investigated before a decision on their protection can be made.

Mt. Selinda Sheet (2032 B2)

107. Chirinda Forest, in every respect the best medium altitude forest found in Zimbabwe (Type 11). It is in a nearly pristine state and shows a mature age structure with regards to its woody species. The Forestry Commission, who is responsible for it, have recognised this. Their efforts to enhance the conservation status of the forest are timely and will make an important contribution to genetic resources conservation. Woody species for which Chirinda is the only locality in Zimbabwe are: *Allophylus chirindensis*, *Argomuellera macrophylla*, *Celtis mildbraedii*, *Didymosalpinx norae*, *Excoecaria madagascariensis*, *Gardenia posoquerioides*, *Lovoa swynnertonii*, *Necepsia castaneifolia* var. *chirindica* (endemic), *Strychnos mellodora*, *Swynnertonia cardinea* (endemic) and *Zanthoxylum gillettii*. Apart from one tree found in the Mutarazi forest, it is also the only locality for *Alangium chinense*.
108. Chipete Forest, a small satellite of Chirinda. Some time ago there were settlements in this forest, much of it is therefore degraded and the canopy exists only in patches. Regeneration is hampered by an abundance of lianas which cover much of the ground. This has not been noticed elsewhere and is difficult to explain.
109. A very small Chirinda outlier dominated by *Ekebergia capensis*. This is the last of several similar small forests on private land and should be legally protected.

110. A small forest in the Chinyaduma Small Scale Commercial Farming Area which has been successively decimated over the last 25 years and is now practically obliterated. This was once a drier version of Chirinda and if protected could still regenerate into a potentially interesting forest. It is the only locality for *Mallotus oppositifolius* in Zimbabwe. Despite the advanced degradation, gazettement the area as a Botanical Reserve is considered worthwhile.

Tamandayi Sheet (2032 B4)

111. A small forest which is transitional between Types 11 and 12. It is dominated by *Newtonia buchananii* and contains a good number of marginal forest species. Large trees are only found in the upper portion, the rest is severely degraded.

Table 2. Extent of rainforest in 'natural' geographical units.

Area	Extent (ha)	% total forest
Nyangui	10	0.09
Kwaraguza	55	0.52
Nyafaru	165	1.55
Nyanga Block/Gleneagles	2900	27.27
Nyazengu/Pungwe Gorge	3180	29.90
Lower Pungwe Valley	35	0.33
Mtarazi Falls	260	2.44
Stapleford/Sheba	255	2.40
Mutare	25	0.24
Vumba North	430	4.04
Vumba South & East	545	5.12
Banti, Engwa, Chetora	305	2.87
Mudima, Nyambena, Tandai Forests	300	2.82
Chikukwa C.L.	70	0.66
Gwendingwe	290	2.73
Mutema C.L.	40	0.38
Mermaids Grotto/Glencoe	200	1.88
Chimanimani Nat. Park	190	1.79
Chimanimani Town	25	0.24
Haroni/Rusitu/Chisengu rivers	425	4.00
Upper Rusitu Valley	35	0.33
Waterfalls	60	0.56
Chipinge Tea Estates	20	0.19
Mount Selinda area	815	7.66
TOTAL	10,635	100.01

5.1 Geographical Units of Rainforest

Table 2 shows the extent of rain forest groups in "natural" geographical units as determined from the 1:50,000 map sheets. Almost 60% of the total forest area is associated with the Nyanga massif, nearly all of it is within National Parks. Approximately 9% occurs on the Vumba Mountains, Chirinda forest comprises 7.5% and the Haroni / Rusitu / Chisengu forest make up approximately 4%.

6. CONSERVATION

6.1 Overview

Out of nearly 6000 vascular plants recorded in Zimbabwe, about 740 occur in rainforest. They comprise 125 Pteridophytes, 3 Gymnosperms, 90 Monocotyledons (of which 46 are Orchidaceae and 17 Poaceae) and 520 Dicotyledons. Only one endemic (*Swynnertonia cardinea*) and few endangered species occur, and species richness is low compared with the forests of the equator region. Most of the species rare in Zimbabwe are common elsewhere. Nevertheless, conservation of rainforest is considered to be of utmost importance. Approximately 430 (almost 40%) of the 1180 woody species recorded for this country are confined to rainforest, 265 of which are trees with a diameter of at least 8 cm. Furthermore, the forests occur at the dry end of rainforest distribution and it can be assumed that unusual ecotypes and genotypes are contained in them. Apart from this the forests are of great aesthetic value and part of our national heritage. Because of this alone, efforts should be made to ensure their survival. The protection of rainforest is also in line with the National Conservation Strategy (1978) which states that examples of all natural ecosystems and vegetation types should be protected.

Practically all montane forest is at present well protected, with much of it falling under the Department of National Parks and Wildlife Management, some of it is on Forest Land. The relatively small remainder is either on private land, mainly forest estates, or on Communal Land. Much of it is protected by its inaccessibility and the extent of montane forest has probably not been significantly reduced by man.

Sub-montane forest is naturally less widespread than montane forest, and since some of the environment on which it occurs is suitable for agriculture a significant portion of it has been destroyed, especially on the lower slopes of the Vumba and Nyanga mountains. Today small patches of sub-montane forest are found in Banti, Stapleford and Tarka Forest Land and on private land on the Vumba mountains. More extensive sub-montane forest occurs on the Nyanga mountains, the majority of which is within National Parks.

At medium altitudes, since such forests are out of the main mist belt and receives less orographic rain than the higher regions, rainforest is confined to unusual environments where special mechanisms operate which ensure that sufficient water is provided during the dry season for rainforest to establish and maintain itself. This forest zone falls within an altitude range where the land flattens and the climate is more equable. Rainforest, therefore, is in conflict with agriculture. It is estimated that in the South-East (Chimanimani and Chipinge Districts) medium altitude forest may have once covered up to 120 km², and in the Vumba and Nyanga mountains combined may have been as much as 70 to 100 km². Since the beginning of this century this has been reduced to less than 10 km². Today Chirinda Forest on Mt. Selinda is the best developed and preserved example of medium altitude forest. It is on Forest Land and protected by the Forestry Commission. Some smaller patches are found on the lower slopes of the Nyanga mountains within Nyanga National Park, on Forest Land in Chimanimani District (Mermaids Grotto), on private land on the lower slopes of the Vumba mountains and on the ARDA estate in the Rusitu Valley and in Mutema Communal Land (Chipinge District).

There are only two valleys in this country at sufficiently low altitude and with sufficiently high rainfall to support lowland rainforest. These are the Pungwe valley at the eastern foot of the Nyangani massif and the Rusitu valley south-east of the Chimanimani mountains. In the Pungwe valley, practically all of the 30-40 km² of lowland rainforest which possibly existed in the early part of this century has been cleared, with most of the last few hectares having been destroyed since 1980. Apart from pure *Newtonia buchananii* forest on an isolated hill (Rumbisi forest), and a few patches on Aberfoyle Tea Estate, all that remains are occasional groups of trees and some small fragments of regenerating forest which indicates where rainforest could occur. One continuous block of lowland forest, approximately 2 km² in extent and protected by National Parks, and a few very small and threatened forest patches in the adjacent Communal Land is all

that is left in the Rusitu Valley. These are the remnants of what must have been once the largest continuous lowland forest in Zimbabwe, stretching for 30-40 km² in a strip along the flat-bottomed Rusitu Valley.

A major breakthrough for rainforest conservation occurred when National Parks acquired 136 km² of land in the Nyanga mountains, including the rugged eastern portion of the Nyangani massif which contains on its lowest slopes some of the last remaining medium altitude forest in the area. The acquisition also includes several slopes with continuous forest catenas, covering an altitudinal range from 1150 to 2100 m.

6.2 Forest Regeneration

There are some good examples which illustrate that if available moisture, especially during the dry season, is sufficient to support rainforest, rainforest will re-establish itself even if it has been cleared for settlement. Canopy height in a regenerating forest can be attained within 25 to 30 years. However, it might take several hundred years until the species composition and age structure of climax forest is reached. These observations suggest that there is merit in protecting degraded forest, even more so if some of the original trees are still in place

There are also examples where cleared forest has not come back after removing settlements, and there are cases where cutting lines are still visible after 25 years. However these are exceptions and they are difficult to explain. It could be that the areas are particularly prone to fire or that the environment is marginal for forest development. In the latter case it could be that the shift in microclimate after clearing is such that it renders the environment too dry for re-establishment.

6.3 Forest Conservation and Fire

It is often believed that fire is a danger to forest and that the extent of the forest is gradually reduced by it. Observations over the last 30 years do not confirm this for Zimbabwe. The natural boundary line of a forest is normally related to the amount of available moisture and not to fire. There is also always a dense belt of forest edge vegetation which protects the forest inside. The edge often gets badly burned but recovers during the following rains. However, there are cases where narrow strips of forest along streams or very small patches of forest are totally burned down, especially if there is an exceptional fuel load due to accumulation of litter over several years. This, however, seems to be a periodic event and the forest always comes back.

6.4 Degradation of Rainforest

There is little up-to-date information available on degradation of rainforest in Zimbabwe, and without revisiting the majority of the sites no firm statement on the status of the forests with regards to degeneration can be made. From occasional visits to some of the forests it is assumed that the majority of them are still in the same sound state they were 10 to 15 years ago when field work was carried out and that, on the whole, very little degeneration is taking place. The exceptions are the lower Rusitu Valley (Ngorima Communal Lands), the Mount Selinda area (Chinyaduma Purchase Land) (Timberlake, pers. comm.), the lower Pungwe Valley (Holdenby Communal Lands) (Timberlake, 1994) and the Mutema Communal Land where some small but most interesting patches of medium altitude and lowland forest were found to be partially to severely degraded 12 years ago. Some of them have been further cleared or eliminated since then. There are also some small medium and lowland forests in the Chipinge area and one medium altitude forest in the Vumba area which were significantly degraded 12 years ago, but their present status is not known. Degradation, in a few cases where it is applicable, is also mentioned in the account on individual forests.

6.5 Conservation Recommendations

6.5.1 General Considerations

It is of importance both to national and international conservation that representative examples of each forest type which exists in Zimbabwe are protected. *Afrocrania volkensii* montane forest (Type 2), *Widdringtonia nodiflora* forest (Type 3), *Craibia brevicaudata* forest (Type 8) and *Albizia schimperiana* forest (Type 10) are naturally of limited distribution that all that occurs of these types should be protected. Sub-montane forest (Type 7), medium altitude forest (Type 11) and lowland forest (Type 12) have been so drastically reduced that all that still exists, even if partly degraded, should be considered of national and international importance and a top conservation priority.

6.5.2 Botanical Reserves

Fortunately most of the rainforest is either in National Parks or on Forestry Land. It is part of the mandate of National Parks to protect what it is on their land and it is assumed that the Forestry Commission will make it their policy to do the same.

There are, however, some interesting forests of national or international importance outside National Parks and Forest Land which merit protection. The established procedure to do this is to give them legal protection by gazetting them as Botanical Reserves. However, without the cooperation of the people who live in the vicinity, it is extremely difficult to maintain a Botanical Reserve and ways have to be found to get the local people interested.

When preparing a case for a Reserve it will be necessary to investigate or reinvestigate the site to obtain up-to-date information on the state of the forest and also to work out proposals for the boundary.

6.5.2.1 Reserve Boundaries

When determining the boundary of a rainforest reserve it is desirable to include, if possible, a buffer zone consisting of the surrounding woodland or grassland within the protected area.

6.5.2.2 Botanical Reserves on Communal Land

The most urgent conservation priority is the protection of the few remnants of medium and low altitude forest on Communal Land all of which are of national and international importance. They are in acute danger of elimination and efforts to conserve them should start immediately. The first step is probably to commence negotiations with the Conservation Committees of the relevant Rural Councils. The following are map and grid square references for the proposed reserves:

Inyangani sheet (1832 B4) Grid Square Ref. 9467, No.27; Pungwe Bridge Forest

Stapleford Forest (1832 D) Grid Square Ref. 7654, No. 28; about half is in Mtarazi Falls National Park.

Makambiru Sheet (1932 D3) Grid Square Ref. 5789, 5889, 5788, 5789, No. 69, 70 and 71; in Mutema Communal Land.

Chipinge Sheet (2032 B1) Grid Square Ref. 5788, 5888, No. 70 and 71; 5685, No. 89; 5987, No. 90; in Mutema Communal Land.

Junction Gate (2032 B2) Grid Square Ref. 8480, 8580, No. 101; two small patches in the Ngorima Communal Land.

Mt. Silinda (2032 B3) Grid Square Ref. 6440, No. 110; a very small forest in the Chinyaduma Purchase Land.

6.5.2.3 *Botanical Reserves on Private Land*

There are a number of forests of national and international on private land. The majority of them are reasonably well protected by the land owners or by the ruggedness of their terrain. But in the long term efforts should be made to give their protection legal status.

Some of them, mostly below an altitude of 1500 m are of particular interest or particularly threatened and legal protection should be given to them as a matter of urgency. Their map and grid square references are as follows:

Troutbeck Sheet (1833 A1) Grid Square Ref. 9583, 9685, 9684, 9683, 9784, No. 4.

Inyangani Sheet (1832 B4) Grid Square Ref. 9680, 9679, No. 24; 9475, No. 25.

Stapleford Forest Sheet (1832 D2) Grid Square Ref. 8327, No. 31.

Mutare Sheet (1832 D3) Grid Square Ref. 7207, No. 34.

Zimunya Sheet (1832 B1) Grid Square Ref. 7187, 7186, No. 41; 7186, 7185, 7285, No. 43.

Vumba Sheet (1932 B2) Grid Square Ref. 7585, southern portion of No. 48 Bunga forest which has good sub-montane forest; 8285, 8385, No. 49; 7585, 7685, No. 50; 7785, No. 51; 7883, No. 53; 8084, No. 54; 8184, 8284, No. 55; 7881, 7880, 7980, No. 56; 8180; No. 57 and part of 58; 8282, 8281, No. 59 and part of 58.

Chimanimani Sheet (1932 D4) Grid Square Ref. 8806, No. 77; 9789, No. 87; 9889, 9888, No. 88.

Chipinge Sheet (2032 B1) Grid Square Ref. 6181, 6180, 6281, 6280, No. 91; 5262, No. 92.

Junction gate Sheet (2032 B2) Grid Square Ref. 7580, No. 98; 7761, No. 100; 8480, 8478, No. 101.

Mt. Silinda 92032 B3) Grid Square Ref. 6541, No. 109.

Tamandayi (2032 B4) Grid Square Ref. 7960, No. 111.

The following are map and grid square references of rainforest sites proposed for Botanical Reserves which are of national importance but not in immediate danger:

Troutbeck Sheet (1833 A1) Grid Square Ref. 9186, 9185, 9184, 9286, 9285, 9284, 9386, 9385, 9488, 9487, 9486, No.3.

Zimunya Sheet (1932 B1) Grid Square Ref. 7091, 7192, 7191, 7292, 7291, 7393, 7392, 7391, No. 37, 38 and 39.

Vumba Sheet (1932 B2) Grid Square Ref. 7495, 7494, 7493, 7492, 7491, 7596, 7595, 7594, No. 45 and 46; 7797, 7796, 7897, 7896, No.44; 7793, 7792, 8193, 8192, 8293, No. 47; 7885, 7884, 7985, 7984, No. 52.

Banti Sheet (1932 B4) Grid Square Ref. 7660, 7659, 7658, 7758, No. 63.

Cashel Sheet (1932 D2) Grid Square Ref. 9124, 9224, 9223, 9323, No.68.

Makambiru Sheet (1932 D3) Grid Square Ref. 6393, 6494, 6493, 6594, 6593, 6693, 6692, No. 76.

6.5.2.4 Botanical Reserves on the ARDA Estate in the Rusitu Valley

There are some forests in the Rusitu Valley which fall within an ARDA estate and are of national importance and therefore worth protecting. Negotiation with ARDA should commence as soon as possible on how this can be done most effectively. The map and grid square references are as follows:

Chipinge Sheet (2032 B1) Grid Square Ref. 7283, 7384, 7383 and 7382, No. 93, 94, 95, 96, and part of 97.

Junction Gate Sheet (2032 B2) Grid Square Ref. 7484, 7485 and 7884, part of 97 and 99.

6.5.3 Conservation of Rainforest on Forest Land

Approximately 1850 ha of rainforest occurs on Forest Land. As mentioned above it is assumed that the Forestry Commission will protect all rain forests on Forest Land. Among these are some very special forests of national and international importance which should be given conservation priority. They are listed below in order of importance, their map and grid square references are as follows:

Mt. Selinda Sheet (2032 B2) Grid Square Ref. 6743, 6742, 6741, 6740, 6843, 6842, 6841, 6840, 6839, 6943, 6942, 6941, 6940, 6939, Chirinda Forest.

Banti Sheet (1932 B4) Grid Square Ref. 7763, 7762, 7761, 7760, 7863, 7862, 7861, 7860, 7962, 7961, 8063, 8062, Banti Forest Reserve.

Chimanimani Sheet (1932 D4) Grid Square Ref. 8890, 8990, 9090, 9989, Mt. Pene Forest; 8689, 8688, 8790, 8789, 8788, 8787, 8888, 8887, Mermaids Grotto.

Stapleford Forest Sheet (1832 D2) Grid Square Ref. 8129, 8128, 8229, 8228, 8329, Rupere Forest near John Meikle Forest Research Station; 9534, 9533, Forest on Gorongo.

6.5.4 Important Forests in National Parks

As mentioned before, a significant portion of Zimbabwe's rainforests are protected by the Department of National Parks and Wildlife Management. Those of particular interest which are rated of national and international importance are listed below:

Nyanga National Park (1832 B2), the *Syzygium masukuense* montane forests (Type 1) on the uppermost south-eastern and eastern slopes of Nyangani and Little Nyangani Mountains (uppermost portion of No. 6, 14 and 16); the two continuous forest catenas covering an altitudinal range of nearly 1 000m down from the Little Nyangani Mountain to the Nyamingura Valley (Types 1, 5, 6, 7, and 11, No. 14) and down from Nyangani Mountain to the Chitana Valley (Types 1, 5, 6, 7, and 14, No. 16); the forest covering the eastern ridge above and both sides of the Nyasengu Valley (No. 6 and 16).

Mutarazi Falls National Park (1932 B2), the forest beneath Mutarazi Falls (Type 11, No. 10).

Vumba National Park (1932 B2), Bunga forest (Types 5, 6 and 7, No. 48).

Chimanimani National Park (1932 B4), two forests on the western slopes of the westernmost ridge of the Chimanimani Mountains (Type 7, No. 81 and 83).

Chimanimani National Park (2033 A1), the Haroni/Makurupini forest at the foot of the southern end of the Chimanimani Mountains (Type 12, No. 105).

6.5.5 Protection of Rainforest Along Watercourses and Catchment Areas

Rainforest where it occurs along streams and rivers is of great importance in stabilising the banks, thus preventing excessive erosion. The law which prohibits the cutting of vegetation along watercourses should be strictly enforced. In planted forests, rainforest in gulleys forms an effective fire break and should be kept or re-established wherever possible. In many areas rainforest serves as catchment protection and should be protected for this reason alone.

6.5.6 Environmental Impact Assessment

An environmental impact assessment should be mandatory for all developments which necessitates the clearing of rainforest.

7. MANAGEMENT OF RAINFOREST RESERVES

Rainforest is able to maintain itself and regenerate as long as the available moisture is adequate. However, clear felling or drastic removal of undergrowth can cause drying up of the microclimate beyond the critical point and regeneration of forest species might not be possible.

Mainly because of the small size of the forests it is considered that management for resource utilisation will be detrimental and gradually destroy the forests. Only non-consumptive utilisation should therefore be tolerated. The total area of rainforest in Zimbabwe is very small and it is suggested that all of it should be maintained as biodiversity reserves.

The forests which are still well preserved today are in this state because they have been relatively untouched by humans. Management requirements for biodiversity are therefore minimal and principally involve protection from disturbance by human activities.

This is, of course, a most difficult task and regular patrolling as well as good relations with the local people are essential.

Cattle adversely affect the regeneration of rainforest and should be kept out of the reserves.

Fire guards are only necessary in exceptional circumstances, but care should be taken that there is no accumulation of exceptional quantities of litter on the land outside the forest.

Most montane forest is well protected by its inaccessibility and practically no management is needed. The exceptions are the *Widdringtonia nodiflora* forests. These are rare and prone to damage by fire. Often they are very narrow following water courses like ribbons. They are too small to be mapped and their periodic destruction by fire is a natural event which cannot be avoided and they are best left alone. There are, however, a few *Widdringtonia nodiflora* forests, mainly on the rainshadow side of Nyangani Mountain and in the Chimanimani District, which have a broader outline and where the need for fire protection needs to be investigated.

Some of the submontane and all of the medium altitude and lowland forest falls into highly populated areas. Here the main management task is to keep people from damaging and destroying the forest. In the few instances where forests are being destroyed in Communal and Purchase Lands (Ngorima, Mutema, Chinyaduma and Holdenby) great efforts have to be made to get the cooperation of the local people and especially the local conservation committees. It is necessary to explain to them how rare the forest habitat is and that genetic resources conservation is of great importance to the long-term survival of mankind.

It should be recognised that, contrary to popular belief, optimal biological conservation is generally not compatible with management for resource utilisation. There are, of course, exceptions as for instance when a forest can be used for tourism. However, the main function of a rainforest reserve should be simply to conserve species, natural ecosystems and ecological processes, and in addition it should provide genetic material for breeding and plants for horticulture and research. Limited, controlled and sustainable collecting of plants for medicine can also be tolerated.

If local people support a Forest Reserve on Communal Lands, they should derive some indirect benefit, e.g. by receiving donor support for projects which benefit the community.

8. SUGGESTIONS FOR FUTURE WORK

1. There is a need to have a research project to scientifically determine why rainforest ends where it does. This can produce guidelines for management.
2. A checklist should be prepared of all plants which have been recorded in rainforest in Zimbabwe with an indication of where they occur.
3. Botanical investigation should be carried out in forests which have so far not been looked at. Priorities are the forests marked on the following map sheets:
 - Troutbeck Sheet 91833 B2), No. 3 and 4
 - Vumba Sheet (1932 B4), north end of No. 45 and 55
 - Banti sheet (1932 B4), No. 63 and 65
 - Cashel Sheet (1932 D2), No. 66 to 68
 - Makambiru Sheet (1932 D3), No. 85
 - Chipinge Sheet (2032 B1), No. 89 and 90
 - Junction Gate Sheet (2032 B2), No. 101.
4. The state of degradation of all important forests should be reassessed.
5. Work should commence as soon as possible on preparing a case for the Botanical Reserves which are suggested in this report, starting with the top priorities.

9. REFERENCES

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APPENDIX A: Overview of Rainforest Extent in the Eastern Highlands of Zimbabwe

[3 maps @ 1: 250,000 scale].

APPENDIX B: Detailed Maps of Rainforest Areas in the Eastern Highlands of Zimbabwe.

[39 maps @ 1: 50,000 scale]