

**MINISTRY OF ENVIRONMENT AND TOURISM
Directorate of Forestry**



**INVENTORY REPORT FOR OHEPI, OSHAAMPULA AND
EKOLOLA FORESTS**

Namibia-Finland Forestry Programme

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SUMMARY

The inventory of Ohepi, Oshaampula and Ekolola areas was a request from CFED project. These forest areas are located in Oshikoto and Ohangwena region. The area of Ohepi is 5160 ha, Ekolola 578 ha and Oshaampula 719 ha. A systematic sampling without stratification was applied. A total of 42 plots were measured in Oshaampula, 88 plots in Ekolola and 90 plots in Ohepi.

The Ohepi inventory area is characterized by a relatively high number of trees and volume of trees (308 trees per hectare, 28 m³/ha). *Terminalia sericea*, *Combretum collinum* and *Burkea africana* are the most frequent species. However, most of the big trees are *Burkea africana* trees. In the area, the amount of dead wood is high too. There are about 20 dead trees per hectare with a volume of 3.4 m³/ha. The most frequent dead wood species are *Burkea africana*, *Terminalia sericea* and *Combretum collinum*. *Burkea africana* has the highest dead wood volume. About 1256 tree saplings were found to grow per hectare. A good number of regeneration- especially *Combretum collinum* and *Terminalia sericea* saplings was found. About 281 shrubs per hectare were recorded. *Grewia retinervis* being the most frequent one. In this area, severe signs of dead wood were detected on most of the plots.

The Oshaampula inventory area has 290 trees growing per hectare with a mean volume of 21 m³/ha. The most frequent species is *Combretum collinum* with 138 trees per hectare and *Terminalia sericea* with 64 trees per hectare. The big trees in this area are mainly *Combretum collinum* trees and this species has the highest volume (7 m³/ha). In this area there are relatively many dead trees too. Altogether 55 dead wood stems per hectare were found with a volume of 5 m³/ha. About 981 tree saplings were found to grow per hectare. *Acacia ataxacantha* is having the biggest share of them (19%). *Combretum collinum*, *Croton gratissimus* and *Terminalia sericea* have a reasonably good number of saplings too. About 167 shrubs per hectare were recorded (*Grewia retinervis*, *Mundulea sericea* and *Ozoroa schinzii* being the most frequent species).

The Ekolola inventory area is characterized by a high number of trees and volume of trees. There are about 317 stems per hectare with a mean volume of 43.8 m³/ha. *Acacia ataxacantha*, *Baphia massaiensis* and *Mundulea sericea* are dominating in smaller diameter classes and *Burkea africana* and *Baikiaea plurijuga* in the larger diameter classes. The amount of dead wood is 22.6 stems per hectare with a volume 4.1 m³/ha. The most frequent species among dead wood are *Burkea africana* and *Combretum collinum*. About 1853 tree saplings were found to grow per hectare. *Terminalia sericea* and *Combretum collinum* have a reasonably good number of saplings. About 155 shrubs per hectare were recorded (*Baphia massaiensis*, *Mundulea sericea* and *Acacia ataxacantha*) being the most frequent species. In this area, there was a lot of grazing and cutting.

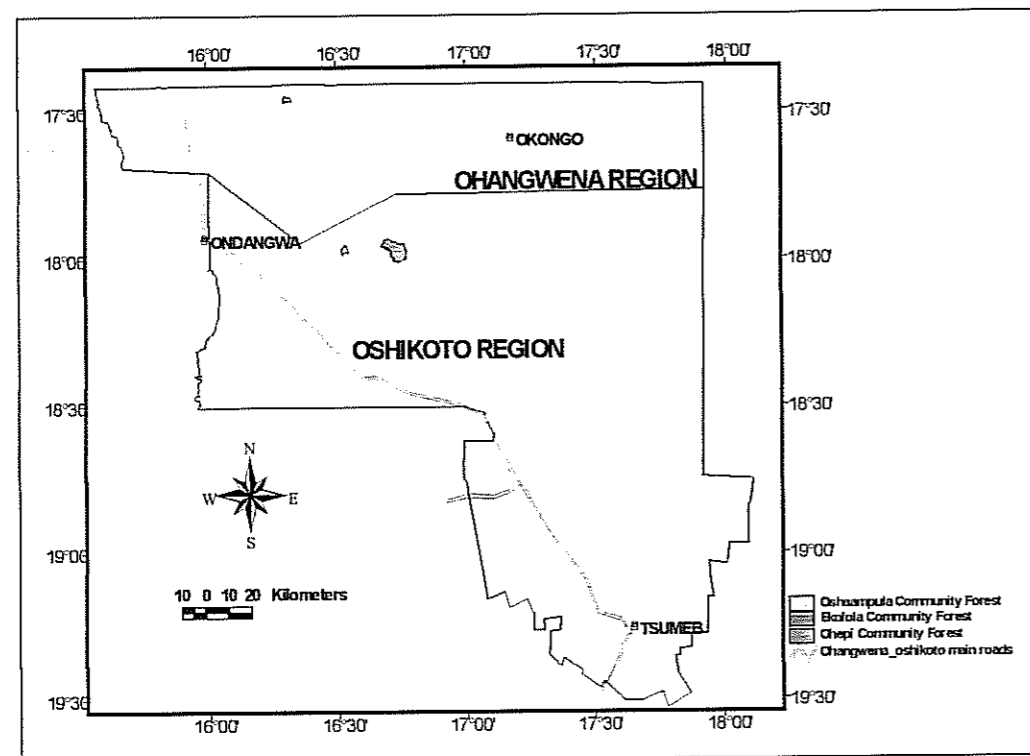
1. INTRODUCTION

The Directorate of Forestry under the Ministry of Environment and Tourism in Namibia has a mission to carry out forest resource assessments in Namibia. In this task the Government of Finland has supported it since 1995. Initially the aim of the support was to build the capacity of the Directorate to carry out regional forest inventories – that is inventories of very large areas (National Forest Inventory component, NFI). During the years, an increasing number of local level inventories have also been carried out to fulfill specific requests by projects and forest managers. The support from the Government of Finland today – Namibia-Finland Forestry Programme Phase II (NFFP) – aims now more at strengthening the capacity of DoF to serve the needs for local level forest management planning.

A request from the Community Forestry and Extension Project (CFED, DANCED) was received by DoF in July 2002. The request was to help assessing the woody resources of three separate areas in Oshikoto and Ohangwena regions. These three areas are pilot forest areas for community forest management development activities by the CFED Project. The inventory was implemented in early August 2002. The methodology of the earlier NFI was applied (systematic sampling of field plots). The results of all three areas (Ohepi, Oshaampula and Ekolola) are presented in this report.

2. GENERAL INFORMATION OF THE INVENTORY AREAS

The Ohepi and Oshaampula community forests are located in the northern part of Oshikoto region and Ekolola community forest is located in the northern part of Ohangwena region. The size of Ohepi is 5160 ha, Oshaampula 719 ha and Ekolola 578 ha. Common tree species found in Ohepi are *Combretum collinum*, *Burkea africana* and *Terminalia sericea*. Common tree species found in Oshaampula are *Combretum collinum* and *Terminalia sericea*. Common tree species found in Ekolola are *Burkea africana*, *Combretum collinum*, *Terminalia sericea*, *Baikiaea plurijuga* and *Erythrophleum africanum*.



Map 1 : Location of inventory areas (Ohepi, Oshaampula and Ekolola)

3. INVENTORY DESIGN

3.1 Sampling

The inventory areas were defined by using the coordinates given by the CFED Project. Black and white aerial photographs (from the Department of Land Survey) and a Landsat TM satellite image were visually analyzed before the inventory in order to see if there are any possibilities for stratification. Stratification in many cases can improve the efficiency of the fieldwork and results with higher accuracy can be produced for sub-areas of interest. In the case of the three areas, it was found that they are uniform to the extent that no stratification was seen useful. Therefore, a uniform systematic layout of sample units was applied on all areas. One sample unit consist of three concentric plots (See 3.2 Field measurements)

The design of the sampling and sampling intensity were chosen in order to carry out a simple and straightforward inventory and aiming at an accuracy of about 10 % in the main characteristics of the trees (e.g. volume/ha) on each area (standard error).

The size of each area and the number of sampling units are listed in the Table 1 below.

Inventory Area	Area, Hectares	Number of sampling units
1. Ohepi	5160	90
2. Oshaampula	719	42
3. Ekolola	578	88

Table 1: Inventory areas and number of samplings units

The plot coordinates were determined at the office in advance for the fieldwork. Inventory fieldwork was carried out by 2 teams. The teams moved in the field using ATVs and they located plots sites with the help of the predefined coordinates and GPS-receivers.

3.2 Field Measurements

The data collection in the field was carried out using the methodology of several previous inventories. This methodology is described in details in the Manual for Woody Resource inventories by the Directorate of Forestry. One sampling unit consists of one plot which again consists of three concentric circles. In the following text, a sample plot is understood to be the same as a sample unit. The woody vegetation is classified into trees and shrubs. In this inventory trees are defined as woody plants with dbh \geq 5 cm. Shrubs are woody plants with dbh $<$ 5 cm.

A different radius of sample plot was applied for small trees, medium size trees and big trees. For small trees ($5 \text{ cm} \leq \text{dbh} < 20 \text{ cm}$) the radius is 10 m, for medium size trees ($20 \text{ cm} \leq \text{dbh} < 45 \text{ cm}$) the radius is 20 m and for big trees ($\text{dbh} \geq 45 \text{ cm}$) the radius is 30 m. Diameter, location, species, crown class, quality of possible saw log were recorded for all trees in all sample plots. In addition, tree height, diameter of canopy, and crown height were measured for each tree in a sample plot. Shrubs and regeneration were measured in two sub-plots (radius 3.99 m) located on each sampling plot (See figure 1).

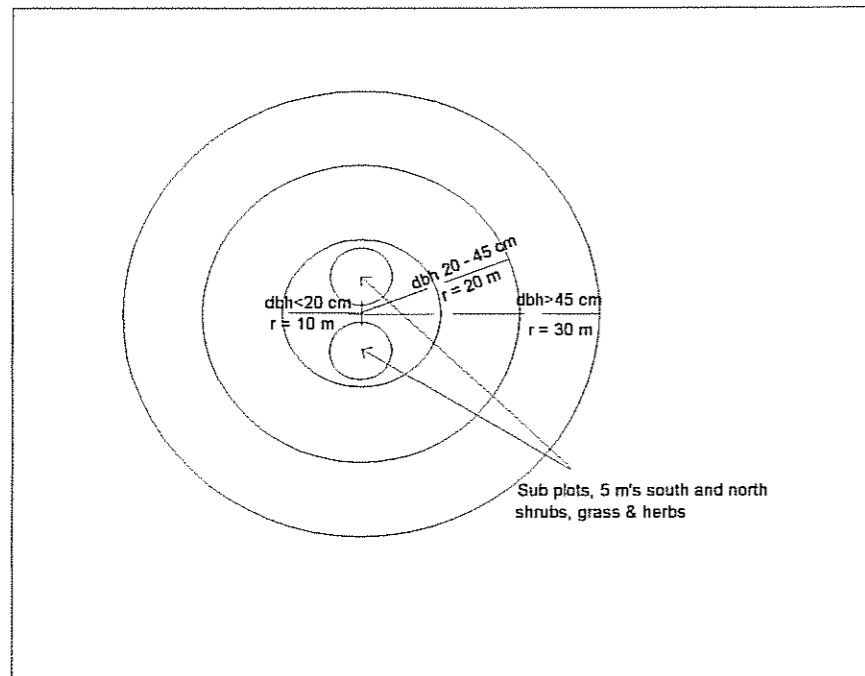


Figure 1: Plot design

Information describing the environment surrounding the sample plot (“the stand”) was also recorded. This description includes e.g. the soil, the land type, damage to the woody vegetation, human influence and grazing.

3.3 Volume functions

Volumes for the trees in this inventory were calculated using the volume functions derived by the DoF. Only the most common tree species have their own volume function. For a tree species without a function of its own, a function of a species with a similar shape of the stem has been applied. The functions used in these calculations can be found in Annex 1. The volume functions are giving the total volume for each tree. This volume includes the volume of branches too.

4. RESULTS FOR OHEPI INVENTORY AREA

4.1 Site and stand data

The size of Ohepi inventory area is 5160 ha. The Ohepi inventory area was classified as a plain by its geomorphology. On all plots, the soil texture was classified as sand. Moderate signs of grazing were found (vegetation still vital). On some plots some pole size trees had been removed. Also signs of damage to trees caused cattle and human being are frequent. In all cases the damages was considered to be mild not really affecting the trees.

4.2 Measured trees

A total of 1161 trees with dbh \geq 5 cm were measured (See table 1, Annex 3), which is on average 12.9 trees per sample plot.

4.3 Species diversity

Species diversity on the area is described by the number of species found in the area and number of plots where each species was detected. The data is presented in table 2.

A total of 34 woody species were found in the Ohepi inventory area. 18 species were recorded as trees and 30 woody species were found in the shrub layer. 14 species were found in both layers.

Table 2: Species diversity by the number of clusters where each species was found

Species	No. of plots dbh < 5cm	No. of plots dbh ≥ 5cm
<i>Acacia ataxacantha</i>	15	1
<i>Acacia fleckii</i>	7	3
<i>Baphia massaiensis</i>	64	1
<i>Bauhinia petersiana</i>	6	
<i>Burkea africana</i>	16	64
<i>Colophospermum mopane</i>	1	
<i>Combretum collinum</i>	57	76
<i>Combretum engleri</i>	6	25
<i>Combretum psidioides (psidioides)</i>	4	7
<i>Combretum zeyheri</i>	23	25
<i>Commiphora angolensis</i>	8	
<i>Croton gratissimus</i>	20	7
<i>Dichrostachys cinerea (Setulosa)</i>	2	10
<i>Erythrophleum africanum</i>	1	6
<i>Grewia bicolor</i>	8	
<i>Grewia flava</i>	6	
<i>Grewia retinervis</i>	30	
<i>Lonchocarpus nelsii</i>	1	2
<i>Markhamia acuminata</i>	1	
<i>Mundulea sericea</i>	4	
<i>Ocina pulchra</i>	34	20
<i>Ozoroa paniculosa</i>	15	
<i>Ozoroa schinzii</i>	12	
<i>Rhigoszum brevispinosum</i>	4	
<i>Rhus tenuinervis</i>	5	
<i>Schinziophyton rautanenii</i>	1	
<i>Terminalia sericea</i>	63	72
<i>Vangueria infausta</i>	1	
<i>Ximenia americana var americana</i>	1	
<i>Ximenia caffra var microphylla</i>	2	
<i>Acacia erioloba</i>		11
<i>Albizia anthelmintica</i>		1
<i>Boscia albitrunca</i>		2
<i>Pterocarpus angolensis</i>		35

4.4 Number of stems by species

Live trees

A total of 18 trees were found in the Ohepi inventory area. Including all species, altogether 308 stems per hectare and a total of 1,589,000 stems have been estimated to grow on this area. The most frequent species are: *Terminalia sericea* (114 stems/ha, 589,000 stems in total), *Combretum collinum* (103 stems/ha, 529,000 stems in total), *Burkea africana* (27 stems/ha, 141,000 stems in total), *Combretum zeyheri* (16 stems/ha, 83,000 stems in total) and *Ochna pulchra* (17 stems/ha, 88,000 stems in total) (See figure 2). See full list of species in Annex 3 (Table 4).

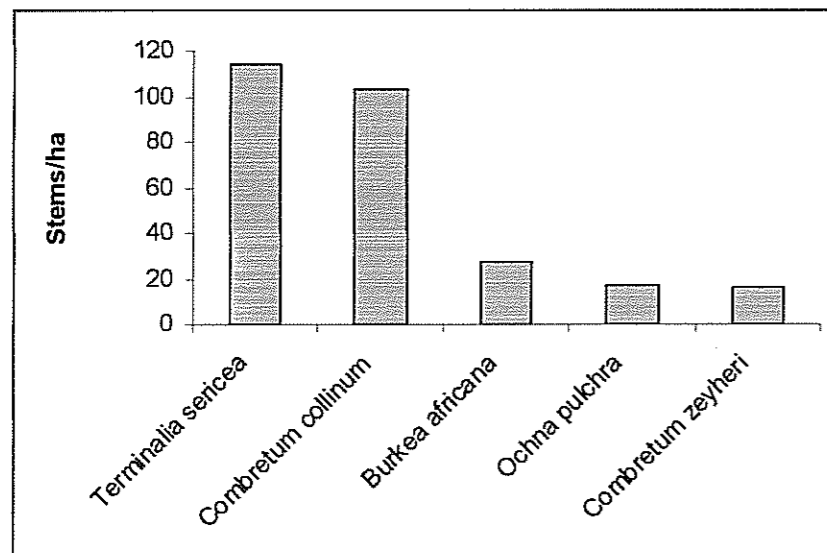


Figure 2: Ohepi inventory area: Most common live tree species, number of trees per ha

Dead trees

A total of 9 species were found among the dead trees. Including all species, 20 trees per hectare and a total of 101,185 dead trees were estimated to be in the area. The most frequent species were *Terminalia sericea* (6.5 stems/ha), *Combretum collinum* (5.7 stems/ha) *Burkea africana* (4.1 stems/ha) and *Pterocarpus angolensis* (0.9 stems/ha) (see figure 3). See full list of dead wood species in Annex 3 (Table 5).

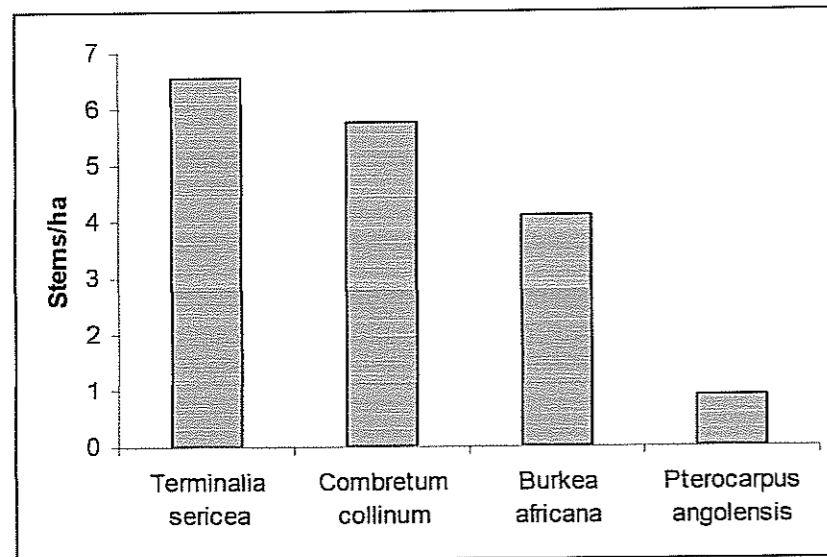


Figure 3: Ohepi inventory area: Most frequent dead tree species, stems per ha

4.5 Diameter distribution

Live trees

The diameter distribution for the 5 most dominant live tree species has been illustrated in figure 4. It can be seen that *Terminalia sericea* and *Combretum collinum* have most of the stems in the small diameter class (5-15 cm). Only some *Pterocarpus angolensis*, *Burkea africana* and *Acacia erioloba* trees were found having a dbh more than 45 cm. A complete diameter distribution for all species in numbers is given in the Annex 3 (Table 6).

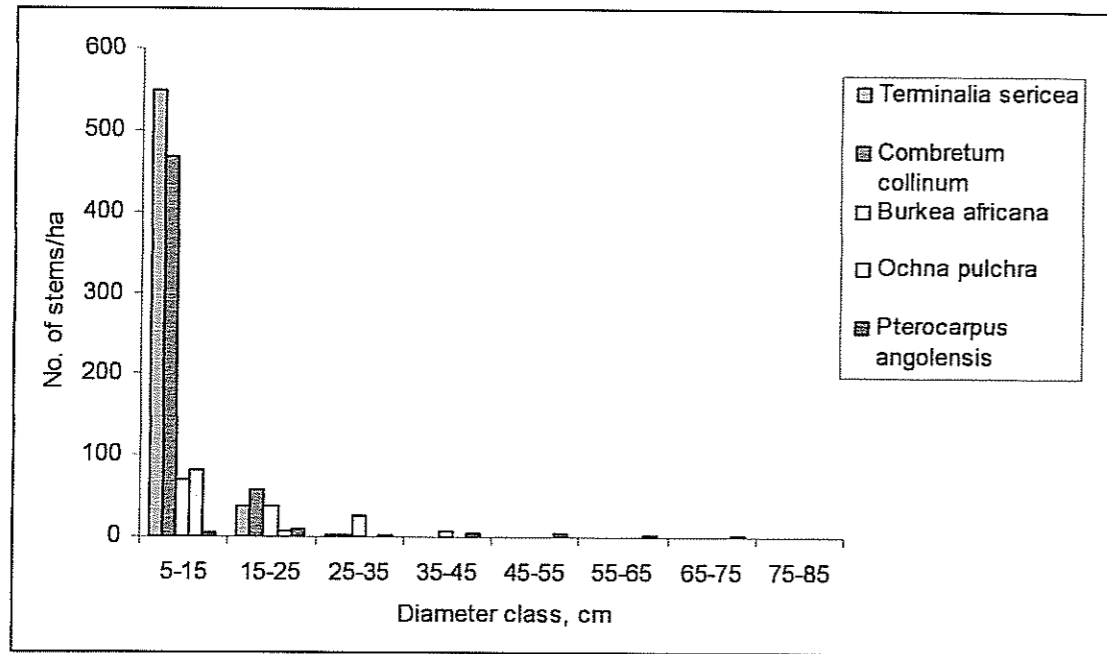


Figure 4: Ohepi inventory area: Diameter distribution of the 5 most frequent tree species (stems/ha)

Dead trees

The diameter distribution of the 4 most frequent species among dead trees is shown on the figure 5 below. Dead *Terminalia sericea*, *Burkea africana* and *Combretum collinum* trees were found in the smaller diameter classes (5-15 cm and 15-25 cm). There are also some bigger dead stems of *Burkea africana*. A complete diameter distribution for dead trees by species in numbers can be found in Annex 3 (Table 7).

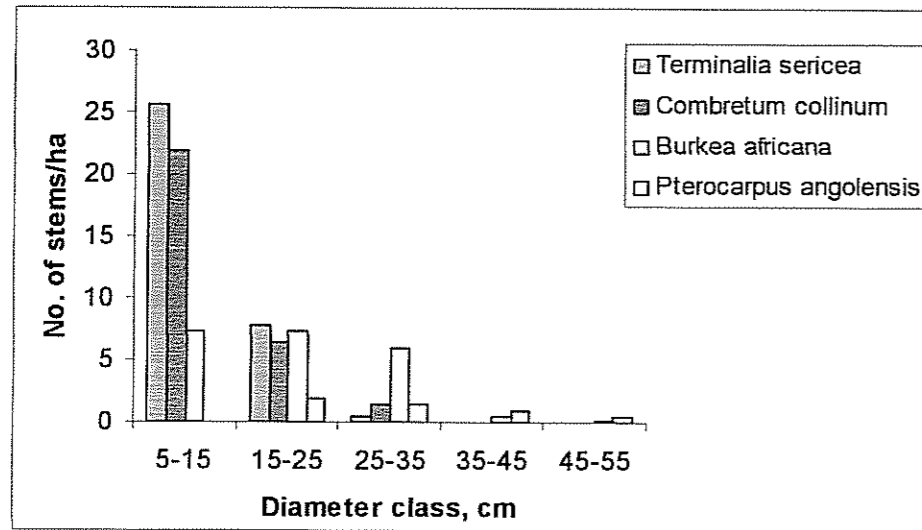


Figure 5: Ohepi inventory area: Diameter distribution of the 4 most frequent species among dead trees.

4.6 Volumes by species

Live trees

The total volume of all live trees in Ohepi inventory area is 145,600 m³ (28 m³/ha). The volume of *Pterocarpus angolensis* is 41,000 m³ (7.9 m³/ha) and the volume of *Burkea africana* is 41,100 m³ (8 m³/ha). The volume of *Combretum collinum* is 25,500 m³ (4.9 m³/ha) and for *Terminalia sericea* is 21,300 m³ (4.1 m³/ha). See figure 6 and Annex 3 for full list of species and volumes.

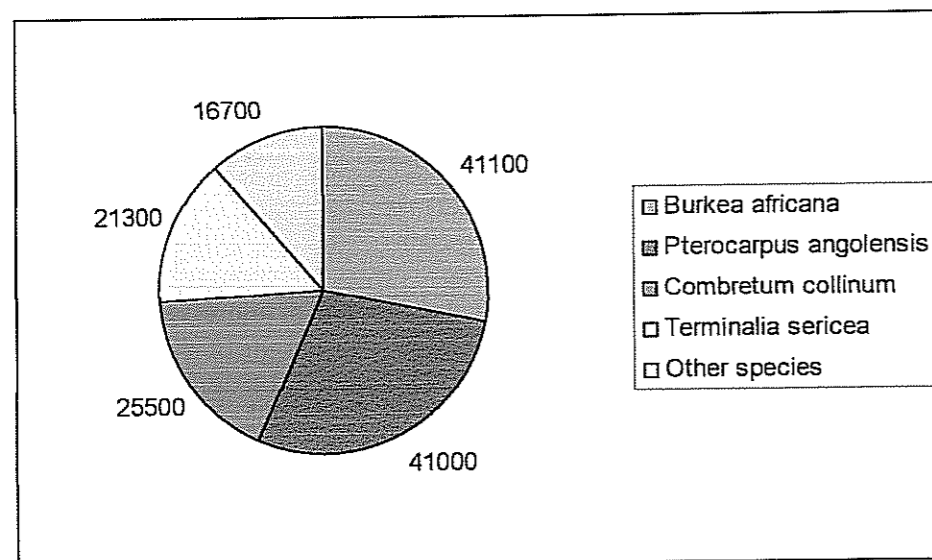


Figure 6: Ohepi inventory area: Total volume of live trees by species (m³)

Dead trees

The volume of all dead trees is about 3.4 m³/ha which accounts for a total of 17,355 m³. *Burkea africana* is the species with the biggest dead wood volume, that is 7,776 m³ and 1.5 m³/ha on the area. *Pterocarpus angolensis* has a total of 3,892 m³ and 0.8 m³/ha of dead wood. *Combretum collinum* has a total of 2,668 m³ and 0.5 m³/ha and *Terminalia sericea* has a total of 2,337 m³ and 0.5 m³/ha of dead wood. All other species have less than 0.5 m³/ha of dead wood (See figure 7 and table 5 in Annex 3).

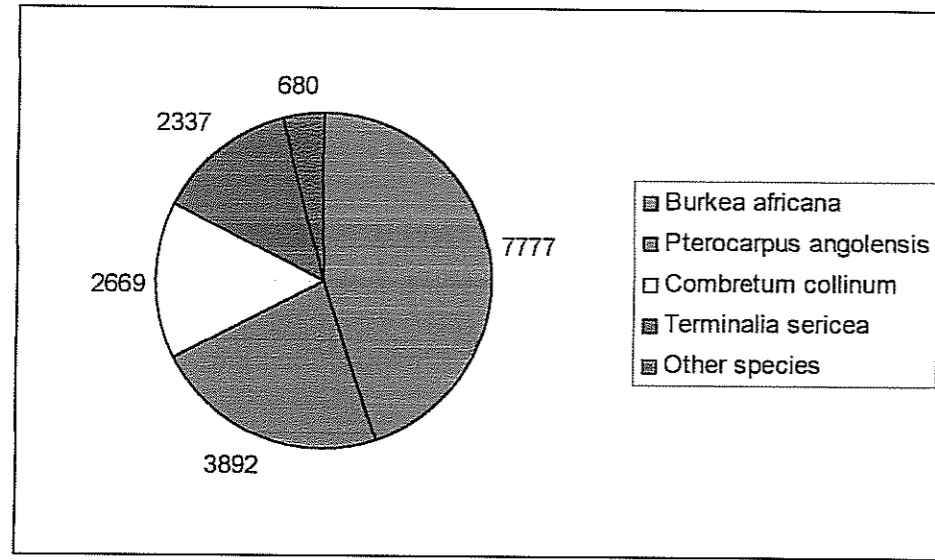


Figure 7: Ohepi inventory area: Total volume of dead trees (m³)

Timber volume of live trees

In this inventory, the big trees- that is trees with dbh 45 cm or more were classified according to the quality of the sawlog part of the stem. The height of the sawlog was measured and the volume of that part was calculated. The number of stems having good, medium or poor quality timber and the total volume of potential sawlogs are presented in the following table. Good quality means that there is at least a 2 m long straight stem without damages. Medium quality means that the stem is slightly curving or having other damages but is still having at least 2 m of sawable log. Poor quality means that it is only possible to find a 1.2 m long sawlog in the stem. Only one species have dimensions big enough to be considered as timber size: *Pterocarpus angolensis* has a total of 8,922 with good and medium timber quality (see table 3). Other species were found having dbh < 45 cm sawlog.

Table 3: Ohepi inventory area: Number of stems (dbh 45 cm and more) and the total volume of logs

		<i>Pterocarpus angolensis</i>	
Status	Quality	Total No. of stems	Total log volume, m ³
Live tree	Good quality	7908	8492
Live tree	Medium quality	1014	738
Live tree	Not sawable	406	
Standing dead tree	No code	608	
Total		9936	9230

4.7 Regeneration and shrubs

Regeneration

In the inventory, trees with a dbh less than 5 cm were enumerated as regeneration of trees (saplings). A total of 1256 saplings per hectare were found in the area. The most frequent species is *Terminalia sericea* with 298 saplings per hectare and *Combretum collinum* with 216 saplings per hectare. The regeneration of other species is mostly *Baphia massaiensis* with 366 saplings per hectare. Full list of the number of saplings by species and by height classes can be found in Annex 3 (Table 8). These figures indicate that there is a good number of regeneration coming up to secure the future of the forest too.

Shrubs

In addition to enumerating the regeneration, shrub species were counted too. A total of 9 different species were identified with a total of 281 shrubs per hectare. The most frequent species is *Grewia retinervis* with 124 shrubs per hectare. The full list of shrubs enumerated by height classes can be found in Annex 3 (table).

5. RESULTS FOR OSHAAMPULA INVENTORY AREA

5.1 Site and stand data

The size of Oshaampula inventory area is 719 ha. By its geomorphology, the Oshaampula inventory area was classified as plain. On all plots, soil texture was classified as sand. Moderate signs of grazing were found in most of the plots (vegetation being still vital). Moderate damages caused by domestic cattle's are visible. Damage of fire was seen in some plots.

5.2 Measured trees

A total of 537 trees with a dbh \geq 5 cm were measured in the plots (See table 1 in Annex 4) which is on average of 6.1 trees per sample plot.

5.3 Species diversity

A total of 31 woody species were found in the Oshaampula inventory area. 17 species were found in the tree layer and 28 species in the shrub layer. 14 species were found in both layers. The data are presented in table 4.

Table 4: Oshaampula inventory area: Species diversity by the number of plots where each species was found.

Species	No. of plots dbh < 5cm	No. of plots dbh > 5cm
<i>Acacia ataxacantha</i>	22	
<i>Acacia erioloba</i>	1	13
<i>Acacia fleckii</i>	1	1
<i>Acacia mellifera</i>	1	
<i>Baphia massaiensis</i>	11	1
<i>Bauhinia petersiana</i>	3	
<i>Burkea africana</i>	1	20
<i>Colophospermum mopane</i>	1	
<i>Combretum collinum</i>	22	31
<i>Combretum engleri</i>	7	
<i>Combretum zeyheri</i>	4	5
<i>Commiphora angolensis</i>	6	1
<i>Croton gratissimus</i>	17	6
<i>Dichrostachys cinerea (Setulosa)</i>	8	12
<i>Grewia bicolor</i>	2	
<i>Grewia retinervis</i>	14	
<i>Markhamia acuminata</i>	1	
<i>Mundulea sericea</i>	4	
<i>Ochna pulchra</i>	5	10
<i>Ozoroa paniculosa</i>	1	
<i>Ozoroa schinzii</i>	3	
<i>Rhus tenuinervis</i>	2	
<i>Terminalia prunoides</i>	1	
<i>Terminalia sericea</i>	19	30
<i>Vangueria infausta</i>	2	
<i>Ximenia americana var americana</i>	6	1
<i>Ximenia caffra var microphylla</i>	5	2
<i>Ziziphus mucronata</i>	1	1
<i>Acacia karroo</i>		1
<i>Acacia hebeclada (hebeclada)</i>		1
<i>Lonchocarpus nelsii</i>		1

5.4 Number of stems by species

Live trees

A total of 17 tree species were found in the Oshaampula inventory area. Including all species, altogether 291 stems per hectare and a total of 212, 000 stems have been estimated to grow on this area. The most frequent species is *Combretum collinum* with 139 stems per hectare (a total of 100, 000 stems). *Terminalia sericea* with 63 stems per hectare (46, 000 stems in total) is the second most common species (See figure 8). A full list of species and their number of stems can be found in Annex 4 (Table 4).

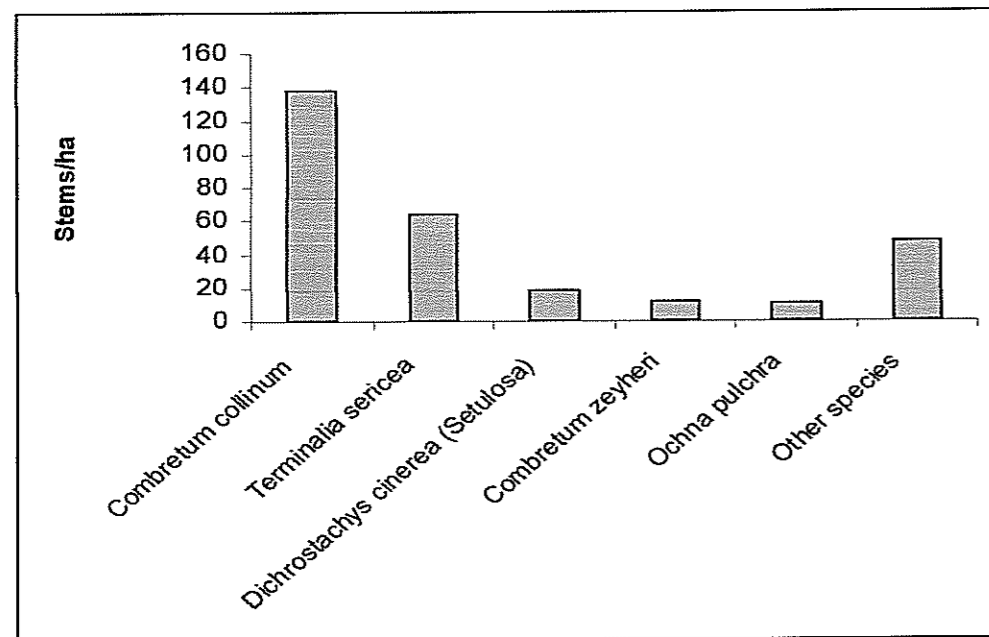


Figure 8: Oshaampula inventory area: Dominant live tree species, number of trees per ha

Dead trees

A total of 5 tree species were found among the dead trees. The number of dead trees for all species is 55 trees per hectare and a total of 39,643 trees on the whole area. The figures are high. *Terminalia sericea* and *Combretum collinum* are the most frequent dead trees to be found (See figure 9).

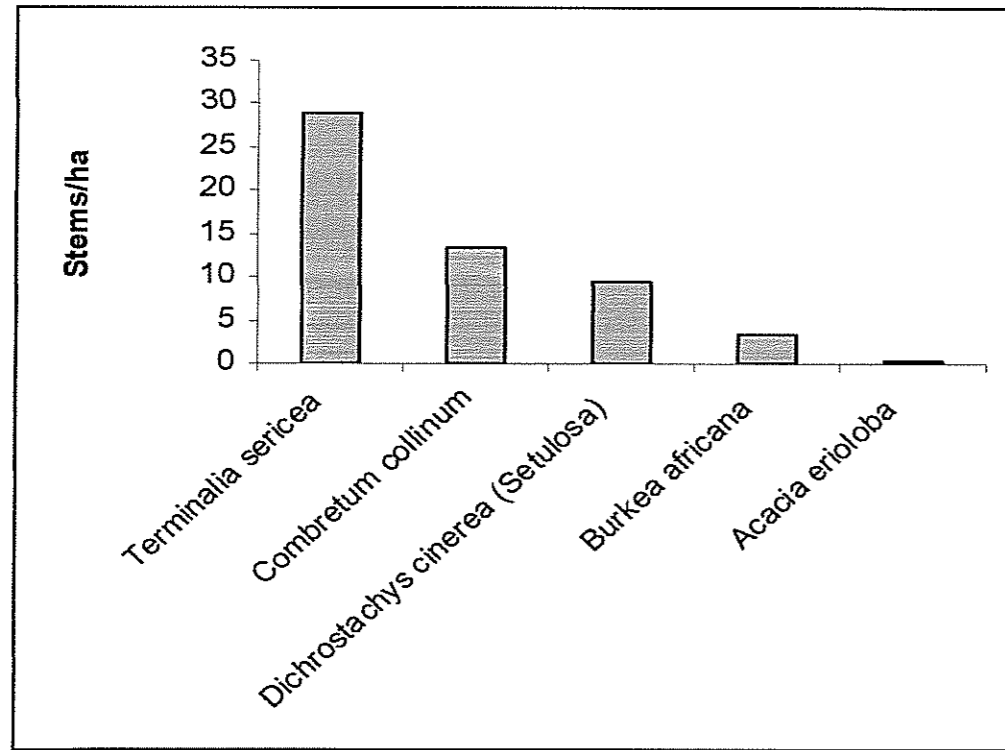


Figure 9: Oshaampula inventory area: Dead tree species, stems per ha

5.5 Diameter distributions

Live trees

The diameter distribution for the 3 most frequent live tree species has been illustrated in figure 10. *Terminalia sericea* and *Combretum collinum* have a very big share of their number in the diameter class 5-15 cm. *Acacia erioloba* and *Burkea africana* are much less in the small diameter class. For other species a complete diameter distribution for all species in numbers is given in the Annex 4 (Table 6).

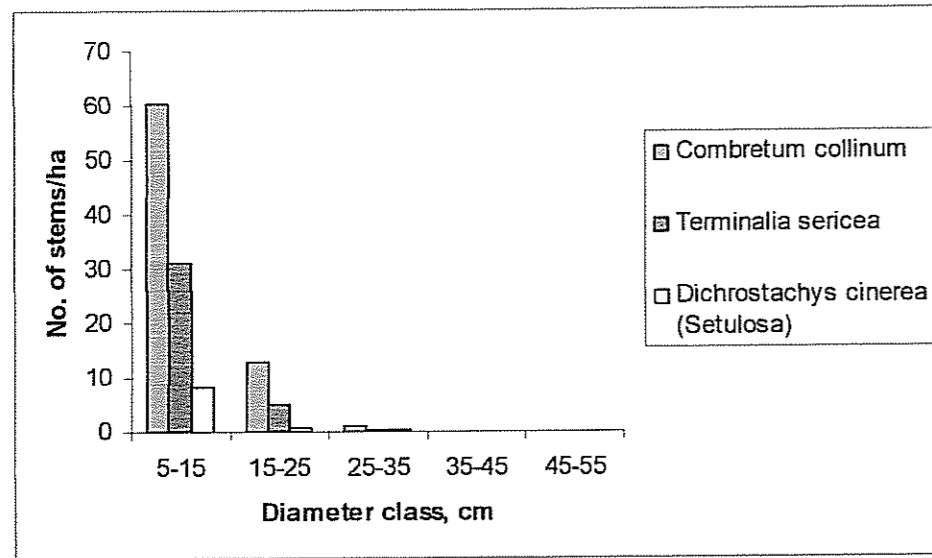


Figure 10: Oshaampula inventory area: Diameter distribution of the 3 most common tree species

Dead trees

The diameter distribution for all dead tree species has been illustrated in figure 11. Most of the trees were found in the small size classes (5-15 cm and 15-25 cm). The diameter distribution of dead trees in numbers by species can be found in Annex 4 (Table 7).

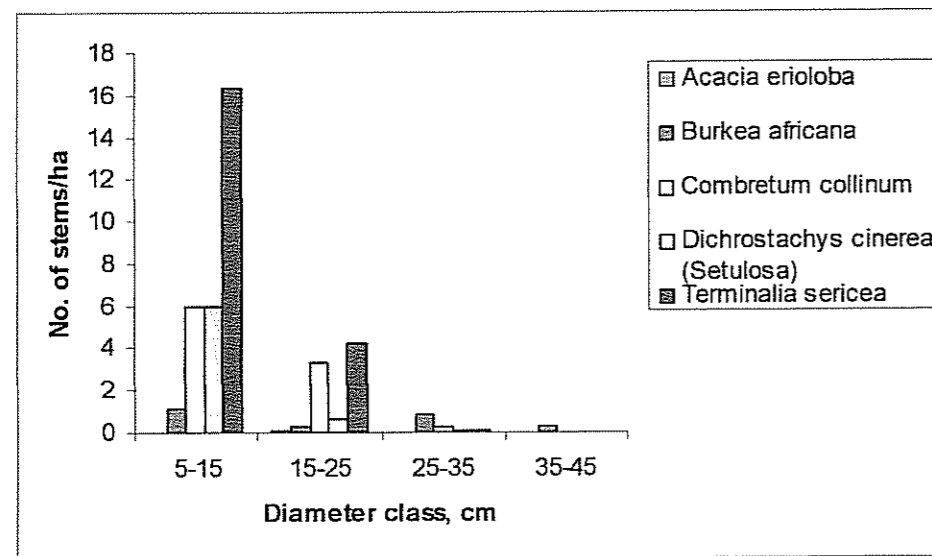


Figure 11: Oshaampula inventory area: Diameter distribution of dead trees

5.6 Volumes by species

Live trees

The total volume of all live trees in Oshaampula inventory area is 148,000 m³ (20.8 m³/ha) (see figure 12). *Combretum collinum* has 5,300 m³ (7.3 m³/ha in total), *Burkea africana* 4,000 m³ (5.6 m³/ha) and *Terminalia sericea* 2,300 m³ (3.1 m³/ha). All other species have volumes less than 1,000 m³. See full list of volumes by species in Annex 4 (Table 4).

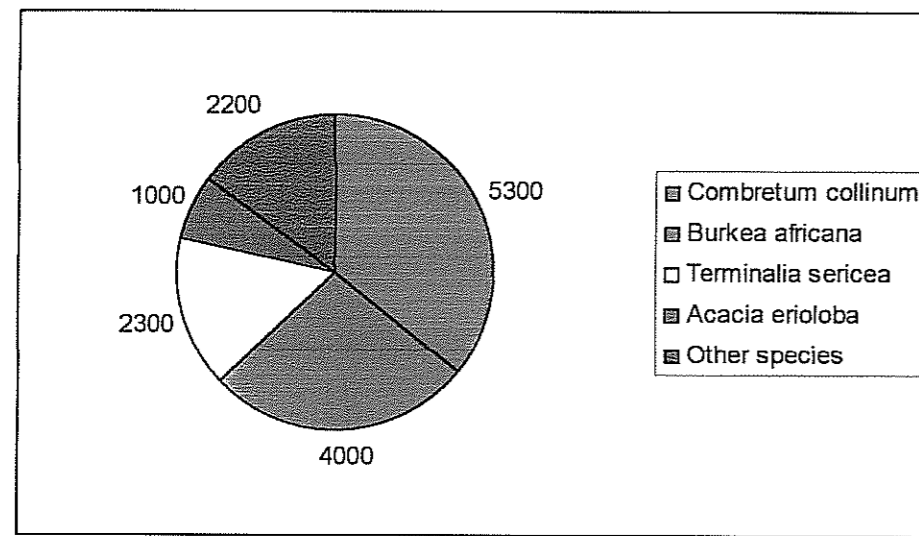


Figure 12: Oshaampula inventory area: Total volume (m³) by species

Dead trees

There is a total of 3,720 m³ (5.2 m³/ha) of dead wood in Oshaampula inventory area (see figure 13). *Terminalia sericea* has got the highest volume of dead wood 1,338 m³. See full list of species and their dead wood volumes in Annex 4 (Table 5).

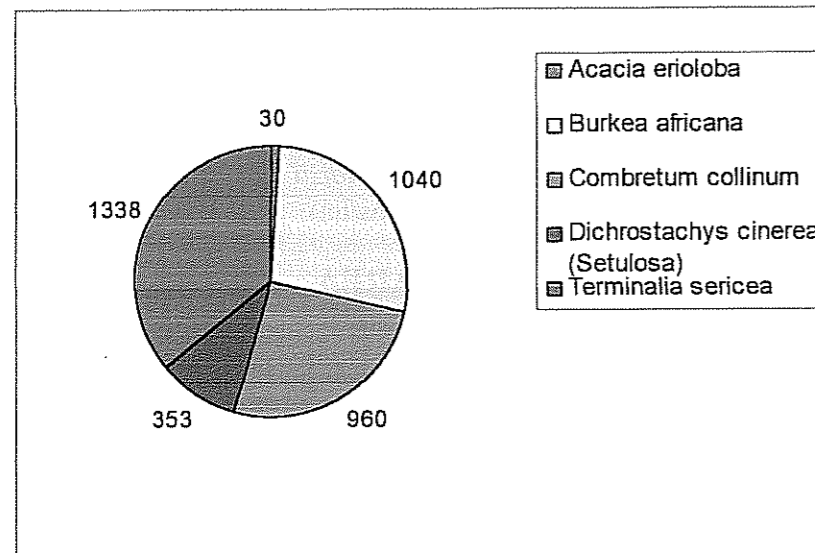


Figure 13: Oshaampula inventory area: Total volume (m³) of dead tree species

Timber volume of live trees

Only one species has dimensions big enough to be considered as timber size: *Burkea africana* has a log volume of 40 m³ (see table 5). Other species were found with number of stems less than 45 cm.

Table 5: Number of stems (dbh 45 cm and more) and the total volume of logs

<i>Burkea africana</i>			
Status	Quality	Total No. of stems	Total log volume, m ³
Live tree	Good quality	60	40
Live tree	Not sawable	120	0
Total		180	40

5.7 Regeneration and shrubs

Regeneration

A total of 981 tree saplings per hectare were found in Oshaampula inventory area. The regeneration of the common big trees like *Combretum collinum* and *Terminalia sericea* is very good. See full list of species in height classes in Annex 4 (Table 8).

Shrubs

Seven shrub species were recorded in Oshaampula inventory area. *Grewia retinervis* (79 shrubs/ha), *Mundulea sericea* (24 shrubs/ha), *Ozoroa schinzii* (24 shrubs/ha), *Rhus tenuinervis* (10 shrubs/ha) and *Vangueria infausta* (5 shrubs/ha).

6. RESULTS FOR EKOLOLA INVENTORY AREA

6.1 Site and stand data

The total area of Ekolola inventory area is 578 ha. By its geomorphology, Ekolola inventory area was classified as plain. On all plots, soil texture was classified as sand. Moderate signs of grazing were seen (vegetation still vital). On some plots big pole size trees had been removed.

6.2 Measured data

A total of 1347 trees with dbh \geq 5cm were measured in the plot (See table 1, Annex 5), which is on average 15.3 trees per sample plot.

6.3 Species diversity

A total of 34 woody species were found in the Ekolola inventory area. 22 species were recorded as trees and 27 woody species were found in the shrub layer. 15 species were found in both layers (See table 6 for the list of species diversity).

Table 6: Ekolola inventory area: Species diversity by the number of clusters where each species was found

Species	No. of plots Dbh < 5cm	No. of plots Dbh ≥ 5
<i>Acacia ataxacantha</i>	15	4
<i>Acacia erioloba</i>	2	25
<i>Acacia fleckii</i>	2	
<i>Baikiaea plurijuga</i>	3	33
<i>Baphia massaiensis</i>	33	7
<i>Bauhinia petersiana</i>		3
<i>Boscia albitrunca</i>		3
<i>Burkea africana</i>	25	68
<i>Combretum collinum</i>	44	70
<i>Combretum engleri</i>	11	
<i>Combretum psidioides (psidioides)</i>	2	16
<i>Combretum zeyheri</i>	5	17
<i>Commiphora angolensis</i>	2	
<i>Croton gratissimus</i>	79	4
<i>Dichrostachys cinerea (Sentlosa)</i>	4	17
<i>Erythrophleum africanum</i>	11	36
<i>Grewia bicolor</i>	2	
<i>Grewia retinervis</i>	5	1
<i>Lonchocarpus nelsii</i>	2	
<i>Mundulea sericea</i>	3	
<i>Ocina pulchra</i>	17	43
<i>Ozoroa paniculosa</i>	9	
<i>Ozoroa schinzii</i>	10	
<i>Peltophorum africanum</i>		1
<i>Pterocarpus angolensis</i>		18
<i>Rhus tenuinervis</i>	2	
<i>Schinziophyton rautanenii</i>		1
<i>Sclerocarya birrea</i>		1
<i>Securidaca longepedunculata</i>		1
<i>Strychnos pungens</i>	1	
<i>Terminalia sericea</i>	48	62
<i>Unknown</i>	2	1
<i>Vangueria infausta</i>	1	
<i>Ximenia caffra var microphylla</i>	7	

6.4 Number of stems by species

Live trees

A total of 22 tree species were found in Ekolola inventory area. Including all species, altogether 317 stems per hectare and a total of 182,972 stems (on an area of 578 hectares) have been estimated to grow on this area. The most frequent species is *Combretum collinum* with 70 stems per hectare (a total of 40,403 stems). *Terminalia sericea* is the second most frequent species with 57 stems per hectare (32,824 stems in total) and *Baikiaea plurijuga* the third with 37 stems per hectare (21,418 stems in total). The number of stems/ha of the 6 most common species has been illustrated in figure 14. See full list of species in Annex 5, Table 4.

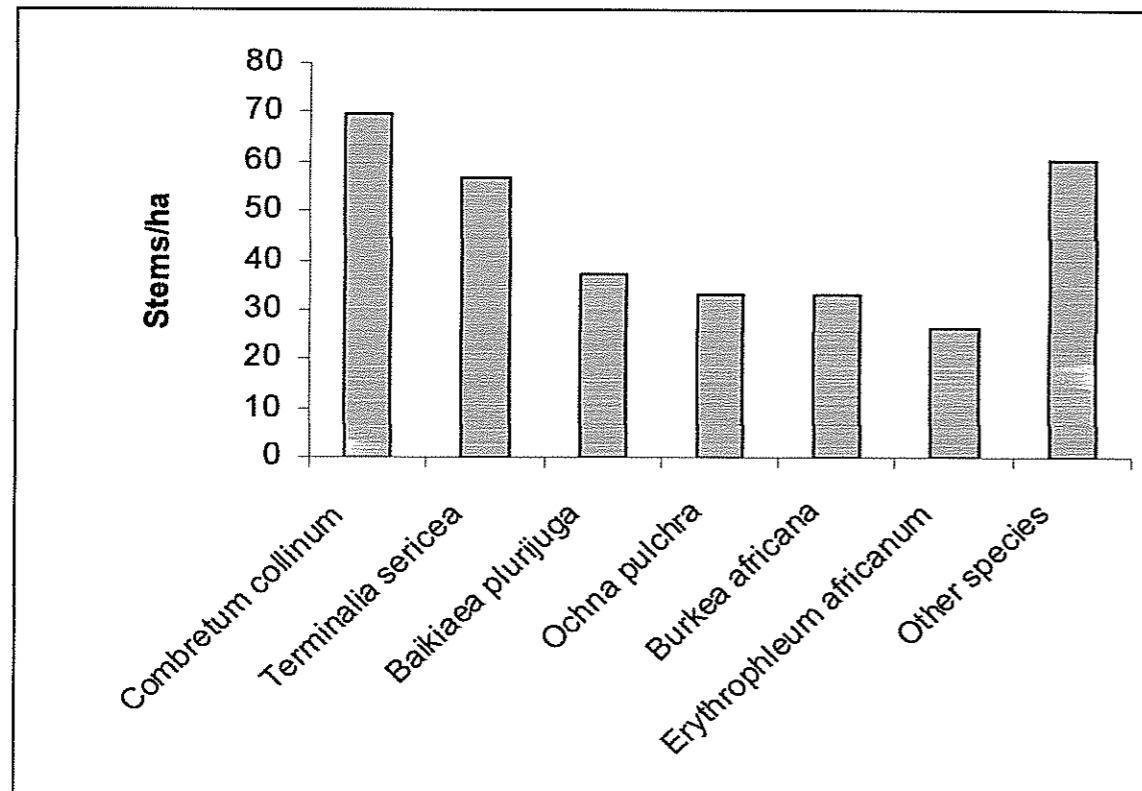


Figure 14: Ekolola inventory area: Live tree species, number of trees per hectare

Dead trees

A total of 10 tree species were found among the dead trees. Including all species there are about 23 dead trees per hectare which totals in about 13,079 dead trees in the whole area. The most frequent species among dead trees is *Terminalia sericea* (7 trees per hectare, 4,234 trees in total) and the second most frequent species is *Combretum collinum* (5 trees per hectare, 2,875 trees in total). The other species are much less frequent. The number of stems/ha of the 4 most common dead tree species has been illustrated in figure 15. See full list of dead tree species in Annex 5 (Table 5).

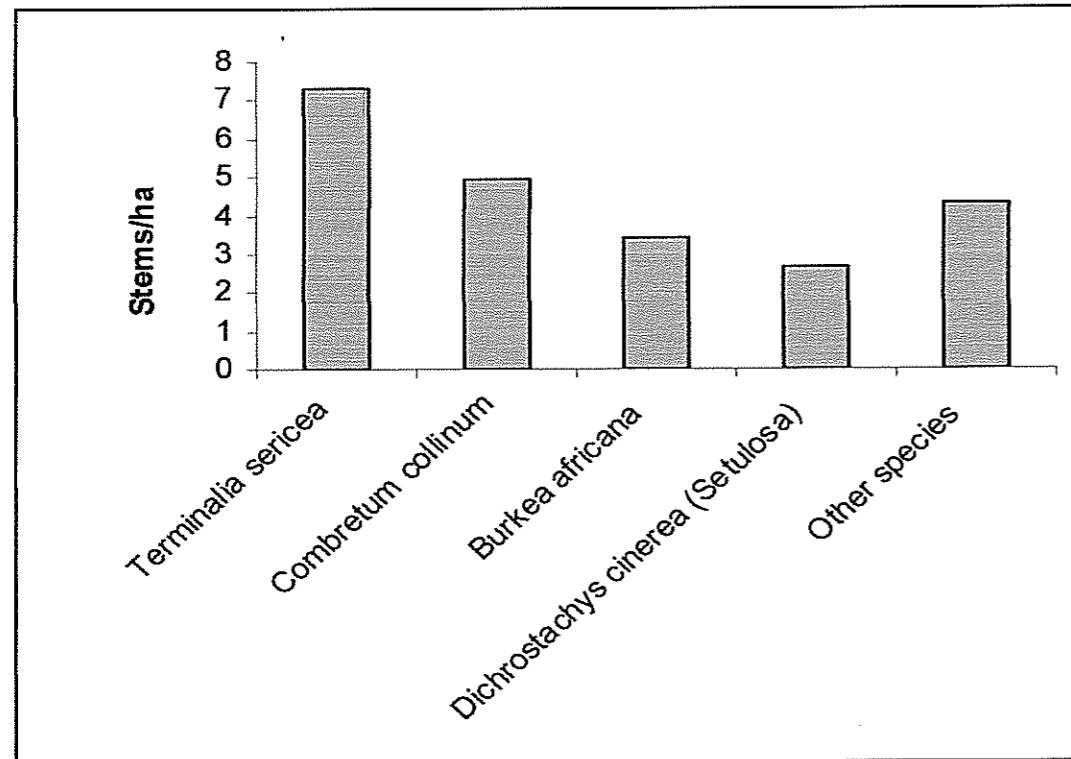


Figure 15: Ekolola inventory area: Most frequent dead tree species, trees per hectare.

6.5 Diameter distribution

Live trees

The diameter distribution for the 5 most common live tree species has been illustrated in figure 16. *Terminalia sericea*, *Combretum collinum*, *Ochna pulchra* and *Baikiaea plurijuga* all have most of the stems in the smaller diameter class 5-15 cm. The full diameter distribution of stems by species can be found in Annex 5, table 6.

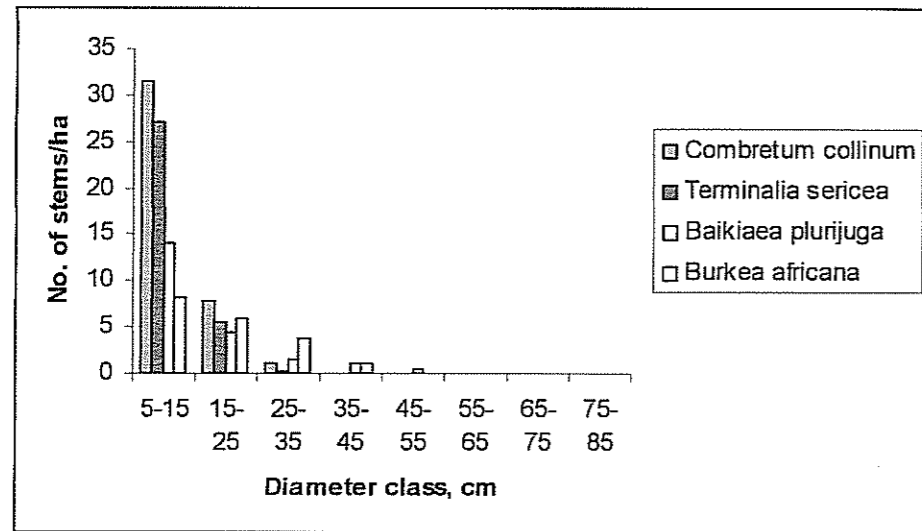


Figure 16: Ekolola inventory area: Diameter distribution of the 5 most frequent species

Dead trees

The number of dead trees in diameter classes is illustrated below in figure 17. Most of the trees were found in the small and medium size diameter classes 5 cm to 25 cm. The diameter distribution of dead trees by species can be found in Annex 5 (Table 7).

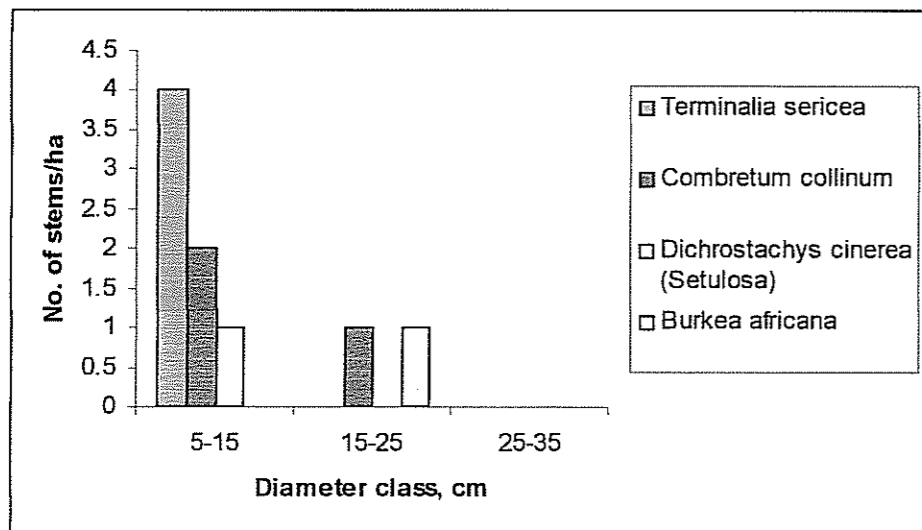


Figure 17: Ekolola inventory area: Diameter distribution of dead trees

6.6 Volumes by species

Live trees

The volume of all live trees in Ekolola inventory area is about 44 m³/ha, that is a total of 25,494 m³ on the whole area. The four species with the biggest volumes are: *Burkea africana* 6,539 m³ (11 m³/ha), *Baikiaea plurijuga* 5,195 m³ (9 m³/ha) *Combretum collinum* 3,258 m³ (6m³/ha) and *Erythrophleum africanum* 2,870 m³ (5 m³/ha) (See figure 18). Full list of species and their respective volumes can be found in Annex 5 (Table 4).

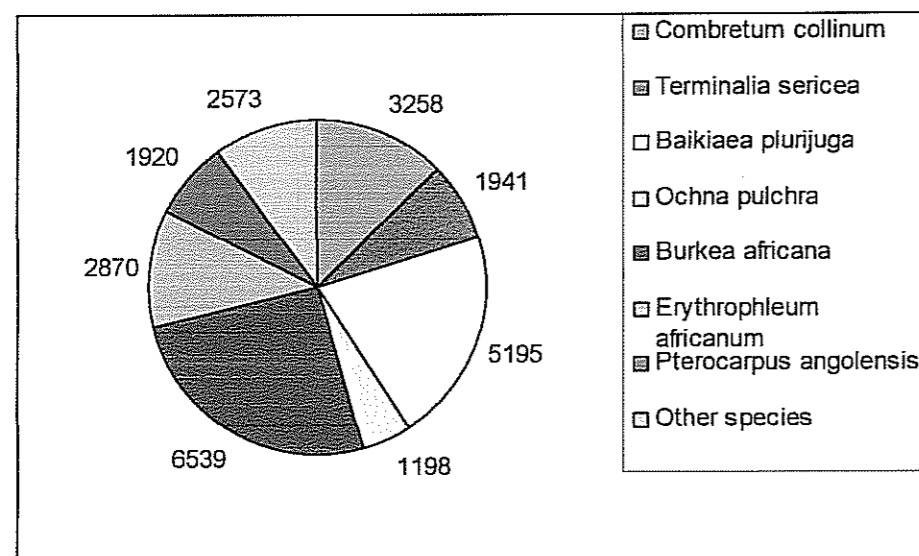


Figure 18: Ekolola inventory area: Total volume (m³) by species

Dead trees

The total volume of dead trees in Ekolola inventory area is about 2,351 m³ (4 m³/ha). *Burkea africana* has a dead wood volume of 747 m³ (1.3 m³/ha). There is also dead wood from *Combretum collinum* (408 m³) and from *Baikiaea plurijuga* (404 m³). See figure 19 and the full list of species and dead wood volume in Annex 5 (Table 5).

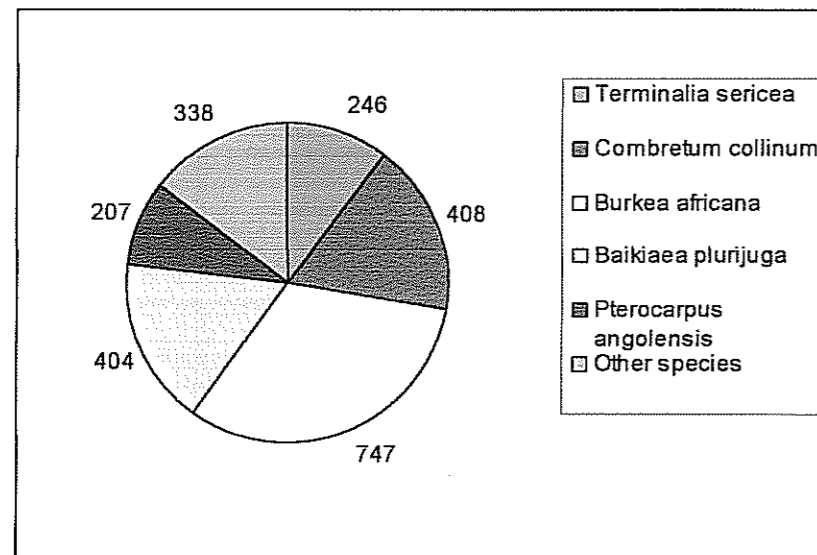


Figure 19: Ekolola inventory area: Volume of 5 most frequent dead wood tree species (total, m³).

Timber volume of live trees

Only two species have dimensions big enough to be considered as timber size. *Baikiaea plurijuga* and *Pterocarpus angolensis* both have a log volume of about 160 m³ with good and medium timber quality (see table 7).

Table 7: Ekolola inventory area: Number of stems (dbh 45 cm or more) and total volume of logs

Species	Quality	Total No. of stem	Total log volume, m ³
<i>Baikiaea plurijuga</i>	Good quality	230	140
	Medium quality	70	20
<i>Pterocarpus angolensis</i>	Good quality	230	20
	Medium quality	70	20

6.7 Regeneration and shrubs

Regeneration

There are about 1853 tree saplings per hectare in Ekolola inventory area. The regeneration of *Terminalia sericea* and *Combretum collinum* is good. See full list of saplings by species and height classes in Annex 5 (table 8).

Shrubs

Seven shrub species were recorded in Ekolola with a total of 155 shrubs per hectare. The most frequent species is *Baphia massaiensis* (84 shrubs per hectare). See full list of shrubs by species and height classes in Annex 5 (Table 9).

7. RELIABILITY OF THE RESULTS

Sources of error

In sampling based forest inventories, the following error sources are always present: sampling error, measurement error including coding error, errors in data processing and errors in models used for e.g. volume estimation.

Training

The Ohepi, Oshaampula and Ekolola forest areas were inventoried by experienced NFI field staff and the field measurement errors can be expected to be very few. Field instructions were reviewed both in the office and in the field. In this work, specific attention was paid to guarantee good quality field data. Data processing programs have been carefully designed and double checked. Several cross checkings have been done to find out possible errors and inconsistencies in the data. The data processing and analysis, as well as reports were double checked.

Volume functions

The applied volume functions are probably the main source of errors. This error however does not affect the figures related to number of stems.

Sampling error and confidence limits for tree volume

The estimates for the standard errors of mean volumes were calculated using the formula applicable for random sampling. The sampling in both areas was done with systematic sampling. Generally, the formula for random sampling gives an overestimate of the sampling error for systematic sampling. Therefore, it is safe to use these estimates.

Table 8: Sampling error and confidence limits (95% probability) for mean tree volume (m³/ha)

	Sampling variance	Standard error, m ³ /ha	Average volume, m ³ /ha	Sampling error, %	Lower confidence limit, m ³ /ha	Upper confidence limit, m ³ /ha
Ohepi	3.4	1.8	28.3	6.3	24.7	31.8
Oshaampula	6.2	2.5	20.8	12	15.9	25.7
Ekolola	7.4	2.7	43.8	6.2	38.5	49.1

In Oshaampula a lower accuracy (12% S.E) was achieved compared to the other two areas (6% S.E). The number of sampling units in Oshaampula (42 plots) was a little too low.

ANNEX 1: VOLUME FUNCTIONS FOR OHEPI, OSHAAMPULA AND EKOLOLA INVENTORY AREAS

For *Pterocarpus angolensis* use:

$$v = e^{(a_0 + a_1 * d + a_2 * d^2)},$$

where v = tree volume in dm^3

d = tree diameter (dbh) in cm

a_0, a_1 & a_2 = parameters (see table below)

Note: 1. ^ means "to the power of"

2. $e = 2.71828$

For *Terminalia sericea*, *Acacias*, *Lonchocarpus nelsii*, *Combretum collinum*, *Colophospermum mopane*, *Burkea africana*, *Baikiaea plurijuga* and *Commiphora angolensis* use:

$$v = (a_0 + a_1 * d + a_2 * d^2) * d^2 \text{ or } v = a_0 * d^2 + a_1 * d^3 + a_2 * d^4$$

where v = tree volume in dm^3

d = tree diameter (dbh) in cm

a_0, a_1 & a_2 = parameters (see table below)

Parameters:

Species	a_0	a_1	a_2
1 ACACIAS	0.21795109	0.01407904	-0.00010783
2 BAIFL	0.260011	0.02368	-0.00021
3 BURAF	0.151269	0.030485	-0.00029
4 COLMO	0.12798339	0.01580639	-0.00014894
5 COMAN	0.18057025	0.01974331	-0.00010431
6 COMCO	0.18057025	0.01974331	-0.00010431
7 LONNE	0.46735748	0.00342083	0.00008758
8 PTEAN	2.81959700	0.14324800	-0.00090000
9 TERSE	0.21795109	0.01407904	-0.00010783

Example 1: For a *Baikiaea plurijuga* tree with diameter (DBH) = 26.5 cm.

$$v = a_0 * d^2 + a_1 * d^3 + a_2 * d^4$$

$$= (0.260011) * (26.5)^2 + (0.02368) * (26.5)^3 + (-0.00021) * (26.5)^4$$

$$= 182.59272 + 440.67592 - 103.56256$$

$$= 519.7 \text{ dm}^3$$

Example 2: For a *Pterocarpus angolensis* tree with diameter (DBH) = 47 cm.

$$v = e^{(a_0 + a_1 * d + a_2 * d^2 + a_3 * d^3)}$$

$$= e^{(2.81959700) + (0.14324800) * (47) + (-0.00090000) * (47)^2}$$

$$= (2.71828)^{(2.819597 + 6.7327 - 1.9881)}$$

$$= (2.71828)^{(7.5641)}$$

$$= 1927.72 \text{ dm}^3$$

Note: $1000 \text{ dm}^3 = 1 \text{ m}^3$

ANNEX 2: LIST OF TREE/SHRUB SPECIES THAT WERE INVENTORIED IN OHEPI, OSHAAMPULA AND EKOLOLA FOREST AREAS

Index refers to the volume model in Appendix 2

CODE	SPECIES	INDEX TO VOLUME MODEL
PTEAN	Pterocarpus angolensis	8
BURAF	Burkea africana	3
BAIPL	Baikiaea plurijuga	2
ACAER	Acacia erioloba	1
TERSE	Terminalia sericea	9
COMCO	Combretum collinum	6
ERYAF	Erythrophleum africanum	3
OCHPU	Ochna pulchra	8
LONNE	Lonchocarpus nelsii	7
COMPS	Combretum psidioides (psidioides)	6
DICCS	Dichrostachys cinerea (setulosa)	9
COMAN	Commiphora angolensis	5
COMZE	Combretum zeyheri	6
ACAFL	Acacia flekii	1
ACAAT	Acacia ataxacantha	1
BOSAL	Boscia albitrunca	8
PELAF	Peltophorum africanum	8
SCHRA	Schnziophyton rautanenii	3
SCLBI	Sclerocarya birrea	8
ACAHE	Acacia hebeclada (hebeclada)	1
ZIZMU	Ziziphus mucronata	8
BAUPE	Bauhia petersiana	9
CROGG	Croton gratissimus	9
BAPMA	Baphia massaiensis	9
SCLBI	Sclerocarya birrea	8
SECLO	Securidaca longepedunculata	8
XIMCA	Ximenia caffra var microphylla	9
XIMAM	Ximenia americana var americana	9
AKAKA	Acacia karroo	1
ALBAN	Albizia anthelmintica	1

ANNEX 3: RESULT TABLES FOR OHEPI INVENTORY AREA

Table 1: Total number of measured trees

Species	Total No. of measured trees	% of measured trees
<i>Acacia ataxacantha</i>	1	0.1
<i>Acacia erioloba</i>	12	1.0
<i>Acacia fleckii</i>	5	0.4
<i>Albizia anthelmintica</i>	8	0.7
<i>Baphia massaiensis</i>	1	0.1
<i>Boscia albitrunca</i>	2	0.2
<i>Burkea africana</i>	180	15.5
<i>Combretum collinum</i>	341	29.4
<i>Combretum psidioides (psidioides)</i>	18	1.6
<i>Combretum zeyheri</i>	48	4.1
<i>Croton gratissimus</i>	11	0.9
<i>Dichrostachys cinerea (Setulosa)</i>	20	1.7
<i>Erythrophleum africanum</i>	10	0.9
<i>Lonchocarpus nelsii</i>	4	0.3
<i>Ochna pulchra</i>	51	4.4
<i>Pterocarpus angolensis</i>	82	7.1
<i>Terminalia sericea</i>	367	31.6
Total	1161	100

Table 2: Average and maximum height by species

Species	Average height (m)	Maximum height (m)
<i>Acacia ataxacantha</i>	4.40	4.4
<i>Acacia erioloba</i>	12.40	20.8
<i>Acacia fleckii</i>	3.30	7.2
<i>Albizia anthelmintica</i>	3.44	11.5
<i>Baphia massaiensis</i>	2.90	2.9
<i>Boscia albitrunca</i>	6.90	7.8
<i>Burkea africana</i>	9.49	19.6
<i>Combretum collinum</i>	4.32	11.1
<i>Combretum psidioides (psidioides)</i>	4.58	6.8
<i>Combretum zeyheri</i>	4.07	10.5
<i>Croton gratissimus</i>	4.08	7.5
<i>Dichrostachys cinerea (Setulosa)</i>	3.09	7.4
<i>Erythrophleum africanum</i>	6.72	13.5
<i>Lonchocarpus nelsii</i>	5.83	7.7
<i>Ochna pulchra</i>	3.69	9.4
<i>Pterocarpus angolensis</i>	12.28	24.8
<i>Terminalia sericea</i>	3.72	15

ANNEX 3: RESULT TABLES FOR OHEPI INVENTORY AREA

Table 4: Volume and number of stems by species totally and per hectare

Species	Total No. of stems	Stems per ha	Total tree volume m ³	Mean volume m ³ /ha
<i>Acacia ataxacantha</i>	2000	0.4	0	0.0
<i>Acacia erioloba</i>	8000	1.6	4000	0.8
<i>Acacia fleckii</i>	7000	1.4	200	0.0
<i>Albizia anthelmintica</i>	12000	2.3	1400	0.3
<i>Baphia massaiensis</i>	2000	0.4	0	0.0
<i>Boscia albitrunca</i>	2000	0.4	400	0.1
<i>Burkea africana</i>	141000	27.2	41100	8.0
<i>Combretum collinum</i>	529000	102.6	25500	4.9
<i>Combretum psidioides</i> (<i>psidioides</i>)	30000	5.7	1000	0.2
<i>Combretum zeyheri</i>	83000	16.0	1600	0.3
<i>Croton gratissimus</i>	20000	3.9	300	0.1
<i>Dichrostachys cinerea</i> (<i>Setulosa</i>)	31000	6.0	900	0.2
<i>Erythrophleum africanum</i>	10000	1.9	1900	0.4
<i>Lonchocarpus nelsii</i>	6000	1.1	400	0.1
<i>Ochna pulchra</i>	88000	17.1	4600	0.9
<i>Pterocarpus angolensis</i>	31000	6.0	41000	7.9
<i>Terminalia sericea</i>	589000	114.1	21300	4.1
Total	1591000	308.1	145600	28.3

Table 5: Volume and number of stems of dead trees (totally and per hectare)

Species	Total No. of stems	Stems per ha	Total tree volume, m ³	Mean volume m ³ /ha
<i>Acacia fleckii</i>	1825	0.4	20	0.0
<i>Burkea africana</i>	21190	4.1	7777	1.5
<i>Combretum collinum</i>	29656	5.7	2669	0.5
<i>Combretum zeyheri</i>	1825	0.4	23	0.0
<i>Dichrostachys cinerea</i> (<i>Setulosa</i>)	2737	0.5	333	0.1
<i>Erythrophleum africanum</i>	1825	0.4	73	0.0
<i>Ochna pulchra</i>	3650	0.7	232	0.0
<i>Pterocarpus angolensis</i>	4715	0.9	3892	0.8
<i>Terminalia sericea</i>	33762	6.5	2337	0.5
Total	101185	19.6	17355	3.4

ANNEX 3: RESULT TABLES FOR OHEPI INVENTORY AREA

Table 6: Diameter distribution of stem by species (1000 stems)

Species	5-15	15-25	25-35	35-45	45-55	55-65	65-75	75-85	85-95	Total	% of total
<i>Acacia ataxacantha</i>	2									2	0.1
<i>Acacia erioloba</i>	5			1	1					7	0.4
<i>Acacia fleckii</i>	7									7	0.5
<i>Albizia anthelmintica</i>	4	8								11	0.7
<i>Baphia massaiensis</i>	2									2	0.1
<i>Boscia albitrunca</i>		2								2	0.1
<i>Burkea africana</i>	69	37	26	7						141	8.9
<i>Combretum collinum</i>	467	59	3							529	33.4
<i>Combretum psidioides (psidioides)</i>	29									29	1.8
<i>Combretum zeyheri</i>	82									82	5.2
<i>Croton gratissimus</i>	20									20	1.3
<i>Dichrostachys cinerea (Setulosa)</i>	31									31	2.0
<i>Erythrophleum africanum</i>	5	2	2							10	0.6
<i>Lonchocarpus nelsii</i>	5									5	0.3
<i>Ochna pulchra</i>	82	6								88	5.6
<i>Pterocarpus angolensis</i>	5	9	1	5	4	3	1	1		31	1.9
<i>Terminalia sericea</i>	547	38	3							589	37.1
Total	1365	161	36	14	5	3	1	1		1586	100.0

Table 7: Diameter distribution of dead trees by species (1000 stems)

Species	Diameter class, cm									Total	% of total
	5-15	15-25	25-35	35-45	45-55	55-65	65-75	75-85	85-95		
<i>Acacia fleckii</i>	2									2	1.8
<i>Burkea africana</i>	7	7	6							21	20.7
<i>Combretum collinum</i>	22	6	1							30	30.0
<i>Combretum zeyheri</i>	2									2	1.8
<i>Dichrostachys cinerea (Setulosa)</i>	2									2	1.8
<i>Erythrophleum africanum</i>	2									2	1.8
<i>Ochna pulchra</i>	4									4	3.7
<i>Pterocarpus angolensis</i>		2	1	1						4	4.1
<i>Terminalia sericea</i>	26	8	0							34	34.1
Total	66	23	9	1						99	100.0

ANNEX 3: RESULT TABLES FOR OHEPI INVENTORY AREA

Table 8: Number of tree seedlings per ha by height classes

Species	0-25	26-50	51-100	101-150	151-200	201-250	251-300	300+	Total	% of total
<i>Acacia ataxacantha</i>		1	6	7	4	3	6	4	31	2.5
<i>Acacia fleckii</i>			1	1	2		1	3	9	0.7
<i>Baphia massaiensis</i>	78	77	70	42	57	26	8	9	366	29.1
<i>Bauhinia petersiana</i>	2	2	4	2		1			12	1.0
<i>Burkea africana</i>	2	7	11	1	3	2	1	2	30	2.4
<i>Colophospermum mopane</i>						1			1	0.1
<i>Combretum collinum</i>	7	12	34	34	51	39	4	33	216	17.2
<i>Combretum engleri</i>		2	7	2	4	4			20	1.6
<i>Combretum psidioides (psidioides)</i>			2	3		1		1	8	0.6
<i>Combretum zeyheri</i>	4	9	3	8	21	10	8	10	73	5.8
<i>Commiphora angolensis</i>	1	2	7	6	2	1		2	21	1.7
<i>Croton gratissimus</i>		1	10	13	16	13	6	6	64	5.1
<i>Dichrostachys cinerea (Setulosa)</i>			1	2					3	0.3
<i>Erythrophleum africanum</i>				3		1	1	3	9	0.7
<i>Lonchocarpus nelsii</i>		1							1	0.1
<i>Ochna pulchra</i>	9	21	33	7	13	4		2	90	7.2
<i>Terminalia sericea</i>	4	10	51	58	68	34	31	41	298	23.7
<i>Ximenia americana var americana</i>				1					1	0.1
<i>Ximenia caffra var microphylla</i>				1			1		2	0.2
Total	108	146	241	192	242	142	67	118	1256	

Table 9: Number of shrub seedlings per ha by height classes

Species	0-25	26-50	51-100	101-150	151-200	201-250	251-300	300+	Total	% of total
<i>Grewia bicolor</i>	0.0	3.3	2.2	3.3	7.8	0.0	0.0	0.0	16.7	5.9
<i>Grewia flava</i>	0.0	2.2	20.0	3.3	7.8	0.0	0.0	0.0	33.3	11.9
<i>Grewia retinervis</i>	6.7	32.2	28.9	27.8	24.4	3.3	1.1	0.0	124.4	44.3
<i>Mundulea sericea</i>	0.0	0.0	0.0	0.0	2.2	2.2	0.0	1.1	5.6	2.0
<i>Ozoroa paniculosa</i>	0.0	5.6	14.4	3.3	4.4	1.1	0.0	1.1	30.0	10.7
<i>Ozoroa schinzii</i>	0.0	0.0	16.7	10.0	8.9	0.0	0.0	0.0	35.6	12.6
<i>Rhigoszum brevispinosum</i>	0.0	2.2	2.2	1.1	13.3	5.6	1.1	0.0	25.6	9.1
<i>Rhus tenuinervis</i>	0.0	0.0	4.4	0.0	3.3	1.1	0.0	0.0	8.9	3.2
<i>Tangueria infausta</i>	0.0	0.0	0.0	0.0	1.1	0.0	0.0	0.0	1.1	0.4
Total	6.7	45.6	88.9	48.9	73.3	13.3	2.2	2.2	281.1	

ANNEX 4: RESULT TABLES FOR OSHAAMPULA INVENTORY AREA

Table 1: Total number of measured trees

Species	Number of measured trees	% of measured trees
<i>Acacia erioloba</i>	19	3.5
<i>Acacia fleckii</i>	2	0.4
<i>Acacia hebeclada (hebeclada)</i>	5	0.9
<i>Acacia karroo</i>	5	0.9
<i>Baphia massaiensis</i>	1	0.2
<i>Burkea africana</i>	50	9.3
<i>Combretum collinum</i>	220	41.0
<i>Combretum psidioides (psidioides)</i>	6	1.1
<i>Combretum zeyheri</i>	17	3.2
<i>Commiphora angolensis</i>	1	0.2
<i>Croton gratissimus</i>	10	1.9
<i>Dichrostachys cinerea (Setulosa)</i>	41	7.6
<i>Lonchocarpus nelsii</i>	1	0.2
<i>Ocina pulchra</i>	15	2.8
<i>Terminalia sericea</i>	135	25.1
<i>Ximenia americana var americana</i>	3	0.6
<i>Ximenia caffra var microphylla</i>	3	0.6
<i>Ziziphus mucronata</i>	3	0.6
Total	537	100.0

ANNEX 4: RESULT TABLES FOR OSHAAMPULA INVENTORY AREA

Table 2: Average and maximum height by species

Species	Average height (m)	Maximum height (m)
<i>Acacia erioloba</i>	8.14	14.5
<i>Acacia fleckii</i>	2.90	5.8
<i>Acacia hebeclada (hebeclada)</i>	1.16	5.8
<i>Acacia karroo</i>	1.68	8.4
<i>Baphia massaiensis</i>	4.30	4.3
<i>Burkea africana</i>	11.13	17.5
<i>Combretum collinum</i>	3.89	14.2
<i>Combretum psidioides (psidioides)</i>	3.97	6.6
<i>Combretum zeyheri</i>	3.98	8.5
<i>Commiphora angolensis</i>	2.50	2.5
<i>Croton gratissimus</i>	4.17	7.6
<i>Dichrostachys cinerea (Setulosa)</i>	2.40	6.3
<i>Lonchocarpus nelsii</i>	7.50	7.5
<i>Ocina pulchra</i>	4.49	8.7
<i>Terminalia sericea</i>	3.63	12.3
<i>Ximenia americana var americana</i>	1.77	5.3
<i>Ximenia caffra var microphylla</i>	1.97	3.1
<i>Ziziphus mucronata</i>	1.50	4.5

ANNEX 4: RESULT TABLES FOR OSHAAMPULA INVENTORY AREA

Table 4: Volume and number of stems by species totally and per ha

Species	Total No. of stems	Stems per ha	Total tree volume, m ³	Average tree volume m ³ /ha
<i>Acacia erioloba</i>	6000	7.7	1000	1.4
<i>Acacia fleckii</i>	1000	1.5	0	0.1
<i>Acacia hebeclada (hebeclada)</i>	3000	3.8	0	0.1
<i>Acacia karroo</i>	3000	3.8	0	0.0
<i>Baphia massaiensis</i>	1000	0.8	0	0.0
<i>Burkea africana</i>	7000	9.2	4000	5.6
<i>Commiphora angolensis</i>	1000	0.8	0	0.0
<i>Combretum collinum</i>	100000	138.5	5300	7.3
<i>Combretum psidioides (psidioides)</i>	3000	4.5	200	0.2
<i>Combretum zeyheri</i>	8000	11.7	500	0.7
<i>Croton gratissimus</i>	5000	7.6	100	0.1
<i>Dichrostachys cinerea (Setulosa)</i>	13000	18.8	600	0.9
<i>Lonchocarpus nelsii</i>	1000	0.8	100	0.1
<i>Ochna pulchra</i>	8000	10.6	400	0.6
<i>Terminalia sericea</i>	46000	63.9	2300	3.1
<i>Ximenia americana var americana</i>	2000	2.3	100	0.1
<i>Ximenia caffra var microphylla</i>	2000	2.3	100	0.1
<i>Ziziphus mucronata</i>	2000	2.3	100	0.2
Total	212000	290.7	14800	20.8

Table 5: Volume and number of stems for dead trees (totally and per ha)

Species	Total No. of stems	Stems per ha	Total tree volume, m ³	Average tree volume m ³ /ha
<i>Acacia erioloba</i>	136	0.2	30	0.0
<i>Burkea africana</i>	2452	3.4	1040	1.4
<i>Combretum collinum</i>	9536	13.3	960	1.3
<i>Dichrostachys cinerea (Setulosa)</i>	6811	9.5	353	0.5
<i>Terminalia sericea</i>	20707	28.8	1338	1.9
Total	39643	55.1	3721	5.2

ANNEX 4: RESULT TABLES FOR OSHAAMPULA INVENTORY AREA

Table 6: Diameter distribution of stems by species (1000 stems)

Species	5-15	15-25	25-35	35-45	45-55	Total	% of total
<i>Acacia erioloba</i>	2					3	2.1
<i>Acacia fleckii</i>	1					1	0.3
<i>Acacia hebeclada (hebeclada)</i>	3					3	1.7
<i>Acacia karroo</i>	3					3	1.7
<i>Baphia massaiensis</i>	1					1	0.3
<i>Burkea africana</i>	1	2	2	1		6	3.8
<i>Combretum collinum</i>	60	13	1			75	46.6
<i>Combretum psidioides (psidioides)</i>	2	1				2	1.4
<i>Combretum zeyheri</i>	6	2				8	4.9
<i>Commiphora angolensis</i>	1					1	0.3
<i>Croton gratissimus</i>	5					5	3.1
<i>Dichrostachys cinerea (Setulosa)</i>	8	1				9	5.7
<i>Lonchocarpus nelsii</i>		1				1	0.3
<i>Ochna pulchra</i>	4					4	2.7
<i>Terminalia sericea</i>	31	5				37	22.9
<i>Ximenia americana var americana</i>	1					1	0.7
<i>Ximenia caffra var microphylla</i>	1					1	0.7
<i>Ziziphus mucronata</i>	1	1				1	0.7
Total	130	24	4	2		160	100.0

Table 7: Diameter distribution of dead trees by species (1000 stems)

Species	Diameter class, cm				Total	% of total
	5-15	15-25	25-35	35-45		
<i>Acacia erioloba</i>					0	0.3
<i>Burkea africana</i>	1		1		2	6.2
<i>Combretum collinum</i>	6	3			10	24.1
<i>Dichrostachys cinerea (Setulosa)</i>	6	1			7	17.2
<i>Terminalia sericea</i>	16	4			21	52.2
Total	29	9	1		40	100.0

ANNEX 4: RESULT TABLES FOR OSHAAMPULA INVENTORY AREA

Table 8: Number of tree seedlings per ha by height classes

Species	0-25	26-50	51-100	101-150	151-200	201-250	251-300	300+	total	% of total
<i>Acacia ataxacantha</i>	7.1	9.5	9.5	11.9	38.1	50.0	21.4	38.1	185.7	18.9
<i>Acacia erioloba</i>	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.2
<i>Acacia fleckii</i>	0.0	0.0	0.0	0.0	2.4	0.0	0.0	0.0	2.4	0.2
<i>Acacia mellifera</i>	0.0	0.0	0.0	2.4	7.1	23.8	0.0	14.3	47.6	4.9
<i>Baphia massaiensis</i>	0.0	14.3	11.9	4.8	4.8	2.4	2.4	4.8	45.2	4.6
<i>Bauhinia petersiana</i>	0.0	0.0	0.0	7.1	9.5	0.0	0.0	2.4	19.0	1.9
<i>Burkea africana</i>	0.0	0.0	0.0	0.0	2.4	0.0	0.0	0.0	2.4	0.2
<i>Colophospermum mopane</i>	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	0.2
<i>Combretum collinum</i>	4.8	0.0	21.4	16.7	23.8	23.8	14.3	31.0	135.7	13.8
<i>Combretum engleri</i>	0.0	4.8	0.0	11.9	9.5	7.1	0.0	2.4	35.7	3.6
<i>Combretum zeyheri</i>	0.0	2.4	0.0	2.4	0.0	2.4	2.4	0.0	9.5	1.0
<i>Commiphora angolensis</i>	2.4	2.4	9.5	4.8	2.4	2.4	2.4	0.0	26.2	2.7
<i>Croton gratissimus</i>	0.0	0.0	7.1	21.4	69.0	59.5	14.3	11.9	183.3	18.7
<i>Dichrostachys cinerea (Setulosa)</i>	0.0	2.4	23.8	11.9	7.1	2.4	45.2	4.8	97.6	10.0
<i>Ochna pulchra</i>	7.1	11.9	0.0	0.0	0.0	2.4	0.0	0.0	21.4	2.2
<i>Terminalia prunioides</i>	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4	2.4	0.2
<i>Terminalia sericea</i>	2.4	7.1	9.5	23.8	31.0	14.3	16.7	16.7	121.4	12.4
<i>Ximenia americana var americana</i>	0.0	2.4	2.4	0.0	7.1	4.8	4.8	0.0	21.4	2.2
<i>Ximenia caffra var microphylla</i>	0.0	0.0	2.4	0.0	11.9	4.8	0.0	0.0	19.0	1.9
Total	28.6	57.1	97.6	119.0	226.2	200.0	123.8	128.6	981.0	100.0

Table 9: Number of shrub seedlings per ha by height classes

Species	0-25	26-50	51-100	101-150	151-200	201-250	251-300	300+	Total	% of total
<i>Grewia bicolor</i>	0.0	7.1	7.1	2.4	2.4	0.0	0.0	0.0	19.0	11.4
<i>Grewia retinervis</i>	0.0	19.0	21.4	23.8	14.3	0.0	0.0	0.0	78.6	47.1
<i>Mundulea sericea</i>	0.0	0.0	4.8	11.9	4.8	2.4	0.0	0.0	23.8	14.3
<i>Ozoroa paniculosa</i>	0.0	0.0	0.0	7.1	0.0	0.0	0.0	0.0	7.1	4.3
<i>Ozoroa schinzii</i>	0.0	0.0	4.8	16.7	0.0	2.4	0.0	0.0	23.8	14.3
<i>Rhus tenuinervis</i>	2.4	0.0	2.4	4.8	0.0	0.0	0.0	0.0	9.5	5.7
<i>Vangueria infausta</i>	0.0	0.0	0.0	0.0	2.4	2.4	0.0	0.0	4.8	2.9
Total	2.4	26.2	40.5	66.7	23.8	7.1	0.0	0.0	166.7	100.0

ANNEX 5: RESULT TABLES FOR EKOLOLA INVENTORY AREA

Table 1: Total number of measured trees

Species	Total No. of measured trees	% of measured trees
<i>Acacia ataxacantha</i>	7	0.5
<i>Acacia erioloba</i>	37	2.7
<i>Acacia fleckii</i>	6	0.4
<i>Baikiaea plurijuga</i>	182	13.5
<i>Baphia massaiensis</i>	11	0.8
<i>Bauhinia petersiana</i>	4	0.3
<i>Boscia albitrunca</i>	6	0.4
<i>Burkea africana</i>	236	17.5
<i>Combretum collinum</i>	263	19.5
<i>Combretum psidioides</i> (<i>psidioides</i>)	28	2.1
<i>Combretum zeyheri</i>	39	2.9
<i>Croton gratissimus</i>	6	0.4
<i>Dichrostachys cinerea</i> (<i>Setulosa</i>)	58	4.3
<i>Erythrophloeum africanum</i>	121	9.0
<i>Lonchocarpus nelsii</i>	1	0.1
<i>Ochna pulchra</i>	98	7.3
<i>Peltoporum africanum</i>	3	0.2
<i>Pterocarpus angolensis</i>	38	2.8
<i>Schinziophyton rautanenii</i>	1	0.1
<i>Sclerocarya birrea</i>	1	0.1
<i>Securidaca longepedunculata</i>	1	0.1
<i>Terminalia sericea</i>	198	14.7
Unknown	2	0.1
Total	1347	100.0

ANNEX 5: RESULT TABLES FOR EKOLOLA INVENTORY AREA

Table 2: Average and maximum height by species

Species	Average height (m)	Maximum height (m)
<i>Acacia ataxacantha</i>	4.1	8.2
<i>Acacia erioloba</i>	10.4	17.6
<i>Acacia fleckii</i>	2.0	7.5
<i>Baikiaea plurijuga</i>	7.2	20.5
<i>Baphia massaiensis</i>	3.3	7.1
<i>Bauhinia petersiana</i>	4.9	10.0
<i>Boscia albitrunca</i>	4.1	8.2
<i>Burkea africana</i>	9.9	18.1
<i>Combretum collinum</i>	5.6	18.2
<i>Combretum psidioides (psidioides)</i>	5.4	12.0
<i>Combretum zeyheri</i>	4.9	11.2
<i>Croton gratissimus</i>	5.4	7.8
<i>Dichrostachys cinerea (Setulosa)</i>	2.3	10.7
<i>Erythrophleum africanum</i>	7.4	18.4
<i>Lonchocarpus nelsii</i>	6.8	6.8
<i>Ocina pulchra</i>	4.2	11.6
<i>Peltophorum africanum</i>	2.8	8.3
<i>Pterocarpus angolensis</i>	10.9	23.5
<i>Schinziophyton rautanenii</i>	18.0	18.0
<i>Sclerocarya birrea</i>	12.9	12.9
<i>Securidaca longepedunculata</i>	6.9	6.9
<i>Terminalia sericea</i>	4.6	12.3
Unknown	5.3	10.6

ANNEX 5: RESULT TABLES FOR EKOLOLA INVENTORY AREA

Table 4: Volume and number of stems by species totally and per ha

Species	Total No. of stems	Stems per ha	Total tree volume (m ³)	Mean volume (m ³ /ha)
<i>Unknown</i>	261	0.5	37	0.1
<i>Acacia ataxacantha</i>	1464	2.5	27	0.0
<i>Acacia erioloba</i>	1527	2.6	884	1.5
<i>Acacia fleckii</i>	1254	2.2	112	0.2
<i>Baikiaea plurijuga</i>	21418	37.1	5195	9.0
<i>Baphia massaiensis</i>	2300	4.0	92	0.2
<i>Bauhinia petersiana</i>	836	1.4	14	0.0
<i>Boscia albitrunca</i>	784	1.4	132	0.2
<i>Burkea africana</i>	19014	32.9	6539	11.3
<i>Combretum collinum</i>	40403	69.9	3258	5.6
<i>Combretum psidioides (psidioides)</i>	5122	8.9	251	0.4
<i>Combretum zeyheri</i>	7683	13.3	369	0.6
<i>Croton gratissimus</i>	1254	2.2	24	0.0
<i>Dichrostachys cinerea (Setulosa)</i>	9670	16.7	464	0.8
<i>Erythrophleum africanum</i>	15280	26.4	2870	5.0
<i>Lonchocarpus nelsii</i>	209	0.4	18	0.0
<i>Ochna pulchra</i>	19130	33.1	1198	2.1
<i>Peltophorum africanum</i>	470	0.8	37	0.1
<i>Pterocarpus angolensis</i>	1626	2.8	1920	3.3
<i>Schinziophyton rautanenii</i>	23	0.0	70	0.1
<i>Sclerocarya birrea</i>	209	0.4	14	0.0
<i>Securidaca longepedunculata</i>	209	0.4	27	0.0
<i>Terminalia sericea</i>	32824	56.8	1941	3.4
Total	182973	316.6	25494	44.1

Table 5: Volume and number of stems for dead trees (totally and per ha)

Species	Total No. of stems	Stems per ha	Total tree volume m ³	Average volume m ³ /ha
<i>Acacia erioloba</i>	232	0.4	193	0.3
<i>Baikiaea plurijuga</i>	830	1.4	404	0.7
<i>Burkea africana</i>	1957	3.4	747	1.3
<i>Combretum collinum</i>	2875	5.0	408	0.7
<i>Combretum psidioides (psidioides)</i>	209	0.4	8	0.0
<i>Dichrostachys cinerea (Setulosa)</i>	1516	2.6	55	0.1
<i>Erythrophleum africanum</i>	836	1.4	66	0.1
<i>Ochna pulchra</i>	209	0.4	16	0.0
<i>Pterocarpus angolensis</i>	180	0.3	207	0.4
<i>Terminalia sericea</i>	4234	7.3	246	0.4
Total	13079	22.6	2351	4.1

ANNEX 5: RESULT TABLES FOR EKOLOLA INVENTORY AREA

Table 6: Diameter distribution stems by species (1000 stems)

Species	Diameter class, cm														Total	% of total
	5-15	15-25	25-35	35-45	45-55	55-65	65-75	75-85	85-95	95-105	105-115	115-125				
<i>Acacia ataxacantha</i>	1														1	0.8
<i>Acacia erioloba</i>		1													2	0.8
<i>Acacia fleckii</i>	1	1													1	0.7
<i>Baikiaea plurijuga</i>	14	4	1	1											21	11.7
<i>Baphia massaiensis</i>	2														2	1.3
<i>Bauhinia petersiana</i>	1														1	0.5
<i>Boscia albitrunca</i>	1														1	0.4
<i>Burkea africana</i>	8	6	4	1											19	10.4
<i>Combretum collinum</i>	31	8	1												40	22.1
<i>Combretum psidioides (psidioides)</i>	5														5	2.8
<i>Combretum zeyheri</i>	7	1													8	4.2
<i>Croton gratissimus</i>	1														1	0.7
<i>Dichrostachys cinerea (Setulosa)</i>	9	1													10	5.3
<i>Erythrophleum africanum</i>	9	4	1												15	8.4
<i>Lonchocarpus nelsii</i>	0														0	0.1
<i>Ochna pulchra</i>	18	1													19	10.5
<i>Peltophorum africanum</i>															0	0.3
<i>Pterocarpus angolensis</i>															2	0.9
<i>Schinziophyton rautanenii</i>															0	0.0
<i>Sclerocarya birrea</i>															0	0.1
<i>Securidaca longepedunculata</i>															0	0.1
<i>Terminalia sericea</i>	27	5													33	17.9
Unknown															0	0.1
Total	136	33	9	4	1										183	100.0

Table 7: Diameter distribution of dead trees by species (1000 stems)

Species	5-15	15-25	25-35	35-45	45-55	55-65	65-75	75-85	85-95	95-105	total	% of total
<i>Acacia erioloba</i>		0	0	0		0					0	1.8
<i>Baikiaea plurijuga</i>	0	0	0			0				0	1	6.3
<i>Burkea africana</i>	0	1	0	0	0						2	15.0
<i>Combretum collinum</i>	2	1	0	0							3	22.0
<i>Combretum psidioides (psidioides)</i>	0										0	1.6
<i>Dichrostachys cinerea (Setulosa)</i>	1	0									2	11.6
<i>Erythrophleum africanum</i>	1	0									1	6.4
<i>Ochna pulchra</i>	0										0	1.6
<i>Pterocarpus angolensis</i>		0	0	0						0	0	1.4
<i>Terminalia sericea</i>	4	0	0								4	32.4
Total	9	3	1	0	0	0				0	13	100.0

ANNEX 5: RESULT TABLES FOR EKOLOLA INVENTORY AREA

Table 8: Number of tree seedlings per ha by height classes

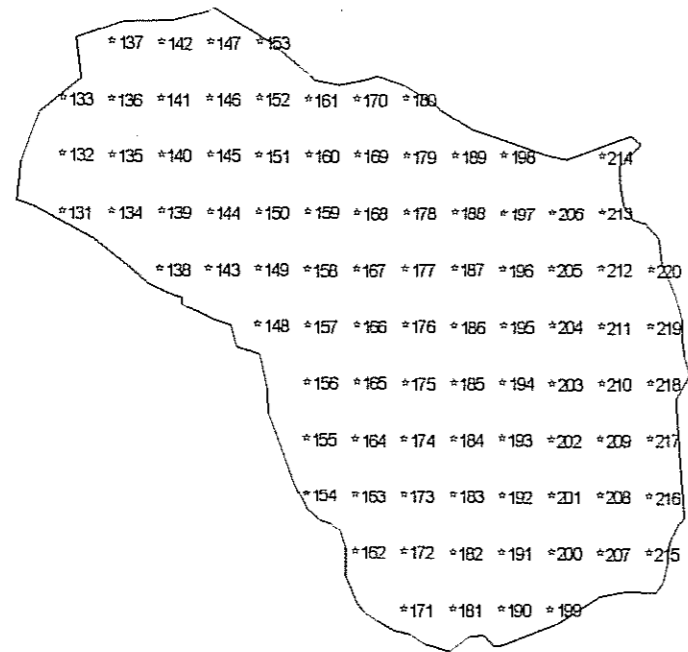
Species	0-25	26-50	51-100	101-150	151-200	201-250	251-300	300+	Total	% of total
<i>Acacia erioloba</i>			3		5				8	0.4
<i>Baikiaea plurijuga</i>					2	1		1	5	0.2
<i>Burkea africana</i>		2	2	9	8	9	3	3	38	2.0
<i>Combretum collinum</i>	1	2	13	18	26	15	14	27	116	6.3
<i>Combretum engleri</i>	2	2	2	1	2		1	1	13	0.7
<i>Combretum psidioides (psidioides)</i>					1	1		2	5	0.2
<i>Combretum zeyheri</i>					2	1	1	1	6	0.3
<i>Commiphora angolensis</i>					1	1			2	0.1
<i>Croton gratissimus</i>	39	83	209	525	461	34	2	5	1358	73.3
<i>Dichrostachys cinerea (Setulosa)</i>	1	1	2	6	9			1	20	1.1
<i>Erythrophleum africanum</i>	1	1	6	1	22	7	1	7	45	2.5
<i>Lonchocarpus nelsii</i>			1		1				2	0.1
<i>Ochna pulchra</i>	30	14	6	1		1			51	2.8
<i>Ozoroa paniculosa</i>	5	6	10	7	3	1			32	1.7
<i>Ozoroa schinzii</i>		1	1	10	7				19	1.0
<i>Strychnos pungens</i>				1			1		2	0.1
<i>Terminalia sericea</i>		8	13	22	25	34	5	26	132	7.1
Total	78	120	268	601	576	106	28	75	1853	

Table 9: Number of shrub seedlings per ha by height classes

Species	0-25	26-50	51-100	101-150	151-200	201-250	251-300	300+	Total	% of total
<i>Acacia ataxacantha</i>			2		5	6	5	9	26	16.9
<i>Baphia massaiensis</i>	6	8	7	11	32	13	1	7	84	54.4
<i>Grewia bicolor</i>			2						2	1.5
<i>Grewia retinervis</i>			3	7	1			1	13	8.1
<i>Mundulea sericea</i>	6	2	11	1	3	1		1	26	16.9
<i>Rhus tenuinervis</i>			1	1					2	1.5
<i>Vangueria infausta</i>						1			1	0.7
Total	11	10	27	20	41	20	6	18	155	

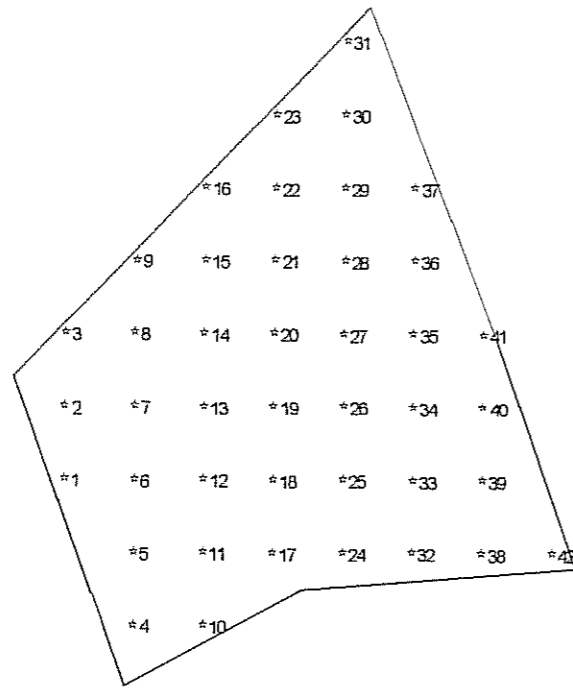
ANNEX 6: OHEPI SAMPLE PLOTS

OHEPI COMMUNITY FOREST



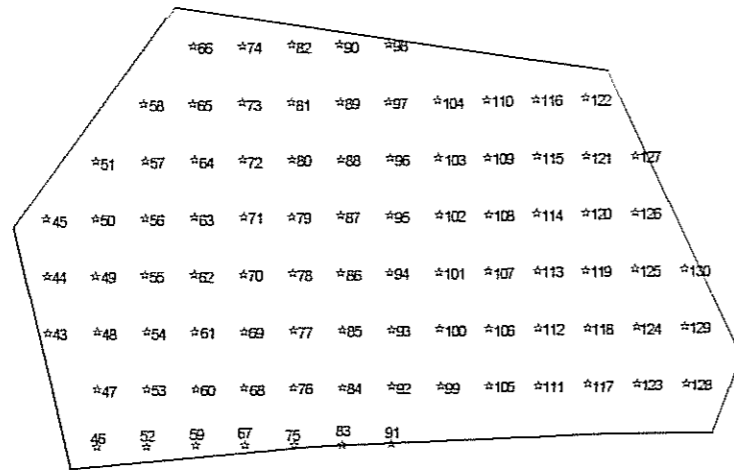
ANNEX 7: OSHAAMPULA SAMPLE PLOTS

Oshaampula Community Forest



ANNEX 8: EKOLOLA SAMPLE PLOTS

Ekolola Community Forest



ANNEX 9: ACKNOWLEDGEMENTS

The inventory of the CFED forest areas was carried out by the NFI-team at the Directorate of Forestry. The key personnel in the inventory were:

Directorate of Forestry

Ndapanda Kanime	Project Manager and Data Analyst
Jonathan Kamwi	Field team Supervisor
Hennie Kakondo	
Natanael Amadhila	
Gerhardt Boois	
Fernando Kaveta	
Henry Vissagie	

NFFP

Risto Laamanen	Technical Advisor for Forest Inventory
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ANNEX 10: LIST OF INVENTORY REPORTS BY THE DIRECTORATE OF FORESTRY

Below is the list of resource reports produced by the Directorate of Forestry and the Namibia-Finland Forestry Programme. The reports are all available at the Directorate of Forestry.

Reports available are:

- Woody Resources of Western Tsumkwe (1997)
- Woody Resources of East and South Tsumkwe, Otjinene and Okakarara Districts (1997)
- Forest Inventory Report of Caprivi Region (1998)
- Forest Inventory Report on Nkurenkuru Concession Area (1998)
- Forest Inventory Report on Ongandjera Community Forest (1998)
- Forest Inventory Report on Uukwaludhi Community Forest (1999)
- Forest Inventory Report on Caprivi State Forestry (1999)
- Inventory of the Directorate of Forestry Eucalyptus Plantations in Kavango Region (1999)
- Inventory Report on the Woody Resources in the Omusati Region (2000)
- Inventory Report on the Woody Resources in the Oshana Region (2000)
- Inventory Report on the Woody Resources in the Okongo Community Forest (2000)
- Wood Resources Report of M'kata Pilot Forest Area (2001)
- Forest Inventory Report on Onankali Eucalyptus Plantation (2001)
- Woody Resources Report of Bukalo Pilot Forest Area (2001)
- Woody Resource Report of Oshikoto Region (2002)
- Forest Inventory Report of Rehoboth Acacia Park (2002)
- Forest Inventory Report of Otjituu Concession Forest (2002)
- Mashare Forest Inventory Report (2002)

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