

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



**WOODY RECOURCES
INVENTORY REPORT ON OMATENDEKA CONSERVANCY
FOREST**



NAMIBIA - FINLAND FORESTRY PROGRAMME

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1. INTRODUCTION AND MISSION OF FORESTRY

The Directorate of Forestry (DoF) under the Ministry of Environment and Tourism has a mission to carry out forest resources assessments in Namibia. In this task the Government of Finland has supported it since 1995. The aim of the support was to build up the capacity of the directorate to carry out regional forest inventories of large areas National Forest Inventory (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 through NFFP Phase II aims now more at strengthening the capacity of Directorate of Forestry to serve the needs for local level forest management planning.

Another component of NFFP, which is the Participatory Integrated Forest Management (PIFM) in North West, is directly working with the community of Omatendeka. They deemed it necessary to find out the amount of resources available in the area in order to compile a sound forest management plan. With regard to the conservancy area, the component is encouraging community to participate in the management of their forest and forest products. More income generating activities for sustainable development are thought of in the near future as the community will be familiarized with the concept of conservancy.

The inventory in Omatendeka conservancy was carried out by the NFI team in November-December 2003. The total area of the Conservancy was 129078.71 hectares, while 7885.96 ha was out side the boundary. The area which has been inventoried was 121192.75 hectares only.

2. GENERAL DESCRIPTION OF THE AREA

The proposed Omatendeka Conservancy Forest is located in the Kunene region. This area is part of the Kalahari and Namib sand. Inventory area covers 121192.75 hectares. Common tree species found in the area are *Colophospermum mopane*, *Acacia karroo* and *Boscia albitrunca*. According to the Atlas of Namibia vegetation map, the area is classified as trees and shrub savanna vegetation and the soil is classified as sandy soil. The annual rainfall is between 300-350 mm (see Atlas of Namibia, 2002).

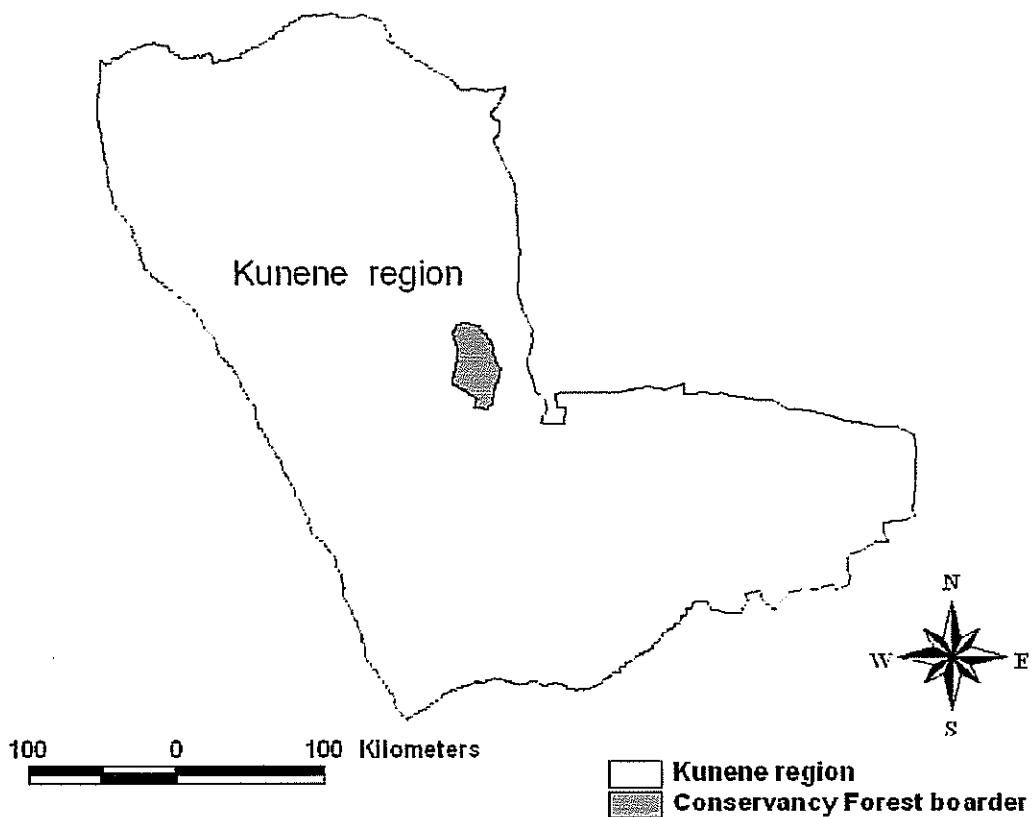


Figure 1: Location of Omatendeka inventory area

3. INVENTORY DESIGN

3.1 Sampling method

The stratification was based on the mountainous conservancy map produced by the National Remote Sensing Center. First, the maximum number of plots possible to measure was determined using the resources available (time, staff and money) as the limiting factor. A total of one hundred and forty four plots were laid. No specific system was used for the allocation of plots; the decision was based on previous experience.

All mountainous areas were left out from the sample in order to improve efficiency of the field work. A uniform grid (plot distance according to the number of plots allocated) was then laid on the land units included in the sample. The plots were then digitized in order to obtain their coordinates.

Finally, a large land unit with a very high expected tree cover was sampled. The number of plots measured in the area is given in the table below:

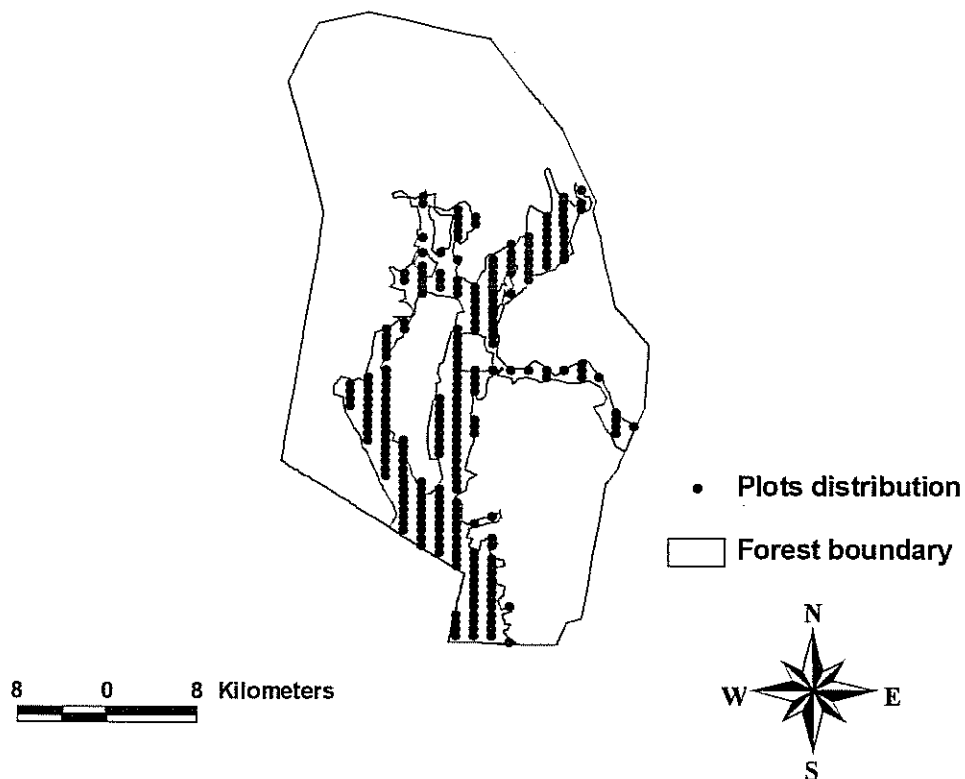


Figure 2: Plots distribution

3.2 Plot design

A total of 144 sample plots were measured in Omatendeka. All trees with at least 5 cm breast height diameter (Dbh) within the plots. Circular sample plots were used. The plots were further divided into three radius to give concentric circles at radius 10, 20 and 30 meters radius respectively (see Figure 3). Trees with breast height diameter (Dbh) 5 – 10 cm, dbh 10 – 15 cm and 15 – 25 cm were measured at 10, 20 and 30 meter radiuses respectively.

The parameters recorded in each plot were dbh, location, species, crown class, height, and quality. Regeneration was recorded on two sub-plots of 3.99 m radius, south and north respectively. Several variables describing the site, soil and tree cover were observed for each plot. All measurements are described in more detail in the Manual for Woody Resource Inventories by the Directorate of Forestry 2001. Coordinates for the measured plots are available from the Inventory Section in Windhoek.

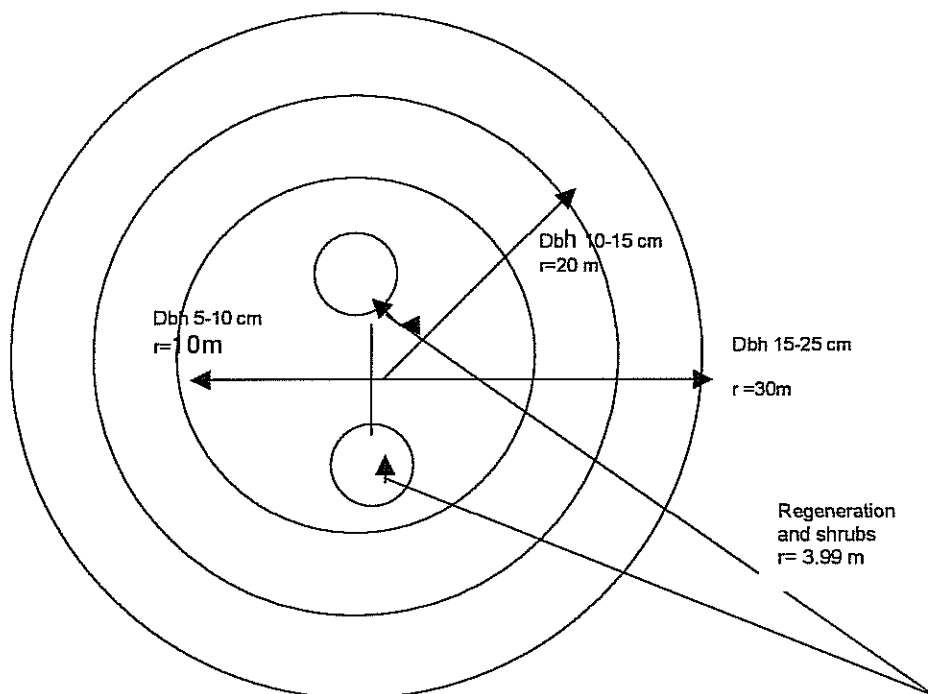


Figure 3: Plot design

4. INVENTORY RESULTS

4.1 Measured data

A total of 144 plots were measured on an area of 121192.75 hectares. A total of 623 trees with a diameter of at least 5 cm were measured on the plots. Table 1 shows the total number of measured trees by species found in the forest area.

Table 1: Number of measured trees

| Species | Total No. of measured trees | % of measured trees |
|--|-----------------------------|---------------------|
| <i>Acacia karroo</i> | 21 | 3.4 |
| <i>Acacia mellifera</i> | 1 | 0.2 |
| <i>Boscia albitrunca</i> | 13 | 2.1 |
| <i>Colophospermum mopane</i> | 563 | 90.4 |
| <i>Combretum apiculatum</i> (apiculatum) | 3 | 0.5 |
| <i>Maerua schinzii</i> | 3 | 0.5 |
| <i>Terminalia prunioides</i> | 19 | 3 |
| Total | 623 | 100 |

The three most frequent tree species in the data set were *Colophospermum mopane* (90.4%), *Acacia karroo* (3.4%) and *Terminalia prunioides* (3%). Other amounts of species are less than 3%, which are not common compared to other areas.

4.2 Average and maximum height by species

Table 2: Average and maximum height by species found

| Species | Average height (m) | Maximum height (m) |
|--|--------------------|--------------------|
| <i>Acacia karroo</i> | 4.41 | 8.7 |
| <i>Acacia mellifera</i> | 7.20 | 7.2 |
| <i>Boscia albitrunca</i> | 1.96 | 6.2 |
| <i>Colophospermum mopane</i> | 2.00 | 13.2 |
| <i>Combretum apiculatum</i> (apiculatum) | 2.13 | 6.4 |
| <i>Maerua schinzii</i> | 4.47 | 8.3 |
| <i>Terminalia prunioides</i> | 3.68 | 8.5 |

The highest tree that was measured was *Colophospermum mopane*, a tree with 13.2 m. The second highest tree species is *Acacia karroo* with a height of 8.7 m. The third and fourth is *Terminalia prunioides* and *Maerua schinzi* with the heights of 8.5 m and 8.3 m respectively.

4.3 Species diversity

A simple measure of species diversity is to express the number of species found in the area and the number of plots where each species was found. Table 3 shows the number of plots where each species was found for shrubs (<5 cm) and trees (dbh >5).

Table 3: Species diversity by the number of plots where each species was found

| Species | No. of plots dbh < 5 cm | No. of plots dbh > 5 cm |
|--------------------------------------|----------------------------|----------------------------|
| Acacia erioloba | 1 | |
| Acacia hebeclada (hebeclada) | 1 | |
| Acacia karroo | 1 | 4 |
| Boscia albitrunca | 7 | 5 |
| Colophospermum mopane | 56 | 76 |
| Combretum apiculatum (apiculatum) | 1 | 1 |
| Commiphora angolensis | 1 | |
| Grewia retinervis | 1 | |
| Terminalia prunioides | 7 | 4 |
| Acacia mellifera | | 1 |
| Maerua schinzii | | 2 |

A total number of 11 woody species were recorded Omatendeka. 7 species are occurring as trees while 9 species are found in shrub layer. 5 species were found in tree and shrub layer.

4.4 Tree volumes and number of stems

Live trees

Table 4: Volume and number of stems for live trees

| Species | Total No. of stems | Stems per ha | Total tree volume, m ³ | Mean volume m ³ /ha |
|-----------------------------------|-----------------------|-----------------|--------------------------------------|-----------------------------------|
| Acacia karroo | 285755 | 2 | 34983 | |
| Acacia mellifera | 11906 | | 920 | |
| Boscia albitrunca | 250035 | 2 | 22296 | |
| Colophospermum mopane | 9456687 | 78 | 429618 | 4 |
| Combretum apiculatum (apiculatum) | 50602 | | 3315 | |
| Maerua schinzii | 35719 | | 4597 | |
| Terminalia prunioides | 425655 | 4 | 9439 | |
| Total | 10516360 | 86 | 505167 | 4 |

Table 4 above shows that there are 10516360 stems in total, which is 86 stems per ha. The biggest share of stems is of *Colophospermum mopane* (78 stems/ha) seconded by *Terminalia prunioida* (4 stems/ha), *Acacia karroo* and *Boscia albitrunca* (2 stems/ha) each. The mean volume of all species is 4 m³/ha. The amount is less, compared to other similar areas.

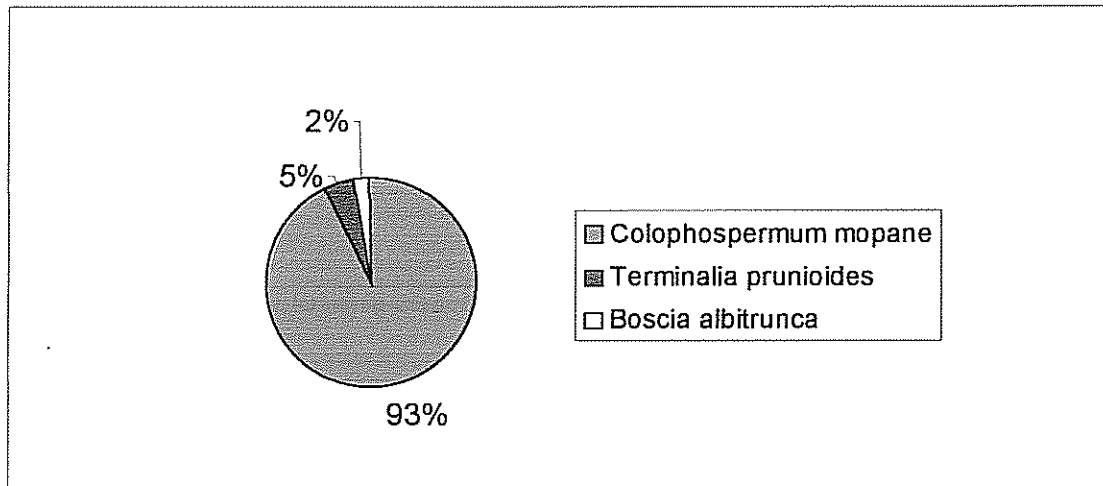


Figure 4: The volume of the live tree species expressed in % of the total volume of all species (50,516.7 m³)

The total volume of all live trees is 50,516,7m³. The total volume of *Colophospermum mopane* is 429.618 m³, *Acacia karroo* is 34,983 m³ and *Boscia albitrunca* is 22,296 m³.

Dead trees

The most common dead trees in Omatandeka are *Colophospermum mopane* (18.456 m³) and *Terminalia prunioides* 1.238 m³. The total volume for *Colophospermum mopane* is the highest of the two (see table 5).

Table 5: Volume and total number of stems for dead trees

| Species | Total No. of stems | Stems per ha | Total tree volume, m ³ | Mean volume m ³ /ha |
|------------------------------|--------------------|--------------|-----------------------------------|--------------------------------|
| <i>Colophospermum mopane</i> | 892983 | 7 | 18456 | 0 |
| <i>Terminalia prunioides</i> | 53579 | | 1238 | 0 |
| Total | 946562 | 7 | 19694 | 0 |

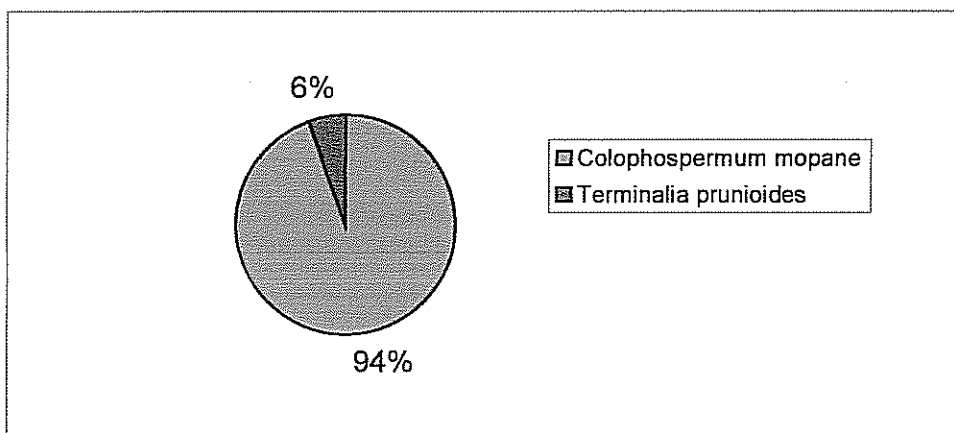


Figure 5: The volumes of the dead trees expressed in % of the total volume of all species (19,694m³)

4.5 Diameter distribution

Live trees

Appendix 1 shows the diameter distribution of live trees. The bulk of the trees in are in the small and medium sized diameter classes. The distribution also gives indications on which tree species have a potential to grow into big size trees in the area. The biggest live trees are *Colophospermum mopane*, *Acacia karroo* and *Boscia albitrunca* trees.

Their diameter distribution is also good in the sense that the majority of the stems are in lower diameter classes. The number of small size of *Colophospermum mopane* is very high, compared to other species.

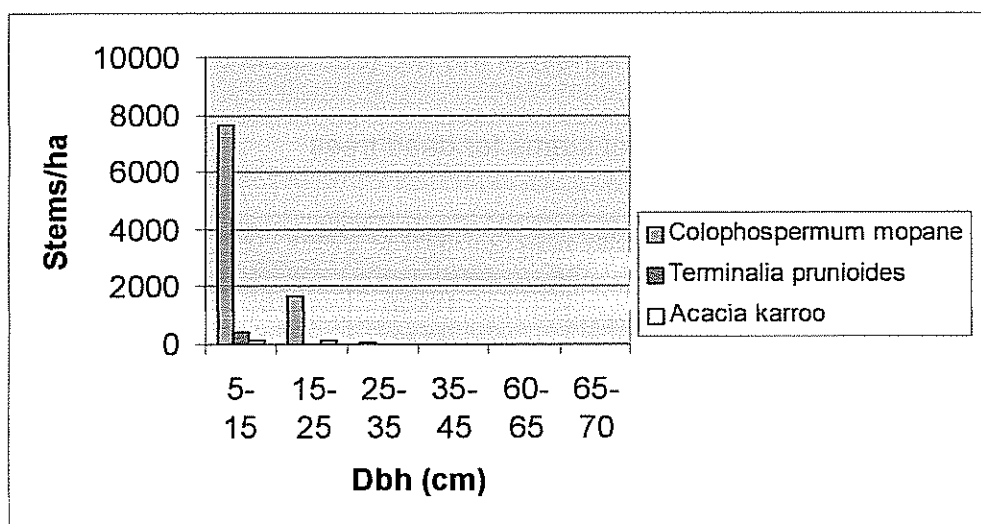


Figure 6: Live wood diameter distribution for common species

Dead trees

Figure 7 and Appendix 2 show that dead stems are *Colophospermum mopane* and *Terminalia prunioides*. They are mainly found in small size, which is a diameter less than 15 cm at breast height. *Colophospermum mopane* is the highest of the two. That means trees are dying in younger age.

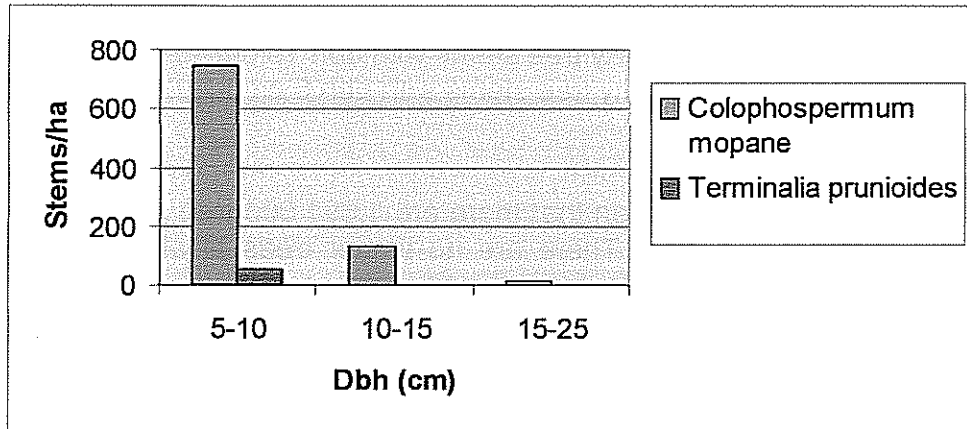


Figure 7: Dead wood diameter distribution for most common species

A specific tree quality classification designed for Omatendeka was used as follows:

- ❖ 1 = Timber: tree stems with dbh >25 cm and upwards quality good enough for timber
- ❖ 2 = Pole for house: good quality tree stems with dbh 15 cm to 25 cm.
- ❖ 3 = Pole for fence: good quality tree stems with dbh 10 cm to 15 cm.
- ❖ 4 = Pole for *kraal*: good quality tree stems with dbh 5 cm to 10 cm.
- ❖ 5 = Firewood: dead trees
- ❖ 6 = Other than above

From the table below, it can be seen that there are 1,691,000 tree stems with a quality good enough for housing. There are no timber trees at all. There are about 572,000 tree stems suitable for fencing and *kraal*.

Table 6: Utilizable tree species according to quality classes (1000s)

| species | quality | No. of stems per ha | Total No. of stems | % of utilizable stems |
|--|---------|---------------------|--------------------|-----------------------|
| Colophospermum mopane | 2 | 13 | 1545 | 13 |
| Terminalia prunioides | 2 | 1 | 146 | 1 |
| Colophospermum mopane | 3 | 5 | 548 | 4 |
| Terminalia prunioides | 3 | 0 | 12 | 0 |
| Colophospermum mopane | 4 | 0 | 12 | 0 |
| Acacia karroo | 5 | 0 | 36 | 0 |
| Boscia albitrunca | 5 | 0 | 12 | 0 |
| Boscia foetida | 5 | 0 | 30 | 0 |
| Colophospermum mopane | 5 | 49 | 5903 | 48 |
| Combretum apiculatum subsp. Leutweinii | 5 | 0 | 51 | 0 |
| Maerua schinzii | 5 | 0 | 12 | 0 |
| Terminalia prunioides | 5 | 1 | 161 | 1 |
| Acacia karroo | 6 | 2 | 250 | 2 |
| Acacia mellifera | 6 | 0 | 12 | 0 |
| Boscia albitrunca | 6 | 2 | 238 | 2 |
| Boscia foetida | 6 | 6 | 697 | 6 |
| Colophospermum mopane | 6 | 19 | 2336 | 19 |
| Maerua schinzii | 6 | 0 | 24 | 0 |
| Sesamothamnus guerichii | 6 | 0 | 12 | 0 |
| Terminalia prunioides | 6 | 0 | 162 | 0 |
| Total | | 101 | 12195 | 100 |

4.7 Damages to the woody vegetation

No fire damages on the trees were observed in the area. Several human activities in form of cutting were observed in the conservancy.

4.8 Regeneration of the trees and shrub layer

The regeneration potential of *Colophospermum mopane* is good with 186 seedlings per hectare. Other tree species have much less regeneration. The number of seedlings of all species is 199 seedlings per hectare. The number of saplings per hectare of all tree species is expressed in the table 7 below.

Table 7: Number of tree seedling per hectare by height classes

| | 0-25 | 26-50 | 51-100 | 101-150 | 151-200 | 201-250 | 251-300 | 300+ | Total | % of total |
|------------------------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------------|------------|
| <i>Acacia erioloba</i> | 1 | | | | | | | | 1 | |
| <i>Boscia albitrunca</i> | 1 | 3 | 2 | 5 | | | | | 11 | 6 |
| <i>Colophospermum mopane</i> | 10 | 21 | 36 | 55 | 34 | 11 | 10 | 10 | 186 | 94 |
| <i>Commiphora angolensis</i> | | 1 | | | | | | | 1 | |
| Total | 11 | 25 | 38 | 59 | 34 | 11 | 10 | 10 | 199 | 100 |

Table 8 shows the number of seedlings for shrub species. There is an average of 1 shrub per hectare in the shrub layer. Each species is having 1 seedling per hectare in total. This shows that regeneration is very low.

Table 8: Number of shrubs per hectare by height classes

| Species | 0-25 | 26-50 | 51-100 | 101-150 | 151-200 | 201-250 | 251-300 | 300+ | Total | % of total |
|--|------|-------|----------|----------|---------|---------|---------|------|----------|------------|
| <i>Combretum apiculatum</i> (apiculatum) | | | 1 | | | | | | 1 | 35 |
| <i>Grewia retinervis</i> | | | | 1 | | | | | 1 | 35 |
| Total | | | 1 | 1 | | | | | 2 | 100 |

5. RELIABILITY OF RESULTS

The following error sources are always present in sampling based forest inventories: sampling error, measurement error including coding error, errors in data processing and errors in models for volume estimation. In this work, specific attention was paid to guarantee good quality of the field data. Several cross checking's done to find out possible errors and inconsistencies in the data. The applied volume functions are probably the main source of errors. The functions in this report are from previous inventory results of similar vegetation type.

6. INVENTORY COSTS

All inventories require financial inputs which are either direct or indirect costs. The design of the inventory determines the financial implications that will be incurred during the inventory activities on the ground. National Forest Inventory team (NFI) carried out inventory in Ehirovipuka and Omatendeka Conservancies in December 2003.

One field trip was undertaken for 25 days, and six people did the actual fieldwork. In the calculation, a cost for a man-day includes the salary plus the daily subsistence costs, calculated at a fixed rate for fieldwork. Three motor vehicles, from Windhoek via Opuwo to respective Conservancy were used, and four ATV's for moving from one plot to another at a fixed distance of 700 meters, between plots and two bikes per group of three people. The cost for fuel is more or less real. This calculation only includes immediate costs of the fuel during the actual fieldwork period.

Table 9: Inventory costs

| Item | Unit | Cost/unit, \$ | Total cost, \$ |
|-----------------|--------------------|---------------|------------------|
| Field Equipment | | | 2,000.00 |
| Fieldwork | 15 days X 6 people | 150 | 13,500.00 |
| Fuel | 300 litres | 4.03 | 1,209.00 |
| Report printing | | | 1,000.00 |
| Total | | | 17,709.00 |

7. CONCLUSION

The majority of people depend on the forest resources for fuel wood and poles for homestead construction. Other plants are also used for nutrition and medicinal purposes. Domestic animals and game also depend on the forest resources for fodder and shelter. Hence, there is need to manage and maintain the forest bio-diversity of the area. The most common utilizable tree species found in Omatendeka Conservancy Forest were *Colophospermum mopane* and *Terminalia prunioides*. Straight stems of *Colophospermum mopane* and *Terminalia prunioides* are used for household construction, fuel wood, poles for fencing and construction of *kraal*. There are two types of *Commiphoras* in this area, *Commiphora angolensis* and *Commiphora glandulosa*; both species are used for carving.

The area inventoried has very good potential for management by the local community. The information in this report creates now a sound basis for forest management planning.

ACKNOWLEDGEMENTS

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

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Hennie Kakondo
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Gerhardt Boois
Phillip Shipa
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APPENDIX 1

Diameter distribution of the total number stems per hectare by species for live trees

| Species | Diameter class in cm; No of stems(1000 ^s) | | | | | | | Total | % of total |
|-----------------------------------|---|------------|-----------|----------|-------|----------|----------|-------------|------------|
| | 5-15 | 15-25 | 25-35 | 35-45 | 45-55 | 55-65 | 65-75 | | |
| Acacia karroo | 29 | 30 | 1 | | | | | 60 | 2.7 |
| Acacia mellifera | 2 | | | | | | | 2 | 0.1 |
| Boscia albitrunca | 42 | 10 | | 1 | | | | 52 | 2.4 |
| Colophospermum mopane | 1606 | 355 | 19 | 3 | | 1 | 1 | 1985 | 89.9 |
| Combretum apiculatum (apiculatum) | 8 | 2 | | | | | | 11 | 0.5 |
| Maerua schinzii | 5 | 2 | | | | | | 7 | 0.3 |
| Terminalia prunioides | 84 | 5 | | | | | | 89 | 4.0 |
| Total | 1778 | 405 | 20 | 4 | | 1 | 1 | 2207 | 100 |
| % of total | 80.53 | 18.3 | 0.91 | 0.17 | 0 | 0.03 | 0.03 | | 100 |

APPENDIX 2

Diameter distribution of the total number of stems per hectare by species

Diameter distribution of dead stems by species (1000^s)

| Species | 5-15 | 15-25 | Total | % of total |
|-----------------------|------------|----------|------------|------------|
| Colophospermum mopane | 185 | 2 | 187 | 94 |
| Terminalia prunioides | 11 | | 11 | 6 |
| Total | 196 | 2 | 199 | |
| % of total | 99 | 1 | | 100 |