

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



***Woody Resource Report of Ncaute Community Forest***

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## 1. INTRODUCTION

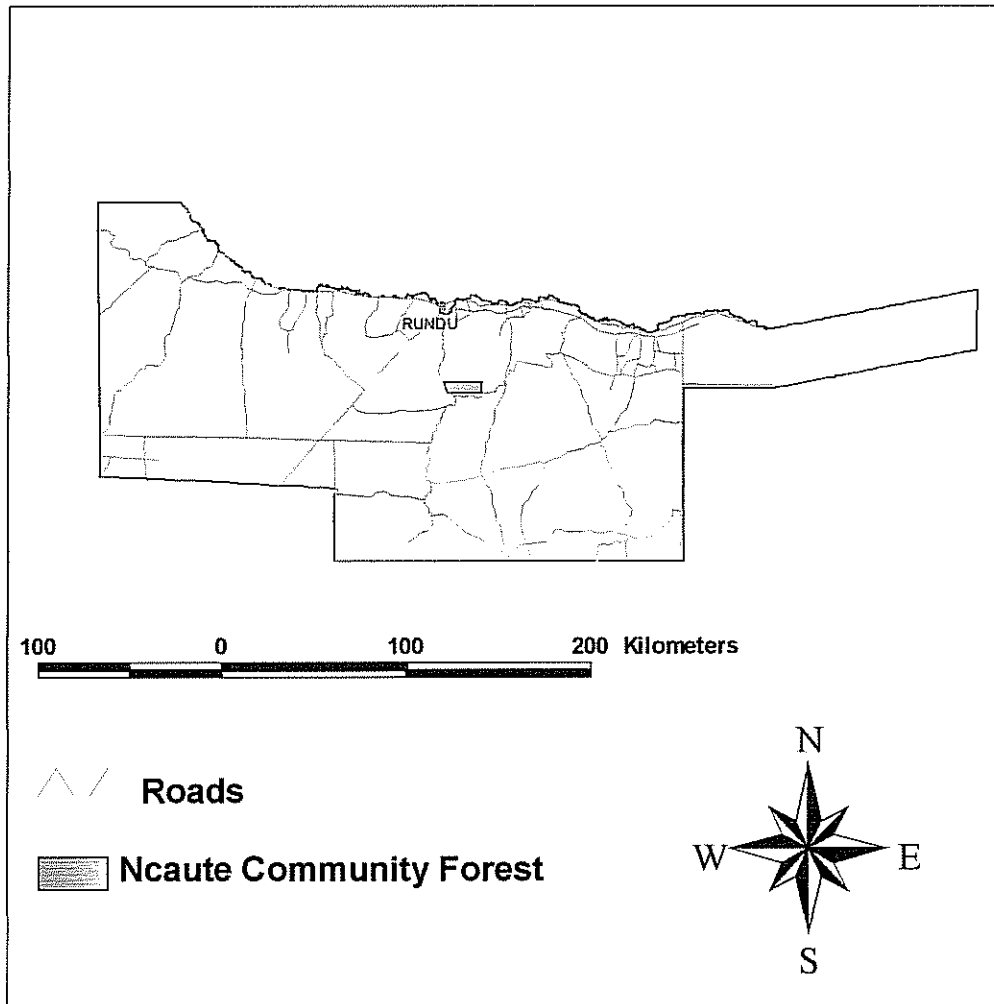
The Directorate of Forestry (DoF) under the Ministry of Environment and Tourism in Namibia has a mission to carry out forest resource assessments in Namibia. In this task the Government of Finland has supported it since 1995. Initially the aim of the support was to build up the capacity of the Directorate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

DED – DoF project community forestry in North-East Namibia (CFNEN), is directly working with the community of Ncaute. They deemed it necessary to find out the amount of resources available in the area in order to compile a sound management plan. With regard to community forestry, the DED 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 synthesized to the concept of community forestry.

The inventory in Ncaute was carried out by the NFI team in July 2003. Community members of the villages Kawe, Ncaute and Makandina supported the inventory team during the time of fieldwork. The inventory covered an area of 11,905 hectares, in Kavango region.

## 2. GENERAL DESCRIPTION OF THE AREA

The Ncaute Community Forest is located in the Kavango region. Common tree species found in the area are *Burkea africana*, *Pterocarpus angolensis* and *Guibourtia coleosperma*. According to the Atlas of Namibia vegetation map, the area is classified as trees savanna vegetation and the soil is classified as sandy soils. The annual rainfall is between 500-550 mm (see Atlas of Namibia, 2002). The four coordinates corners are: 19 45 802 East, -18 17 100 South, 19 57 600 east, -18 17 100 South, 19 47 252 east, -18 20 300 South, 19 57 600 east, -18 20 300 South.

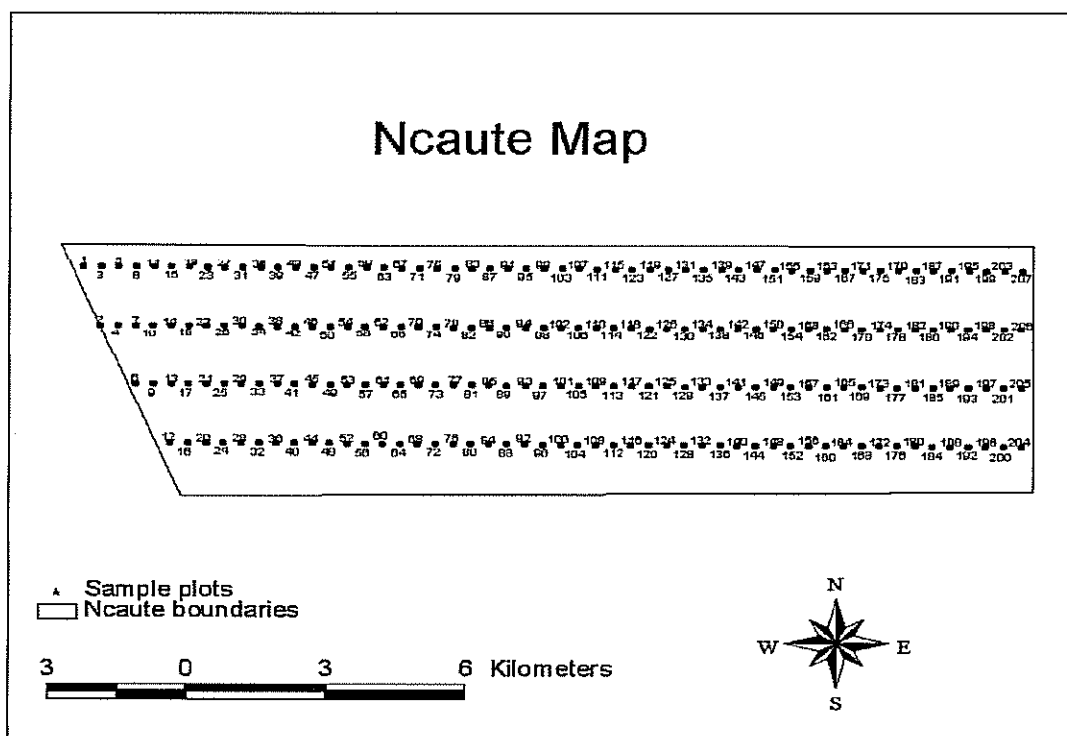


Map 1. Location of Ncaute community inventory area

### 3. INVENTORY DESIGN

#### 3.1 Sampling method

The woody resources were estimated using a systematic sampling of field plots. A total of 207 sample plots were measured in Ncaute Community Forest. This was much dictated by the given number of working days available for the inventory.

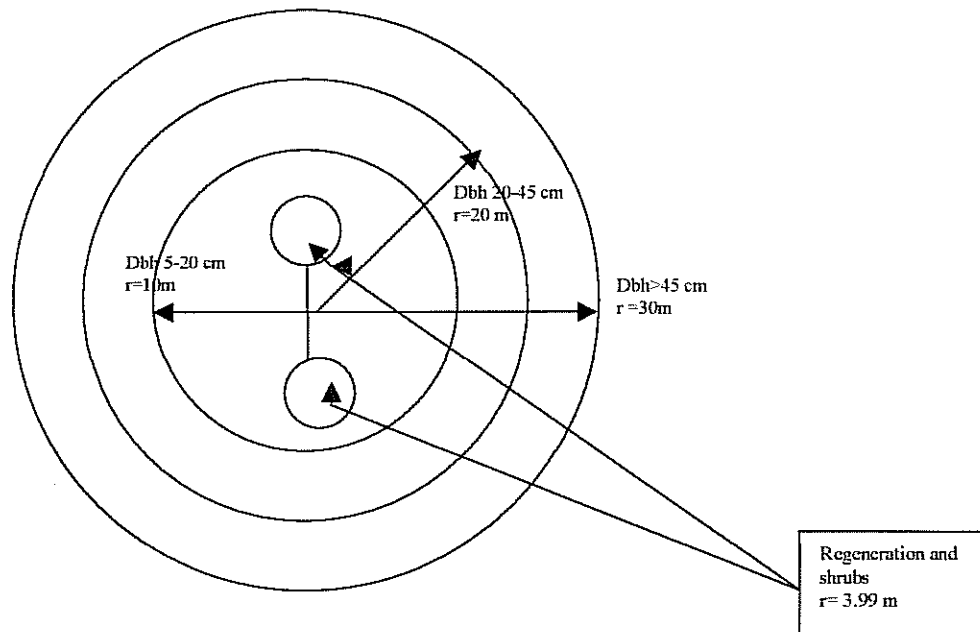


**Map 2. Location of sample plots**

All trees, with at least 5 cm DBH, inside the circular plot of 30 m radius were measured. The plot consisted of three concentric circles. The size of the plot depended on the size of the tree so that the radius of the plot is 30 m for trees with a breast height diameter (DBH) more than or equal to 45 cm; 20 m for trees with  $20 \leq \text{DBH} < 45$  cm; and 10 m for trees with  $5 \leq \text{DBH} < 20$  cm. Diameter, location, species, crown class, quality, length and quality of possible saw log were measured. Height, canopy diameter and crown height were recorded for each tree in the plot.

In addition, shrubs and regeneration were measured using two circular sub plots of 3.99 m radius (South and North from the center). Woody plants with a diameter at breast height less than 5 cm were recorded on the shrub and regeneration field form.

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 shown on appendix 4, page 27.



**Figure 1:** Plot design



## 4. INVENTORY RESULTS

### 4.1 Measured data

A total of 207 plots were measured on an area of 11,905 hectares. Each plot represents an area of 57.5 ha. A total of 2,049 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.

**Table 1. Number of measured trees by species**

Species	Total No of measured trees	% of measured trees
<i>Acacia fleckii</i>	6	0.3
<i>Baikiaea plurijuga</i>	127	6.2
<i>Burkea africana</i>	845	41.2
<i>Combretum collinum</i>	30	1.5
<i>Combretum engleri</i>	1	0.0
<i>Combretum imberbe</i>	4	0.2
<i>Combretum psidioides (psidioides)</i>	14	0.7
<i>Combretum zeyheri</i>	24	1.2
<i>Commiphora angolensis</i>	16	0.8
<i>Dialium engleranum</i>	97	4.7
<i>Diospyros mespiliformis</i>	8	0.4
<i>Diplorhynchus condylocarpon</i>	51	2.5
<i>Guibourtia coleosperma</i>	175	8.5
<i>Lonchocarpus capassa</i>	1	0.0
<i>Lonchocarpus nelsii</i>	4	0.2
<i>Ochna pulchra</i>	40	2.0
<i>Peltophorum africanum</i>	12	0.6
<i>Pterocarpus angolensis</i>	276	13.5
<i>Schinziophyton rautanenii</i>	107	5.2
<i>Securidaca longepedunculata</i>	1	0.0
<i>Strychnos cocculoides</i>	6	0.3
<i>Strychnos pungens</i>	102	5.0
<i>Swartzia madagascariensis</i>	11	0.5
<i>Terminalia sericea</i>	91	4.4
<b>Total</b>	<b>2,049</b>	<b>100.0</b>

The four most frequent tree species in the data set were *Burkea africana* (41.2 %), *Pterocarpus angolensis* (13.5 %), *Guibourtia coleosperma* (8.5 %) and *Baikiaea plurijuga* (6.2%).

## 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 fleckii</i>	4.2	15.5
<i>Baikiaea plurijuga</i>	6.0	15.2
<i>Burkea africana</i>	8.4	19.4
<i>Combretum collinum</i>	7.2	17.2
<i>Combretum engleri</i>	4.1	4.1
<i>Combretum imberbe</i>	3.6	7.5
<i>Combretum psidioides (psidioides)</i>	6.0	9.5
<i>Combretum zeyheri</i>	5.1	8.6
<i>Commiphora angolensis</i>	3.0	8.4
<i>Dialium englerianum</i>	7.8	18.1
<i>Diospyros mespiliformis</i>	9.6	16
<i>Diplorhynchus condylocarpon</i>	3.1	7.9
<i>Guibourtia coleosperma</i>	5.3	20.3
<i>Lonchocarpus capassa</i>	19.7	19.7
<i>Lonchocarpus nelsii</i>	8.6	9.8
<i>Ochna pulchra</i>	4.2	8.5
<i>Peltophorum africanum</i>	2.4	6.8
<i>Pterocarpus angolensis</i>	9.4	18.4
<i>Schinziophyton rautanenii</i>	5.0	19.9
<i>Securidaca longepedunculata</i>	7.0	7
<i>Strychnos cocculoides</i>	4.4	6.9
<i>Strychnos pungens</i>	4.9	13.6
<i>Swartzia madagascariensis</i>	4.9	10.4
<i>Terminalia sericea</i>	5.7	14.2

The highest tree that was measured was *Guibourtia coleosperma* a tree with 20.3 m. The second highest tree species is *Schinziophyton rautanenii* with a height of 19.9 m. The third highest tree was *Lonchocarpus capassa* followed by *Burkea africana*.

## 4.3 Species diversity

Simple measurement for 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 both trees ( $\geq 5$  cm) and shrubs ( $< 5$  cm).

**Table 3. Species diversity expressed by the number of plots where each species was found**

Species	No. of plots dbh<5cm	No of plots dbh>5cm
<i>Acacia erioloba</i>	4	
<i>Acacia fleckii</i>	1	2
<i>Acacia mellifera</i>	1	24
<i>Baikiaea plurijuga</i>	10	
<i>Baissea wulforthii</i>	65	
<i>Baphia massaiensis</i>	58	
<i>Bauhinia petersiana</i>	98	
<i>Burkea africana</i>	142	179
<i>Combretum collinum</i>	39	20
<i>Combretum engleri</i>		1
<i>Combretum imberbe</i>		2
<i>Combretum psidioides (psidioides)</i>	48	8
<i>Combretum zeyheri</i>	71	17
<i>Commiphora angolensis</i>	3	5
<i>Croton gratissimus</i>	3	
<i>Dialium englerianum</i>	99	55
<i>Diospyros mespiliformis</i>	7	5
<i>Diplorhynchus condylocarpon</i>	44	19
<i>Dombeya rotandifolia</i>	3	
<i>Euclea divinorum</i>	1	
<i>Grewia bicolor</i>	4	
<i>Grewia retinervis</i>	9	
<i>Guibourtia coleosperma</i>	16	60
<i>Lonchocarpus capassa</i>	6	1
<i>Lonchocarpus nelsii</i>	9	2
<i>Markhamia acuminata</i>	7	
<i>Ochna pulchra</i>	162	26
<i>Ozoroa longipes</i>	16	
<i>Ozoroa paniculosa</i>	37	
<i>Parinari capensis</i>	69	
<i>Peltoporum africanum</i>	1	3
<i>Pterocarpus angolensis</i>	11	130
<i>Rhus tenuinervis</i>	5	
<i>Salacia luebbertii</i>	2	
<i>Schinziophyton rautanenii</i>	22	37
<i>Securidaca longepedunculata</i>		1
<i>Strychnos cocculoides</i>		5
<i>Strychnos pungens</i>	102	60
<i>Swartzia madagascariensis</i>	2	9
<i>Terminalia sericea</i>	109	39
<i>Crossopteryx febrifuga</i>	20	
<i>Vangueria infausta</i>	1	
<i>Gymnosporia senegalensis</i>	5	
<i>Ximenia caffra var microphylla</i>	4	
<i>Ziziphus mucronata</i>	1	

A total of 45 woody species were recorded in Ncaute Community Forest. 24 species are occurring as trees while 41 species are found in the shrub layer. 20 species occurred both as trees and in the shrub layer.

#### 4.4 Tree volumes and number of stems

The tree volumes were divided into dead and live tree volumes.

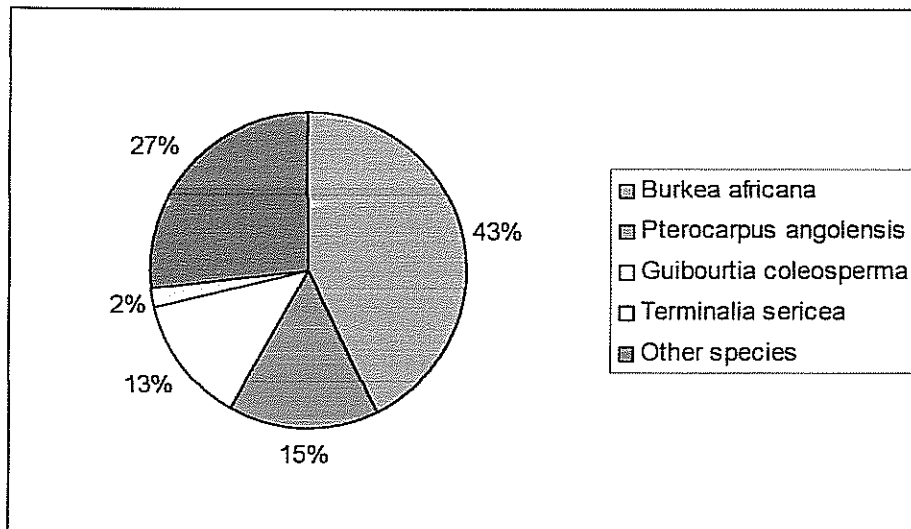
##### *Live trees*

**Table 4: Volumes and number of stems for live trees**

Species	Total number of stems	Stems per ha	Total tree volume (m <sup>3</sup> )	Mean volume m <sup>3</sup> /ha
<i>Acacia fleckii</i>	9,357	0.8	1,403	0.1
<i>Baikiaea plurijuga</i>	117,061	9.8	31,784	2.7
<i>Burkea africana</i>	938,267	78.8	166,577	14.0
<i>Commiphora angolensis</i>	23,799	2.0	2,545	0.2
<i>Combretum collinum</i>	33,867	2.8	3,952	0.3
<i>Combretum imberbe</i>	5,695	0.5	1,503	0.1
<i>Combretum psidioides (psidioides)</i>	22,426	1.9	1,395	0.1
<i>Combretum zeyheri</i>	43,936	3.7	1,797	0.2
<i>Dialium englerianum</i>	90,059	7.6	14,080	1.2
<i>Diospyros mespiliformis</i>	7,068	0.6	1,809	0.2
<i>Diplothyrsus condylocarpon</i>	84,211	7.1	2,895	0.2
<i>Guibourtia coleosperma</i>	150,877	12.7	51,472	4.3
<i>Lonchocarpus capassa</i>	203	0.0	460	0.0
<i>Lonchocarpus nelsii</i>	1,831	0.2	886	0.1
<i>Ochna pulchra</i>	61,327	5.2	4,224	0.4
<i>Peltoporum africanum</i>	9,153	0.8	805	0.1
<i>Pterocarpus angolensis</i>	241,648	20.3	59,091	5.0
<i>Schinziophyton rautanenii</i>	91,533	7.7	24,311	2.0
<i>Securidaca longepedunculata</i>	1,831	0.2	223	0.0
<i>Strychnos cocculoides</i>	10,984	0.9	625	0.1
<i>Strychnos pungens</i>	173,913	14.6	8,671	0.7
<i>Swartzia madagascariensis</i>	15,103	1.3	1,093	0.1
<i>Terminalia sericea</i>	146,199	12.3	7,700	0.6
<b>Total</b>	<b>2,280,349</b>	<b>191.5</b>	<b>389,303</b>	<b>32.7</b>

Table 4 above shows that there are 2,280,349 stems, which is 191,5 stems per hectare. The biggest share of stems are of *Burkea africana*, *Pterocarpus angolensis* and *Guibourtia coleosperma*. The mean volume of all species is 32.7 m<sup>3</sup>/ha.

**Figure 2: The volumes of the main live species expressed in % of the total volume of all species (389,303 m<sup>3</sup>).**



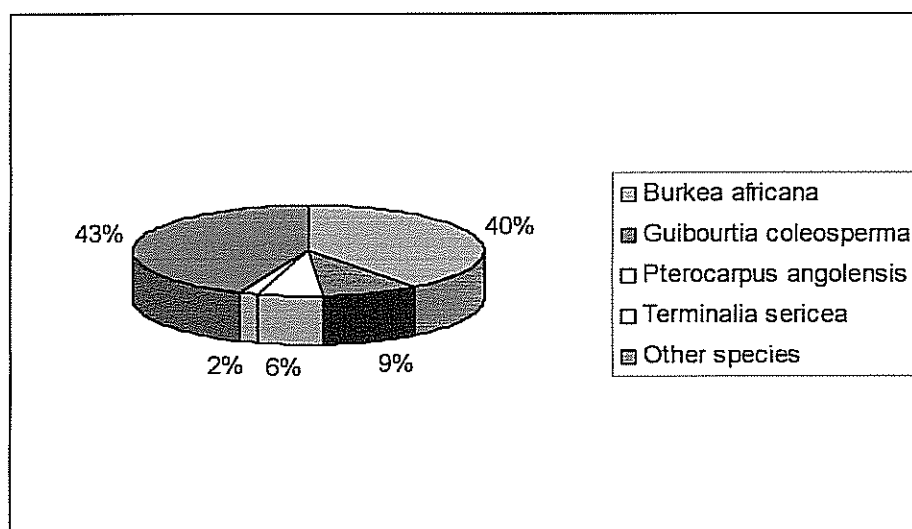
The total volume of all live trees is 389,303 m<sup>3</sup>. The total volume of *Burkea africana* is 166,577 m<sup>3</sup>, *Pterocarpus angolensis* is 59,091 m<sup>3</sup>, *Terminalia sericea* is 7,700 m<sup>3</sup> and the total volume for *Guibourtia coleosperma* is 51,472 m<sup>3</sup>. The 4 most common species represent 73 % of the total volume.

#### *Dead trees*

The majority of dead trees in Ncaute are *Burkea africana* and *Dialium engleranum* trees. The total volume for *Burkea africana* is the highest (see table 5). The 4 most common species represent 57 % of the total volume.

**Table 5: Volumes and number of stems for dead trees**

Species	Total No. of stems	Stems per ha	Total volume, m <sup>3</sup>	Mean volume m <sup>3</sup> /ha
<i>Baikiaea plurijuga</i>	10,933	0.9	4,728	0.4
<i>Burkea africana</i>	68,396	5.7	10,124	0.9
<i>Combretum collinum</i>	1,831	0.2	371	0.0
<i>Combretum engleri</i>	458	0.0	550	0.0
<i>Combretum psidioides (psidioides)</i>	1,831	0.2	15	0.0
<i>Dialium engleranum</i>	21,256	1.8	3,164	0.3
<i>Diospyros mespiliformis</i>	458	0.0	236	0.0
<i>Diplohynechus condylocarpon</i>	9,153	0.8	316	0.0
<i>Guibourtia coleosperma</i>	10,475	0.9	2,238	0.2
<i>Ochna pulchra</i>	3,661	0.3	433	0.0
<i>Peltophorum africanum</i>	12,815	1.1	914	0.1
<i>Pterocarpus angolensis</i>	3,661	0.3	1,542	0.1
<i>Swartzia madagascariensis</i>	3,661	0.3	400	0.0
<i>Terminalia sericea</i>	9,153	0.8	438	0.0
Total	157,742	13.3	25,469	2.1

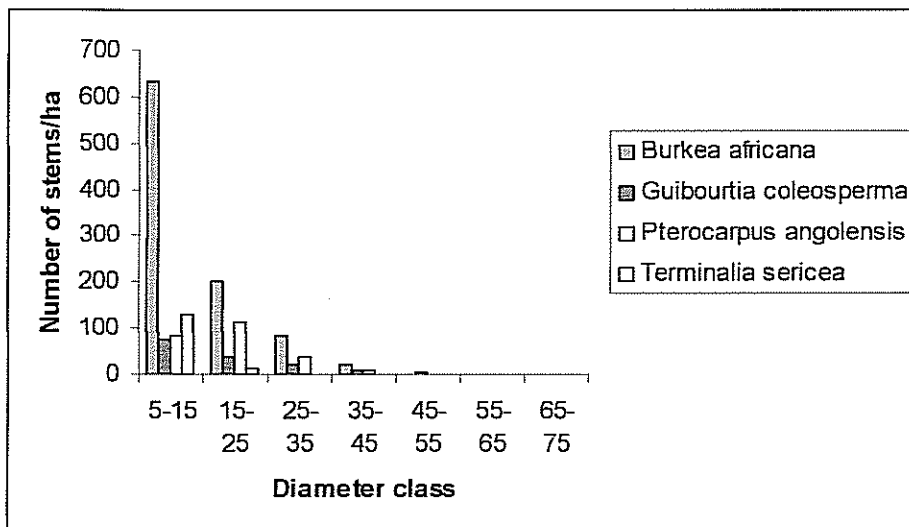
**Figure 3: The volumes of the main dead species expressed in % of the total volume of all species (25,469 m<sup>3</sup>).**

#### 4.5 Diameter distribution

##### *Live trees*

The biggest live trees in Ncaute Community Forest are *Schinziophyton rautanenii*, *Burkea africana*, *Pterocarpus angolensis*, *Baikiaea plurijuga*, *Dialium engleranum* and *Guibourtia coleosperma* trees. Their diameter distribution is also good in the sense that the majority of the stems are in lower diameter classes. These trees, if managed properly, will grow into bigger trees and provide poles in the future. The number of small size of *Burkea africana* is very high compared to other species. The full list of species with total number of trees per diameter class are shown in Appendix 1.

**Figure 4. Live wood diameter distribution for the main species**



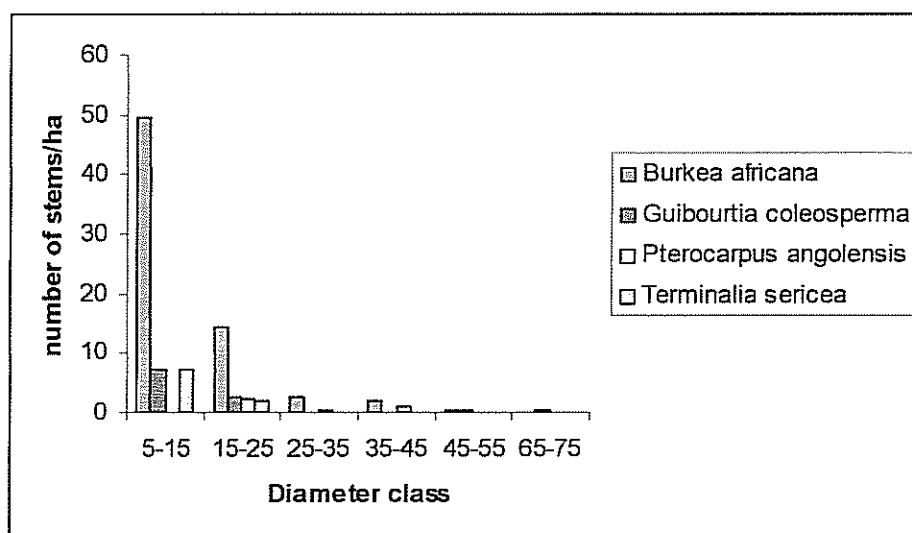
The bulk of the trees in Ncaute Community Forest were found in the small and medium sized diameter classes. More than 80% of the stems were found between 5-25 cm.

Appendix 1 also shows, which species have a potential to grow into big trees. Species that were found in the biggest diameter classes were: *Baikiaea plurijuga*, *Guibourtia coleosperma* and *Schinziophyton rautanenii*.

### Dead trees

Figure 5 and Appendix 2 shows that most of dead stems are of *Burkea africana*. They are mainly small size trees, less than 25 cm at breast height.

**Figure 5: Dead wood diameter distribution for the main species**



### 4.6 Regeneration and shrubs

Regeneration plays a critical role in the renewal and perpetuation of forest/woodland ecosystem. Good regeneration of trees means that there is continuously going to be a sufficient number of saplings growing into tree sizes, which in turns means later on trees entering into mature stage. Saplings are small specimen of species that are known to become trees, while shrubs are specimen that do not grow into trees.

The regeneration potential of *Ochna pulchra* is good with 532 seedlings per hectare followed by *Burkea africana* with 373 and *Dialium engleranum* with 284 seedlings per hectare. There is only very little *Pterocarpus angolensis* regeneration, compared to other most common trees. The regeneration of *Pterocarpus angolensis* has to be improved in order to cut timber from this species. The number of seedlings of all species is 2103 per hectare (see table 6 below).

Table 7 shows the number of seedlings for shrub species. There is an average of 3706 shrubs per hectare in the shrub layer. *Baissea wulfhorstii* is dominating in the shrub layer with 1919 shrubs per hectare, followed by *Parinari capensis* with 1336 shrubs per hectare.



**Table 6: Number of tree seedlings per hectare by height classes**

Species	0-25	26-50	51-100	101-150	151-200	201-250	251-300	300+	Total
<i>Acacia erioloba</i>	0	18	4	12	0	1	0	0	35
<i>Baikiaea plurijuga</i>	1	3	8	7	2	0	0	0	21
<i>Burkea africana</i>	7	77	200	65	15	6	1	2	373
<i>Combretum collinum</i>	0	9	32	14	2	2	0	0	61
<i>Combretum psidioides (psidioides)</i>	0	12	28	12	2	1	0	1	56
<i>Combretum zeyheri</i>	1	26	54	13	2	0	0	0	97
<i>Commiphora angolensis</i>	0	0	0	0	0	1	0	0	2
<i>Croton gratissimus</i>	0	2	2	0	0	0	0	0	5
<i>Diplorhynchus condylocarpon</i>	0	0	9	32	20	4	0	1	67
<i>Dialium engleranum</i>	0	32	130	95	25	2	0	0	284
<i>Guibourtia coleosperma</i>	0	0	11	11	2	0	0	0	24
<i>Lonchocarpus nelsii</i>	2	9	11	5	2	0	0	2	31
<i>Ochna pulchra</i>	50	276	178	12	11	4	0	0	532
<i>Ozoroa longipes</i>	0	0	2	8	7	0	0	0	18
<i>Ozoroa paniculosa</i>	0	1	15	19	24	2	0	0	62
<i>Peltoporum africanum</i>	0	0	0	0	0	0	0	0	1
<i>Pterocarpus angolensis</i>	0	0	2	1	1	0	0	0	7
<i>Schinziophyton rautanenii</i>	0	0	0	6	14	9	0	0	29
<i>Strychnos pungens</i>	24	98	76	26	10	1	1	0	236
<i>Terminalia sericea</i>	1	20	57	37	18	11	3	14	161
<b>Total</b>	<b>87</b>	<b>584</b>	<b>819</b>	<b>375</b>	<b>161</b>	<b>46</b>	<b>8</b>	<b>22</b>	<b>2103</b>

**Table 7: 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
<i>Acacia fleckii</i>	0	5	0	1	0	0	0	0	6
<i>Baissea wulfhorstii</i>	733	1183	3	0	0	0	0	0	1919
<i>Baphia massaiensis</i>	4	30	64	48	29	4	0	1	181
<i>Bauhinia petersiana</i>	4	32	58	65	43	4	0	0	206
<i>Dombeya rotandifolia</i>	0	8	5	1	0	0	0	0	14
<i>Grewia bicolor</i>	0	0	4	0	1	0	0	0	6
<i>Grewia retinervis</i>	0	0	8	3	1	0	0	0	13
<i>Markhamia acuminata</i>	0	5	12	0	0	0	0	0	17
<i>Parinari capensis</i>	360	958	17	0	0	0	0	0	1336
<i>Rhus tenuinervis</i>	0	0	4	2	0	0	0	0	7
<i>Vangueria infausta</i>	0	0	0	1	0	0	0	0	1
<b>Total</b>	<b>1101</b>	<b>2221</b>	<b>177</b>	<b>123</b>	<b>73</b>	<b>9</b>	<b>0</b>	<b>1</b>	<b>3706</b>

## 4.7 Timber quality

The quality classifications used in the inventory are as follows:

Good quality	There is at least 2m long straight stems without damages
Medium quality	The stem is slightly curving or sweeping or having other damages but still having at least 2 m saw-able log
Poor quality	It is possible to find only 1.2-2m long meeting the minimum timber quality requirement
Not saw able	The log is not saw-able and will probably never develop saw-able quality

The above classification was applied to all species. However, only the main species are discussed in this report. Table 8 below shows the timber quality of the main species with dbh > 45 cm. There is a considerable stems of 1420 stems of *Guibourtia coleosperma* and *Pterocarpus angolensis* with good timber quality, 610 stems for *Baikiaea plurijuga*, 410 stems for *Burkea africana* and 200 stems for *Terminalia sericea*. See appendix 3 for the timber quality of the main species with dbh < 45 cm.

**Table 8: Distribution of volume in timber quality classes ( $\geq 45$  cm) for main species**

Species	Quality	Stems per ha	Total number of stems, 1000s	Total log volume, 1000 m <sup>3</sup>	Average log volume m <sup>3</sup> /ha
<i>Burkea africana</i>	Good quality	0.03	0.41	0.32	0.03
	Medium quality	0.05	0.61	0.31	0.03
	Poor quality	0.02	0.20	0.16	0.01
	Not sawable	0.02	0.20	0.00	0.00
<i>Guibourtia coleosperma</i>	Good quality	0.12	1.42	1.49	0.13
	Medium quality	0.07	0.81	0.56	0.05
	Not sawable	0.22	2.64	0.00	0.00
<i>Pterocarpus angolensis</i>	Good quality	0.12	1.42	0.95	0.08
	Medium quality	0.02	0.20	0.13	0.01
	Expected good quality	0.02	0.20	3.40	0.29
<i>Terminalia sericea</i>	Good quality	0.02	0.20	0.10	0.01
<i>Baikiaea plurijuga</i>	Good quality	0.05	0.61	0.28	0.02
	Medium quality	0.06	0.81	0.22	0.01
	Not sawable	0.10	1.22	0	0
	Total	0.92	10.95	7.92	0.67

#### 4.8 Damages to the woody vegetation

Damage to the woody vegetation was recorded only at stand level. In the damage assessment the damages were classified into 5 different classes; (1) no damage, (2) mild), (3) moderate, (4) serious and (5) fatal damage.

**Table 9: Damaging agent and the severity of damage at stand level, in ha**

Damage	Severity of damage					Total	% of total damaged area
	No damage	Mild	Moderate	Serious	Fatal		
No damages	1955					1,955	16
Forest fire		6959	1668	58		8,684	73
Mammals	633	115	58			805	7
Insects			173			173	1
Human		173			115	288	2
Total	2588	7247	1898	58	115	11,905	
% of total area	22	61	16	0	1		100

The table shows that the area seems to be severely affected by fire. On 73% of the total area with woody vegetation the cause of damage is fire. No damages were observed on 1,955 hectares. The signs of cutting were few in the area. Damages related to human activities means cutting here. Only 2% of damage of the total area was caused by human activities (see table 9 above).

#### 4.9 Non-timber forest product and grasses

During the fieldwork in Ncaute Community Forest, five community members were involved. They helped the team to identify the most important fruit trees and grasses. Table 10 shows the most important fruit trees used by the community and table 11 shows the type of grasses used mostly by the community.

**Table 10: Fruit tree species used in Ncaute Community**

Species name	Local name	Uses
<i>Schinziophyton rautenii</i>	Mangeti	Fruits are eatable and use to make mangetti drinking (Kashipembe) and nuts for making oil for cooking
<i>Strychnos pungens</i>	Maguni	Fruits are edible/medicinal use
<i>Parinari capensis</i>	Nonsansi	Fruits are edible/medicinal use
<i>Diospyros chamaethamnus</i>	Makwewo	Fruits are edible/medicinal use
<i>Guibourtia coleosperma</i>	Usivi	Fruits are edible/medicinal use
<i>Strychnos cocculoides</i>		Fruits are edible/medicinal use

**Table 11: Most important grasses used by the community**

Grass name	Uses
<i>Eragrostic pallens</i>	Thatching grass
<i>Trystachya species</i>	House construction

#### 4.10 Reliability of the 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 were done to find out possible errors and inconsistencies in the data. The data processing and analysis, and report were double checked.

The sampling error was estimated using the formula for random sampling. The standard error for the mean volume (32.7 m<sup>3</sup>/ha) was 1.5 m<sup>3</sup>/ha which is 4.5 % of the mean volume. The tree volume for all species with 95 % probability is between 29.7 m<sup>3</sup>/ha and 35.6 m<sup>3</sup>/ha.

## 5. 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. The inventory in Ncaute was carried out by the National Forest Inventory team (NFI) between the 3<sup>th</sup> and the 28<sup>th</sup> of July 2003. 1 field trip was undertaken for 26 days. 6 men and 1 woman did the actual fieldwork. 3 cars (760 km one way, from Windhoek to Ncaute Community Forest) were used to reach the area. 4 ATVs were used for moving from one plot to another. The total cost of the inventory is about N\$ 23,240 which is N\$ 1.9 per hectare.

**Table 12. Inventory costs**

Cost item	Units	Cost/unit, N\$	Total cost, N\$
Inventory preparation	1 week		
Inventory equipment			2,500
Inventory field work	(182 man days)	N\$70 per person, per day	12,740
Fuel	1,800	3.89	7,000
Data entry	2 weeks		
Data analysis	3 weeks		
Report writing	3 weeks		
Report printing			1,000
<b>Total</b>			<b>23,240</b>

The inventory cost per hectare in Ncaute Community forest is N\$ 1.9. This is the same cost as in Uukolonkadhi (N\$ 1.98), where a stratification was done for a large area (Kanime and Laamanen, 2003). In Sikanjabuka, the cost per hectare was N\$ 17.40, which is the highest cost analyzed so far (Kamwi and Laamanen, 2002).

## 6. CONCLUSION

This inventory provides quantitative estimates of the present state of the forest in Ncaute Community Forest and indicates that the resources are still remarkable in terms of volume and stems per hectare.

The majority of people depend on the forest resources for fuel wood, fruits, grass for thatching 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 tree species found in Ncaute Community were *Burkea africana*, *Pterocarpus angolensis*, *Guibourtia coleosperma* and *Schinziophyton rautanenii*.

The most common damage to the woody vegetation is fire. The stand level classification indicates that, on 73% of the area there are visible signs of damages to trees caused by fires. Although the woody vegetation on a big part of the area shows signs of fire damage, surprisingly few trees are damaged, and the damage is usually mild

## 7. REFERENCES

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Lastly, thanks to DED community advisor for giving us the work





**Appendix 2: Diameter distribution of the total number of stems per hectare by species for dead trees (1000s)**

Species	5-15	15-25	25-35	35-45	45-55	65-75	Total	% of total
<i>Baikiaea plurijuga</i>	7	1	1	1	0	0	11	6.9
<i>Burkea africana</i>	49	14	3	2	0		68	43.4
<i>Combretum collinum</i>		2					2	1.2
<i>Combretum engleri</i>				0			0	0.3
<i>Combretum psidioides (psidioides)</i>	2						2	1.2
<i>Dialium engleranum</i>	15	4	1	2	0		21	13.5
<i>Diospyros mespiliiformis</i>			0				0	0.3
<i>Diplorhynchus condylocarpon</i>	9						9	5.8
<i>Guibourtia coleosperma</i>	7	3			0	0	10	6.6
<i>Ochna pulchra</i>	2	2					4	2.3
<i>Peltoporum africanum</i>	11	2					13	8.1
<i>Pterocarpus angolensis</i>		2	0	1			4	2.3
<i>Swartzia madagascariensis</i>	2	2					4	2.3
<i>Terminalia sericea</i>	7	2					9	5.8
<b>Total</b>	<b>112</b>	<b>33</b>	<b>5</b>	<b>6</b>	<b>1</b>	<b>0</b>	<b>158</b>	<b>100.0</b>

**Appendix 3: Distribution of volume in timber quality classes (< 45 cm) for main species**

Species	Quality	Stems per ha	Total number of stems, 1000s	Total log volume 1000m <sup>3</sup>	Average log volume m <sup>3</sup> /ha
<i>Burkea africana</i>	No code	51.78	616.48	0.00	0.00
	Good timber	0.15	1.83	0.00	0.00
	Expected good timber	12.22	145.54	19.53	1.64
	Expected medium timber	6.84	81.46	7.12	0.60
	Expected poor timber	3.38	40.27	4.37	0.37
	Not sawable	4.31	51.26	0.00	0.00
	<b>Total</b>	<b>78.69</b>	<b>936.84</b>	<b>31.02</b>	<b>2.61</b>
<i>Baikiaea plurijuga</i>	No code	5.50	65.45	0.01	0.00
	Expected good timber	1.31	15.56	2.35	0.20
	Expected medium timber	0.85	10.07	1.06	0.09
	Expected poor timber	0.23	2.75	0.31	0.03
	Not sawable	1.73	20.59	0.00	0.00
	<b>Total</b>	<b>9.61</b>	<b>114.42</b>	<b>3.73</b>	<b>0.31</b>
<i>Guibourtia coleosperma</i>	No code	7.19	85.58	0.00	0.00
	Medium timber	0.04	0.46	0.05	0.00
	Expected good timber	0.46	5.49	0.69	0.06
	Expected medium timber	0.38	4.58	0.94	0.08
	Expected poor timber	0.04	0.46	0.07	0.01
	Not sawable	4.15	49.43	0.00	0.00
	<b>Total</b>	<b>12.26</b>	<b>146.00</b>	<b>1.75</b>	<b>0.15</b>
<i>Pterocarpus angolensis</i>	No code	6.80	81.01	0.00	0.00
	Good timber	0.15	1.83	0.00	0.00
	Expected good timber	9.03	107.55	15.84	1.33
	Expected medium timber	2.77	32.95	2.44	0.20
	Expected poor timber	0.50	5.95	0.93	0.08
	Not sawable	0.88	10.53	0.00	0.00
	<b>Total</b>	<b>20.14</b>	<b>239.82</b>	<b>19.21</b>	<b>1.61</b>
<i>Terminalia sericea</i>	No code	11.07	131.81	0.00	0.00
	Expected good timber	0.35	4.12	0.30	0.03
	Expected medium timber	0.12	1.37	0.15	0.01
	Not sawable	0.73	8.70	0.00	0.00
	<b>Total</b>	<b>12.26</b>	<b>146.00</b>	<b>0.45</b>	<b>0.04</b>

**Appendix 4: Cluster coordinates for Ncaute community forest**

POINT	LONGITUDE	LATITUDE	POINT	LONGITUDE	LATITUDE
1	19.7676339	-18.2886883	47	19.8143644	-18.2889839
2	19.7711381	-18.3015429	48	19.8176978	-18.3275013
3	19.7712285	-18.2887114	49	19.8177850	-18.3146696
4	19.7747330	-18.3015660	50	19.8178721	-18.3018379
5	19.7748232	-18.2887345	51	19.8179591	-18.2890062
6	19.7782379	-18.3144206	52	19.8212933	-18.3275235
7	19.7783279	-18.3015890	53	19.8213802	-18.3146918
8	19.7784178	-18.2887575	54	19.8214670	-18.3018601
9	19.7818330	-18.3144435	55	19.8215538	-18.2890284
10	19.7819228	-18.3016120	56	19.8248888	-18.3275457
11	19.7820124	-18.2887804	57	19.8249754	-18.3147140
12	19.7853387	-18.3272980	58	19.8250620	-18.3018823
13	19.7854282	-18.3144665	59	19.8251485	-18.2890505
14	19.7855177	-18.3016349	60	19.8284843	-18.3275678
15	19.7856071	-18.2888033	61	19.8285707	-18.3147361
16	19.7889341	-18.3273209	62	19.8286570	-18.3019043
17	19.7890234	-18.3144893	63	19.8287432	-18.2890726
18	19.7891126	-18.3016577	64	19.8320798	-18.3275899
19	19.7892017	-18.2888261	65	19.8321659	-18.3147581
20	19.7925296	-18.3273436	66	19.8322519	-18.3019264
21	19.7926186	-18.3145121	67	19.8323379	-18.2890946
22	19.7927075	-18.3016805	68	19.8356753	-18.3276119
23	19.7927964	-18.2888489	69	19.8357611	-18.3147801
24	19.7961250	-18.3273664	70	19.8358469	-18.3019483
25	19.7962138	-18.3145348	71	19.8359326	-18.2891165
26	19.7963024	-18.3017032	72	19.8392708	-18.3276338
27	19.7963910	-18.2888715	73	19.8393564	-18.3148020
28	19.7997205	-18.3273890	74	19.8394419	-18.3019702
29	19.7998089	-18.3145574	75	19.8395273	-18.2891384
30	19.7998974	-18.3017258	76	19.8428663	-18.3276556
31	19.7999857	-18.2888941	77	19.8429516	-18.3148238
32	19.8033159	-18.3274116	78	19.8430369	-18.3019920
33	19.8034041	-18.3145800	79	19.8431220	-18.2891601
34	19.8034923	-18.3017483	80	19.8464619	-18.3276774
35	19.8035804	-18.2889167	81	19.8465469	-18.3148456
36	19.8069114	-18.3274341	82	19.8466319	-18.3020137
37	19.8069993	-18.3146025	83	19.8467168	-18.2891819
38	19.8070872	-18.3017708	84	19.8500574	-18.3276991
39	19.8071750	-18.2889392	85	19.8501422	-18.3148673
40	19.8105069	-18.3274566	86	19.8502269	-18.3020354
41	19.8105946	-18.3146249	87	19.8503115	-18.2892035
42	19.8106822	-18.3017933	88	19.8536529	-18.3277208
43	19.8107697	-18.2889616	89	19.8537374	-18.3148889
44	19.8141023	-18.3274790	90	19.8538219	-18.3020570
45	19.8141898	-18.3146473	91	19.8539062	-18.2892251
46	19.8142771	-18.3018156	92	19.8572485	-18.3277423

93	19.8573327	-18.3149105	141	19.9004764	-18.3151639
94	19.8574169	-18.3020786	142	19.9005574	-18.3023318
95	19.8575010	-18.2892467	143	19.9006383	-18.2894997
96	19.8608440	-18.3277638	144	19.9039909	-18.3280166
97	19.8609280	-18.3149319	145	19.9040717	-18.3151845
98	19.8610119	-18.3021000	146	19.9041524	-18.3023524
99	19.8610957	-18.2892681	147	19.9042331	-18.2895203
100	19.8644396	-18.3277853	148	19.9075865	-18.3280372
101	19.8645233	-18.3149534	149	19.9076671	-18.3152051
102	19.8646069	-18.3021214	150	19.9077475	-18.3023730
103	19.8646905	-18.2892895	151	19.9078279	-18.2895409
104	19.8680351	-18.3278066	152	19.9111821	-18.3280578
105	19.8681186	-18.3149747	153	19.9112624	-18.3152257
106	19.8682019	-18.3021428	154	19.9113426	-18.3023936
107	19.8682853	-18.2893108	155	19.9114227	-18.2895614
108	19.8716307	-18.3278279	156	19.9147777	-18.3280783
109	19.8717139	-18.3149960	157	19.9148578	-18.3152462
110	19.8717970	-18.3021640	158	19.9149377	-18.3024140
111	19.8718800	-18.2893321	159	19.9150176	-18.2895819
112	19.8752262	-18.3278492	160	19.9183734	-18.3280987
113	19.8753092	-18.3150172	161	19.9184531	-18.3152666
114	19.8753920	-18.3021852	162	19.9185328	-18.3024344
115	19.8754748	-18.2893533	163	19.9186124	-18.2896022
116	19.8788218	-18.3278703	164	19.9219690	-18.3281191
117	19.8789045	-18.3150384	165	19.9220485	-18.3152869
118	19.8789870	-18.3022064	166	19.9221279	-18.3024547
119	19.8790696	-18.2893744	167	19.9222072	-18.2896225
120	19.8824174	-18.3278914	168	19.9255646	-18.3281393
121	19.8824998	-18.3150595	169	19.9256438	-18.3153072
122	19.8825821	-18.3022275	170	19.9257230	-18.3024750
123	19.8826643	-18.2893954	171	19.9258021	-18.2896428
124	19.8860130	-18.3279125	172	19.9291603	-18.3281596
125	19.8860951	-18.3150805	173	19.9292392	-18.3153274
126	19.8861771	-18.3022485	174	19.9293181	-18.3024952
127	19.8862591	-18.2894164	175	19.9293969	-18.2896629
128	19.8896085	-18.3279334	176	19.9327559	-18.3281797
129	19.8896904	-18.3151014	177	19.9328346	-18.3153475
130	19.8897722	-18.3022694	178	19.9329132	-18.3025153
131	19.8898539	-18.2894373	179	19.9329917	-18.2896831
132	19.8932041	-18.3279543	180	19.9363515	-18.3281998
133	19.8932857	-18.3151223	181	19.9364300	-18.3153676
134	19.8933672	-18.3022902	182	19.9365083	-18.3025353
135	19.8934487	-18.2894582	183	19.9365866	-18.2897031
136	19.8967997	-18.3279752	184	19.9399472	-18.3282198
137	19.8968810	-18.3151431	185	19.9400253	-18.3153876
138	19.8969623	-18.3023110	186	19.9401034	-18.3025553
139	19.8970435	-18.2894790	187	19.9401814	-18.2897231
140	19.9003953	-18.3279959	188	19.9435428	-18.3282398

189	19.9436207	-18.3154075
190	19.9436985	-18.3025752
191	19.9437763	-18.2897430
192	19.9471385	-18.3282596
193	19.9472161	-18.3154274
194	19.9472937	-18.3025951
195	19.9473712	-18.2897628
196	19.9507342	-18.3282794
197	19.9508115	-18.3154472
198	19.9508888	-18.3026149
199	19.9509660	-18.2897826
200	19.9543298	-18.3282992
201	19.9544069	-18.3154669
202	19.9544839	-18.3026346
203	19.9545609	-18.2898023
204	19.9579255	-18.3283189
205	19.9580023	-18.3154866
206	19.9580791	-18.3026542
207	19.9581558	-18.2898219