CHAPTER 3

STUDY AREA, MATERIAL AND METHODS

3.1 Study area

The study on populations of the two sampled medicinal plant species, *viz.* *Elaeodendron transvaalense* Jacq. and *Brackenridgea zanguebarica* Oliv. was conducted in the Venda region, which is found within the Vhembe District Municipality of the Limpopo province, South Africa. The Venda region is situated in the northern part of the Limpopo province. It lies between 23°45′ and 25°15′S and 29°50′ and 31°30′E. It is within the tropics and the warmest period is from October to February with a cool period between April and August (Figure 3.1a and 3.1b).

The winters are generally mild and frost sometimes occurs only in the southern valleys (Jordaan and Jordaan 1987). Mean annual rainfall in the Tshirolwe area (data from the closest weather station at Siloam, Weather Bureau 1998) is 390 mm, whereas it is 688 mm at Thengwe (data from the closest weather station at Tshandama, Weather Bureau 1998). The extreme maximum and minimum temperature recorded for Siloam are 40.5°C and -1.5°C respectively and the comparable temperatures for Tshandama are 43.2°C and -3.4°C respectively (Weather Bureau 1998). The mean temperatures and precipitation of Tshirolwe and Thengwe study areas are indicated in the Walter diagrams in Figure 3.1 (a) and (b).

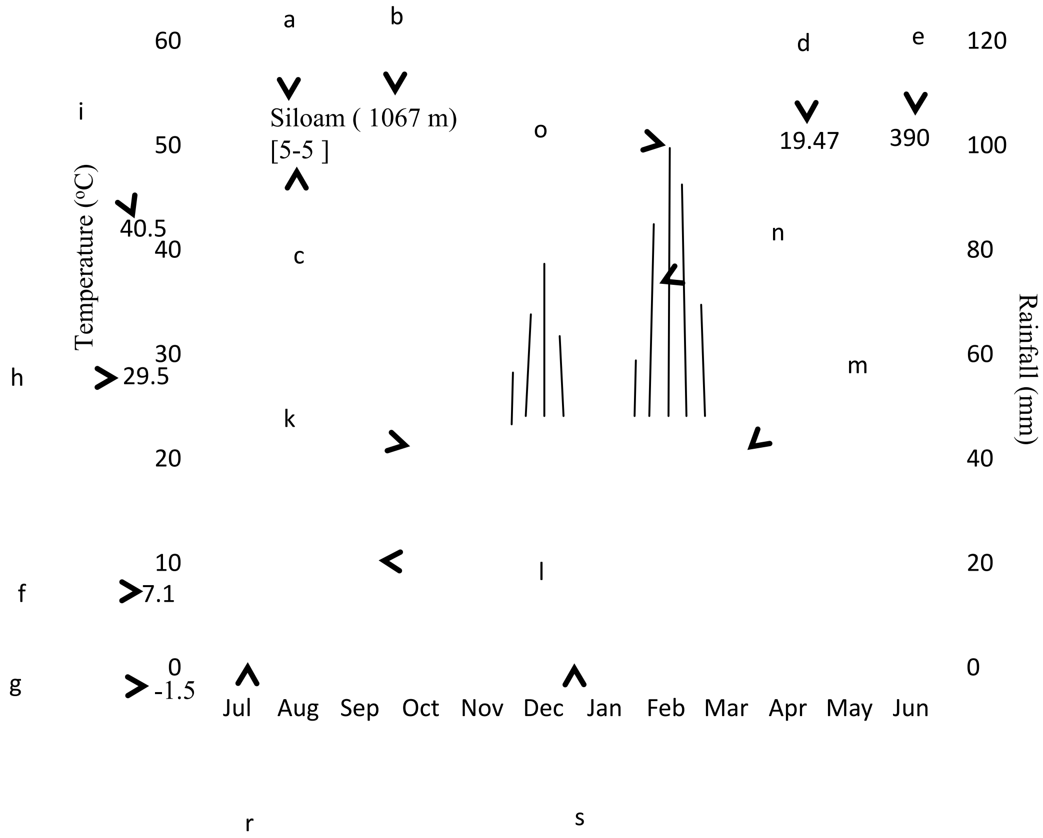

Figure 3.1 (a): Climate diagram, following Walter and Lieth's (1960-1967) convention, for the Tshirolwe study area as represented by the Siloam Weather Station (data obtained from Weather Bureau 1998).

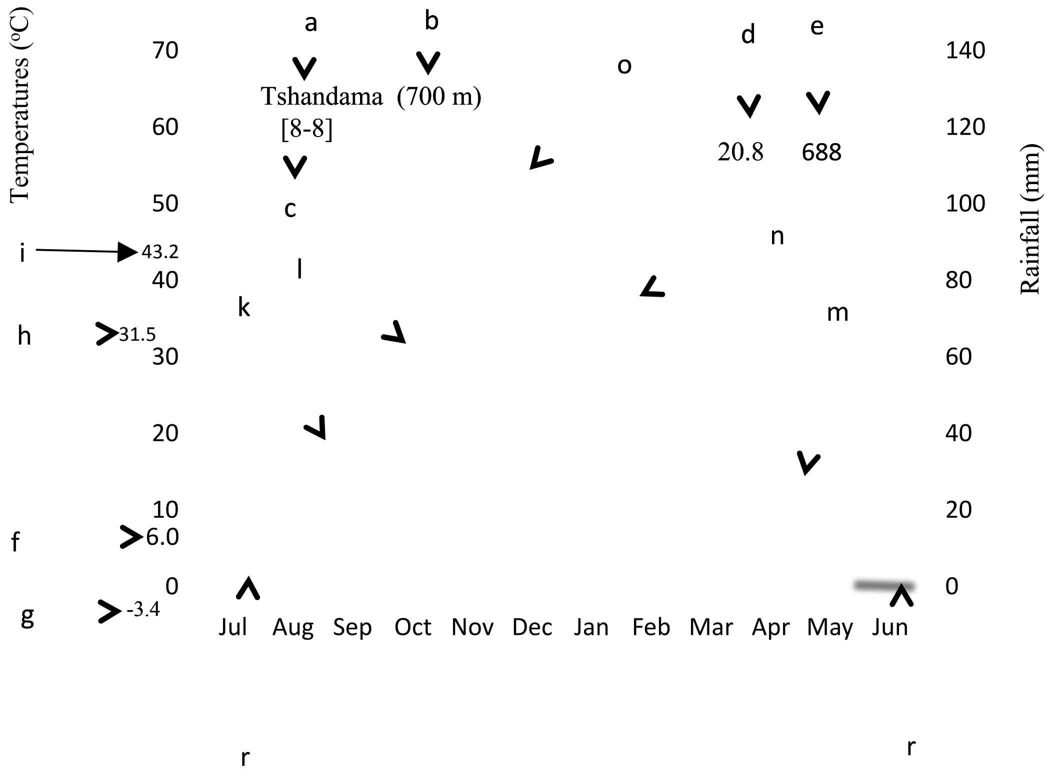

Figure 3.1 (b): Climate diagram, following Walter and Lieth's (1960-1967) convention, for the Thengwe study area as represented by the Tshandama Weather Station (data obtained from Weather Bureau 1998).

The Walter diagram is explained as follows:

a. Weather station
b. Altitude (m above sea level)
c. Number of years of observation [temperature – rainfall]
d. Mean annual temp (°C)
e. Mean annual rainfall (mm)
f. Mean daily minimum temperature of coldest month (°C)
g. Absolute minimum temperature (°C)
h. Mean daily maximum temperature of hottest month (°C)
i. Absolute maximum temperature (°C)
j. Mean daily temperature fluctuation (°C)
k. Curve for mean monthly temperature (°C)
l. Curve for mean monthly precipitation (mm)
m. Dry season
n. Wet season
o. Per humid season – mean monthly precipitation >100 mm

q. Cold season: mean daily min <0°C
r. Months with absolute min less than 0°C
s. Mean duration of frost free period

The Thengwe study area is wetter than the Tshirolwe study area and has more months with a mean precipitation of greater than 100 mm as compared to the Tshirolwe study area (Figure 3.1(a) and 3.1(b)). The wet season of the Thengwe study area is also longer than that of the Tshirolwe study area.

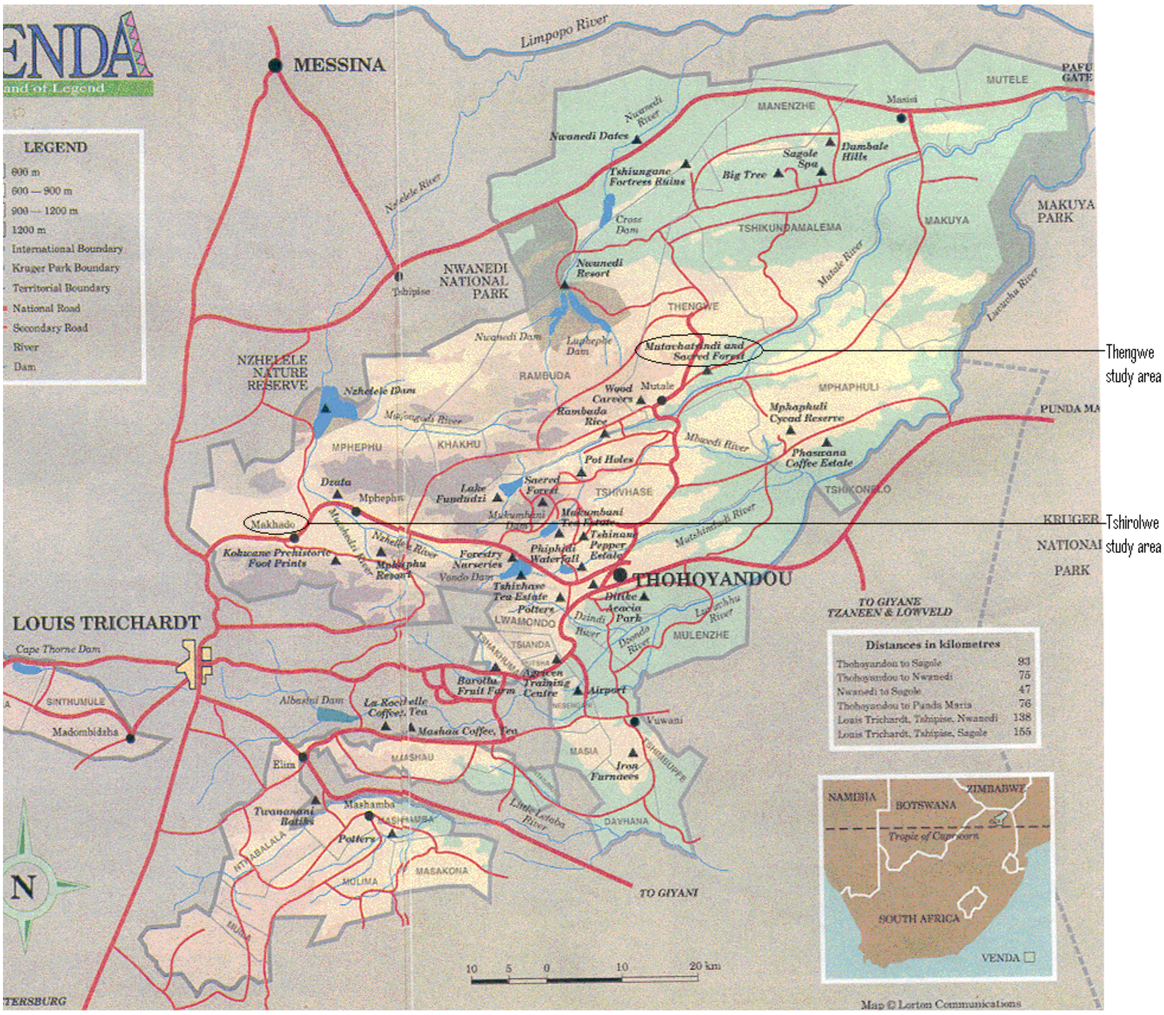

Figure 3.2: A map of the Venda region showing the Tshirolwe and Thengwe study areas that were sampled during the 2004 and 2005 data collection of *Elaeodendron transvaalense* and *Brackenridgea zanguebarica* populations (Lorton communications undated).

Both study areas indicated in Figure 3.2 fall within the savanna biome (Low and Rebelo1996, Rutherford and Westfall 1986). Raventos *et al.* (2004) have indicated that savannas are very important tropical ecosystems characterized by co-dominance of herbaceous vegetation and less abundant trees and shrubs. According to Acocks's (1953, 1988) vegetation map this savanna was classified as Sourish Mixed Bushveld, whereas Low and Rebelo (1996) classified it as part of the Soutpansberg Arid Mountain Bushveld, which occurs on the dry, hot, rocky slopes and summits of the Soutpansberg Mountains.

According to the more detailed vegetation map of Mucina *et al.* (2005) the vegetation type at the two study sites differs. The Tshirolwe study area falls in the Soutpansberg Mountain Bushveld (SVcb21), which is characterized by low to high mountains. The vegetation has a dense tree layer with a grass layer that is poorly developed. Its topographic diversity has made the Soutpansberg Mountain Bushveld a mosaic of sharply contrasting kinds of vegetation within limited areas (Mucina and Rutherford 2006). The Soutpansberg Mountain Bushveld is regarded as vulnerable with approximate 21% of the area being transformed, 14% under cultivation and 6% under forestry and only 2% formally conserved. Furthermore, the rural human population density is high, especially in the eastern lower-lying parts. The Thengwe study area falls in the VhaVenda Miombo (SVcb 22, Mucina and Rutherford 2006). This is a very small and unique vegetation unit found within the eastern extension of the Soutpansberg Mountain Bushveld. No part of this unit is formally conserved and it is heavily impacted by grazing, wood-collecting and agriculture.

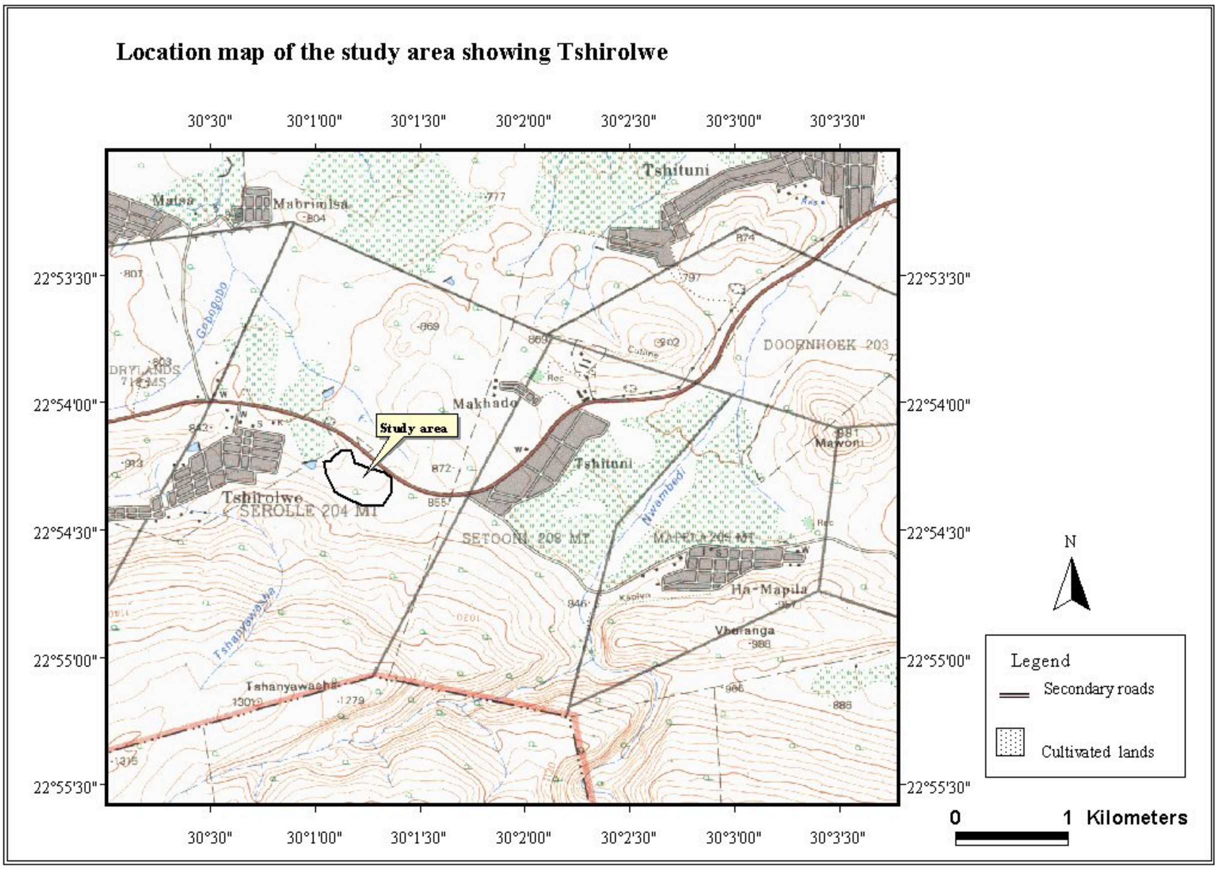

Figure 3.3: A location map showing the Tshirolwe study area.

The selection of the study areas was based on the availability of the populations of species that were being investigated. The study on the *Elaeodendron transvaalense* population was done at Tshirolwe (Figure 3.3), which is situated approximately 55 km to the west of Thohoyandou. The Tshirolwe study area had a large population of *E. transvaalense.* The Tshirolwe population of *E. transvaalense* is in a communal area where there is free access to it by the communities around it.

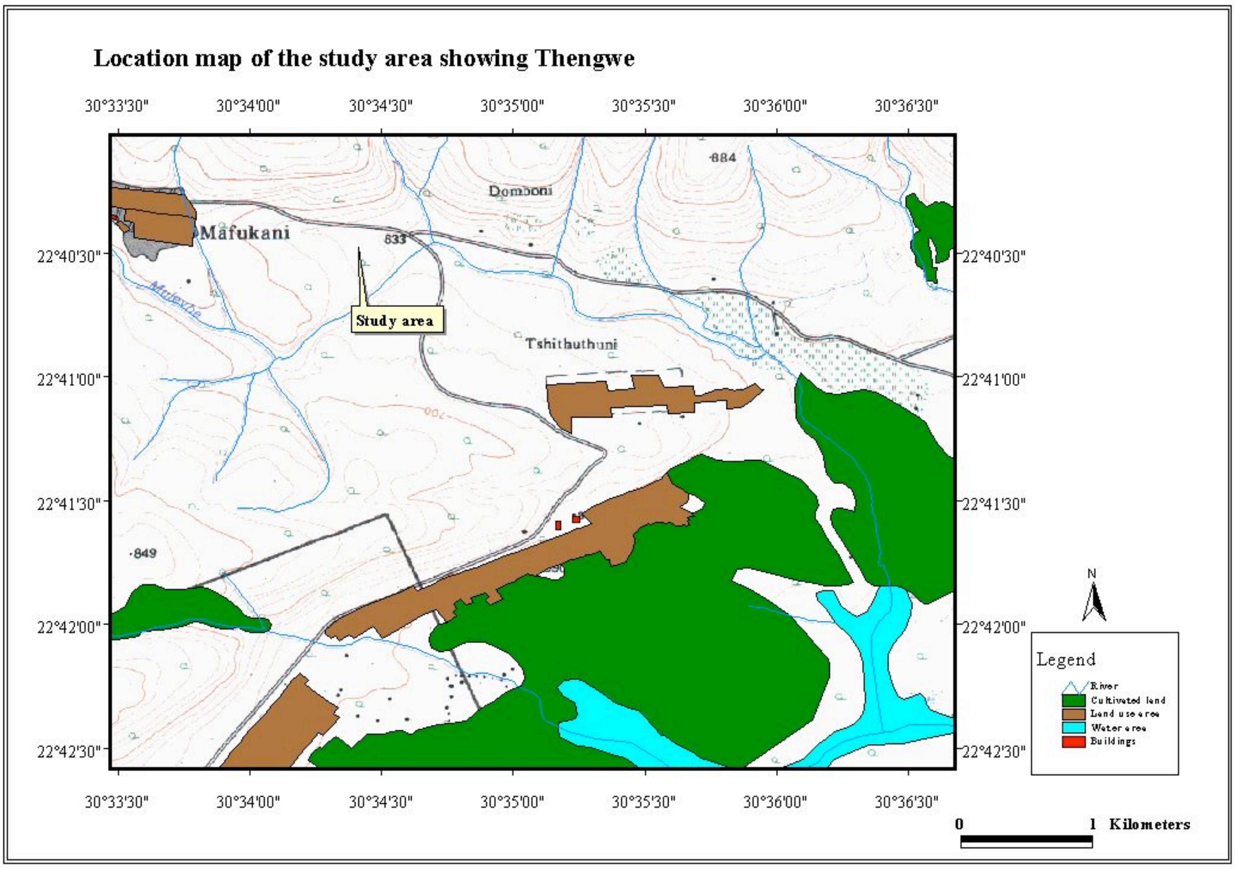

Figure 3.4: A location map showing the Thengwe study area.

The Thengwe study area, which is indicated in Figure 3.4, had a good representative *Brackenridgea zanguebarica* population. In South Africa *B. zanguebarica* has only been recorded in the Thengwe area. (Palgrave 1988). The study was done on an area adjacent to the Brackenridgea Nature Reserve, which has been established by the Department of Economic Development, Environment and Tourism as an initiative towards the conservation of the species. Access into the study area is monitored by the Thengwe traditional authority.

3.2 Description of the species investigated

3.2.1 Elaeodendron transvaalense

Elaeodendron transvaalense is a shrub or small, multi-branched tree, usually around 5m in height but it may reach 10 m or more (Palgrave 1988). The leaves are often clustered on reduced lateral shoots, with the terminal ones sometimes apparently 3-whorled. The leathery leaves are narrowly elliptic to oblong, green to greyish-green, and hairless. The leaf margins are particularly prominently toothed in juvenile growth or sucker shoots with the petiole up to 5 mm long (van Wyk and van Wyk 1997). The small greenish-white flowers are in stalked axillary clusters. The fruit is a drupe, which is round to oval, up to 15 mm in diameter, cream and yellowish when ripe. According to van Wyk *et al.* (1997) the bark is generally smooth and has a very characteristic pale, grey colour.

Elaeodendron transvaalense is found distributed mainly in Limpopo, Mpumalanga and along the coastal region of KwaZulu-Natal. It further extends into the southern parts of Zimbabwe as well as the northern parts of Botswana. The species is also found in Namibia (Mannheimer and Curtis 2009). The stem is debarked for medicinal purposes as is evident in Figure 3.5.

Figure 3.5: An *Elaeodendron transvaalense* tree showing bark removal from the stem in the Tshirolwe study area.

3.2.2 *Brackenridgea zanguebarica*

Brackenridgea zanguebarica (Figure 3.6) is a deciduous shrub or small tree, which occurs in the bushveld or along the forest margins. The bark is rough or corky with a bright yellow pigment in the dead outer layers. The leaves are elliptic to obovate, glossy dark green above, paler green below, hairless, with numerous lateral and tertiary veins prominent on both sides. Margins are finely toothed with each tooth tipped by a minute gland (van Wyk and van Wyk 1997). According to Netshiungani and van Wyk (1980), these glands found along the margins of the lamina, are a characteristic that can be used to differentiate *B. zanguebarica* from other members of the Ochnaceae family. Another characteristic, which differentiates members of *Brackenridgea* genus from the *Ochna* genus, is the presence of the yellow pigment in the bark.

Figure 3.6: *Brackenridgea zanguebarica* showing leathery-coated seeds exposed from ruptured fruits in the Thengwe study area.

Brackenridgea zanguebarica is mostly found in Zimbabwe and Mozambique and some parts of Zambia (Palgrave 1988). In South Africa it is found only in the northern part of Limpopo at Thengwe. Although it may be found in large numbers in other parts of Africa, South Africa only boast a very small population of this species.

3.3 Methods

3.3.1 Population studies

Data were collected using both qualitative and quantitative surveying research methods.

Belt transects of 100 m x 5 m were set out in the Tshirolwe and Thengwe study areas where the above-mentioned plant species were being harvested for medicinal purposes. A 100 m rope marked at 2 m intervals was laid out and a tape measure was used in measuring out 2.5 m on both sides of the 100 m rope as a way of validating those individuals that were growing on the margin of the transect as indicated in Figure 3.7. The size of transects was adopted as a way of careful management of sampling.

A transect is an elongated sample plot in which the vegetational data are recorded in the order that plant individuals are encountered (Phillips 1959, Hill *et al.* 2005). Transects were randomly distributed across the study area in order to obtain a representative sample of the population. The position of the start of each transect was recorded using a 12 channel Garmin Global Positioning System (GPS). The direction of transects were randomly selected and made to follow a straight line in order to eradicate bias. Transects were not allowed to overlap in order to avoid sampling of the same individual more than once. The number of transects was dictated by the number of individuals present in them. Sampling continued until in excess of 150 individuals had been sampled. In the Tshirolwe study area eleven transects in which

Elaeodendron transvaalense individuals were sampled were laid out. In the Thengwe study area seven transects in which *Brackenridgea zanguebarica* individuals were sampled were laid out.

Figure 3.7: A layout of a transect with a hundred meter rope and a tape measure measuring out the 2.5 m width on the both sides of the 100 m rope in a *Brackenridgea zanguebarica* sampling area.

In each transect all individuals of *Elaeodendron transvaalense* and *Brackenridgea zanguebarica* in their respective study areas were measured with reference to the following parameters:

a) Stem circumference (in cm) of the tree above the basal swelling was recorded using a tape measure. In multi-stemmed individuals the thickest stem was measured and number of stems was noted. Measurements on seedlings were done immediately on the aboveground part of the stem with vernier calliper.

b) Heights of the individuals (in m) were measured using a calibrated height rod and a tape measure was used on seedlings. In multi-stemmed individuals the height of the tallest branch was recorded.

c) Bark harvesting intensity was recorded with a sliding scale estimation of 0 to 5. Estimates of bark harvesting were made in relation to the expected unharvested stem. The classes of the sliding scale were interpreted as follows:

0 - no harvest at all,

1 - traces of bark removal (approximately 1 – 25% removal),

2 - light bark removal (approximately >25 – 50% removal),

3 - moderate bark removal (approximately >50 – 75% removal),

4 - severe bark removal (approximately >75 – 99% removal),

5 -100% removal of bark around the stem.

d) The area harvested (i.e. length x width of harvested area) was also measured.

e) Crown health assessment was also done on each individual using a sliding scale of 0 to 5. Crown health is regarded as a good indication of overall tree health (Sunderland and Tako 1999). Crown health was estimated as the percentage of the crown that shown sign of damage. The classes of the sliding scale were interpreted as follows:

0 - no crown at all,

1 – severe crown damage (approximately >75 – 99% damage),

2 – moderate crown damage (approximately >50 – 75% damage),

3 – light crown damage (approximately >25 – 50% damage),

4 – traces of crown damage (approximately 1 – 25% damage),

5 – healthy crown.

f) Adult trees were marked and their stem circumference measured again after 12 months to determine an annual growth rate in stem circumference.

g) An estimate of seed production was also obtained from individuals of all different size classes of each species. Seed production was estimated by counting seeds on one branch and multiplying by the number of similar sized branches on the tree.

Stem circumference data were used to produce a size-class distribution for each species. The size-class distribution data were analyzed in several ways to obtain the maximum information (Condit *et al.* 1998, Lykke 1998, Niklas *et al.* 2003) and to establish whether harvesting was sustainable (Obiri *et al.* 2002). Further detail on these analyses is provided in Chapters 5 and 6.

For the matrix model, the population was divided into three stage classes namely; seedling, vegetative and flowering. The entries for the matrices were then derived based on the three stage classes. This was done following procedures as set out in Desmet *et al*. (1996), Ebert (1999), Caswell (2001), and Stewart (2001). The derived transition matrix was used to explore the viability of the population when subjected to different harvesting strategies and the most sensitive stage identified. Management recommendations were made based on model results.

The results of data collected on the *Brackenridgea zanguebarica* population were also compared with the results of previous research done on the same population (Todd *et al.* 2004). For a valid comparison, the current data were converted to the same size class intervals as for the published data. This comparison gave a clear picture on the development of the *B. zanguebarica* population as reflected in Chapter 6.

3.3.2 Evaluating reserve adequacy of the *Brackenridgea zanguebarica* reserve

The Burgman *et al.* (2001) method together with a modification proposed by Gaugris and Van Rooyen (2010) was used to evaluate the adequacy of the Brackenridgea Nature Reserve in protecting a viable population of *Brackenridgea zanguebarica* in Chapter 7. The method helps in setting conservation goals by providing a transparent means of incorporating the knowledge of experts into processes of identifying and setting conservation priorities (Burgman *et al.* 2001). The methodology is described fully in Chapter 7 and is therefore not repeated here.

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