A PRELIMINARY REVIEW OF GROSS FINANCIAL INCOMES GENERATED BY INDUSTRIES DEPENDENT ON THICKET VEGETATION

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1. EXECUTIVE SUMMARY

Thicket vegetation contains biodiversity of global significance, and provides the resource base for a wide range of economic activities that provide employment for many thousands of people. This summary highlights the potential financial value of thicket in terms of existing economic activities associated with it. In other words, what would society lose if the thicket vegetation became degraded or lost due to unsustainable land use practices?

MOHAIR INDUSTRY: South Africa is the most important producer of mohair, and in 2000 provided 62.3% of world production. 	• More than 80 % of the national mohair production comes from the Thicket Biome area. • A gross income of R192 million (Source: Mohair SA) was generated during 2000 in the STEP planning domain. • It is estimated that 9 000 jobs are directly involved in the production of mohair, with 2 000 producers operating within the core production area. When secondary processing and brokering is taken into account, it is estimated that between 25 000 and 30 000 jobs are generated through the mohair industry. • Using the upper Albany (Grahamstown) area as a case study: an income of R155/ha is generated per annum.
ECO-TOURISM: The eco-tourism industry is heavily reliant upon an intact environment in order to provide both the means to support the wildlife that the public wishes to see, as well as to provide a true "wilderness experience". Eco-tourism is a service provided by both private- and public-sector driven operations. 	**Private Game Reserves – e.g. an upmarket reserve in the STEP planning domain.** • Caters for the more affluent sector of the market, with the principal aim of turning a profit. • Gross annual income: R30–40 million • Employment: 100 skilled and 140 unskilled (jobs/ha = 0.01) • Gross income/ha: R1 944. **Public Conservation Areas – e.g. a National Park** • Primary goal is to ensure the continued protection and management of the environment into the future. • Gross annual income: R6.8 million • Gross income/hectare: R485 • Employment: jobs/ha 0.005 • Various social benefits provided by the park are not reflected in the above financial income. The importance of acknowledging such benefits was emphasized when Geach (1997) estimated the recreation value of the park to be over R300 million/annum (R21 428/ha). **Change in land-use from commercial livestock to eco-tourism – e.g. tourism venture west of Port Elizabeth.** • Income quadrupled from R100/ha to over R400/ ha. • 16 additional jobs were created, of which 4 were skilled and 12 unskilled.
HUNTING: The Eastern Cape is a major role-player in the South African hunting industry, and is the preferred destination of overseas hunters. 	• 8 943 animals were hunted (by professional hunters) in the 2000/2001 hunting season, generating funds in excess of R44 million. • Downstream economic activities resulting from overseas hunters visiting the Eastern Cape in 2000/2001 brought the total gross income generated to R118 million.

ALOE SAP INDUSTRY:

Aloe products are obtained from a single species of *Aloe*, namely *Aloe ferox* (products include aloe sap which is a bitter yellow juice tapped from just below the leaf surface, and aloe gel which originates from the inner fleshy part of the leaf).

- In the Eastern Cape and former homelands, the raw aloe products are harvested in an informal manner with casual labourers collecting the products for entrepreneurs, which are then sold to manufacturers and retailers.
- During peak periods up to 6 000 tappers may be active, and can extract up to 20 liters of bitter sap per day.
- Buyers include pharmaceutical companies, cosmetic manufacturers and raw product exporters.
- The quantity bought by an individual company ranges between 2 500 kg to 80 000 kg/annum.
- Price paid for raw products ranges from R3.20 to R18 per kg.

Total turnover per annum for a single company ranges between R24 000 – R256 000/annum.

HORTICULTURE:

In this industry, all species are propagated in-house, including the cycads, and no species are collected in the wild.

A survey undertaken with two Port Elizabeth nurseries indicated that:

- A total of 71 indigenous thicket species are sold
- The sale of thicket species yields in excess of R72 000/ha/annum/nursery.
- The industry generates on average 4.9 jobs/ha.

Medicinal plant trade:

The trade in medicinal plants is generally through informal street markets or small shops known as *Amayeza* stores (Xhosa) or *Muthi* shops (Zulu). It is estimated that this industry is worth between R750 million and R1 billion/annum in South Africa (Cocks & Dold 2000).

- Within the Eastern Cape 166 plant species are exploited for medicinal purposes, of which 38 species are thicket species.
- In terms of quantities traded annually, 24% is harvested from thicket areas with an additional 14% harvested from both thicket and forest areas.
- Popular thicket species include *Rhoicissus digitata*, *Haworthia attenuata*, *Rubia petiolaris, Gasteria bicolor* and *Bulbine alooides*. Typically, *Gasteria bicolor* sells at R29/kg and *Bulbine alooides* at R31/kg.
- It is estimated that 165 tons of thicket plant material is traded in the six city centres in the Eastern Cape every year, generating an income of R7 million/annum.
- Despite this high total income value, the average monthly income per capita is between R150 and R500 (Dold & Cocks 2001).

NOTE: While the current report does consider the potential economic value of the Thicket Biome, this is not a comprehensive economic valuation of thicket. Complex social economic issues such as non-use values, shadow pricing, opportunity costs, time horizons and discounting are not addressed in the report. The economic activities that are dependent on thicket vegetation are briefly highlighted and the gross financial incomes associated with them are indicated. These incomes are treated as an instantaneous snapshot of the present i.e. prices used are assumed to apply to the present and they do not reflect consumer preferences through time. Furthermore, this is not a comparison of profitability of different land-use types, but a simple indication of the gross income generated by a resource. Finally, because the activities described in this report are often integrated with other economic activities that do not utilize thicket, net incomes (i.e. expenditures removed) are not discussed.

2. INTRODUCTION

The Subtropical Thicket Ecosystem Planning (STEP) Project was initiated in July 2000 to draft a conservation strategy for the Thicket Biome. Its overall objective is to identify priority areas for conservation within the Thicket Biome and to ensure that the implementation of the conservation plan is mainstreamed into land use plans at the national, provincial and municipal levels. A summary of the STEP Project is provided in Appendix 1, while a more detailed description is given by Boshoff and Cowling (1999).

The Thicket Biome is concentrated mainly in the Eastern Cape but also extends into the Western Cape and up the east coast to a limited degree as far as the Tugela River basin (Everard 1987). The STEP planning domain covers an area of roughly 11.65 million ha (116 500 km^2), spanning 57 magisterial districts. Within this area lies 4 744 240 ha of Subtropical Thicket (calculated from map of Subtropical Thicket (referred to hereafter as thicket) by Vlok & Euston-Brown 2002), effectively comprising 41% of the planning domain (Figure 1). Thicket is characterised by a dense spiny, evergreen shrub vegetation, with a tree component of varying proportions. It is a globally significant centre of diversity and endemism for succulents of karroid affinity, especially in the Mesembryanthemeceae, Euphorbiaceae and Crassulaceae, as well as a centre of endemism for certain bulb groups (Hoffman & Cowling 1991, Moolman & Cowling 1994). The Thicket Biome comprises five vegetation types, four of which occur largely or entirely in the Eastern Cape: (a) Dune Thicket (18%); (b) Mesic Succulent Thicket (100%); (c) Spekboom Succulent Thicket (48%); (d) Valley Thicket (66%); (e) Xeric Succulent Thicket (100%). On an overall basis, the Thicket Biome is grossly under-represented in formal conservation areas, with less than 5% occurring within protected areas (Lubke et al. 1986). The unique Noorsveld (a subdivision of Xeric Succulent Thicket) is under serious threat, especially from illegal succulent collectors, and is poorly represented in formal conservation areas. Because the Thicket Biome contains a mixture of elements of all seven biomes, it will provide the genetic diversity to buffer the effects of global change (Boshoff & Cowling 1999).

Faced with tightening budgets and growing needs for environmental actions, government agencies must make difficult decisions about how to allocate public investments to protect and restore the natural environment. In making such decisions, environmental program managers may consider many objectives, including environmental quality, threats to ecosystem integrity, and effects on people's quality of life. Agencies must justify their decisions, not only in terms of benefits to the natural environment, but also in terms of fiscal accountability and public support. Thus, they are being asked to demonstrate the economic benefits of their investments, preferably in monetary terms. However, even if it is impossible or impractical to measure benefits in a financial currency, agency staff can often provide evidence that their environmental investments are being managed to maximize environmental benefits per Rand spent.

The purpose of this report is to highlight the potential economic value of the Thicket Biome in terms of existing economic activities associated with it. In other words, what does society lose, in economic terms, through severe transformation of the Thicket Biome?

3. ECONOMIC ACTIVITIES ASSOCIATED WITH THICKET

The **Total Economic Value** (TEV) of the Thicket Biome is comprised of Direct Use Values (Consumptive and Non-Consumptive), Indirect Use Values and Non-Use Values (Option, Inherent and Bequest/Existence Value) (Turner *et al*. 1993). *Direct Use Values* describe benefits of goods and services that enter directly into the human economy, either by direct consumption of goods, such as harvesting, or by use of services for recreation, tourism and research. Consumptive uses can be distinguished from non-consumptive uses in that the former excludes other uses of the same resource while the latter does not. With non-consumptive uses the resource base remains in the same state before and after use (e.g. game viewing). *Indirect Use Values* are the ecological functions of the Thicket Biome, which indirectly support economic activity and human welfare. These values reflect the value of biodiversity to society at large

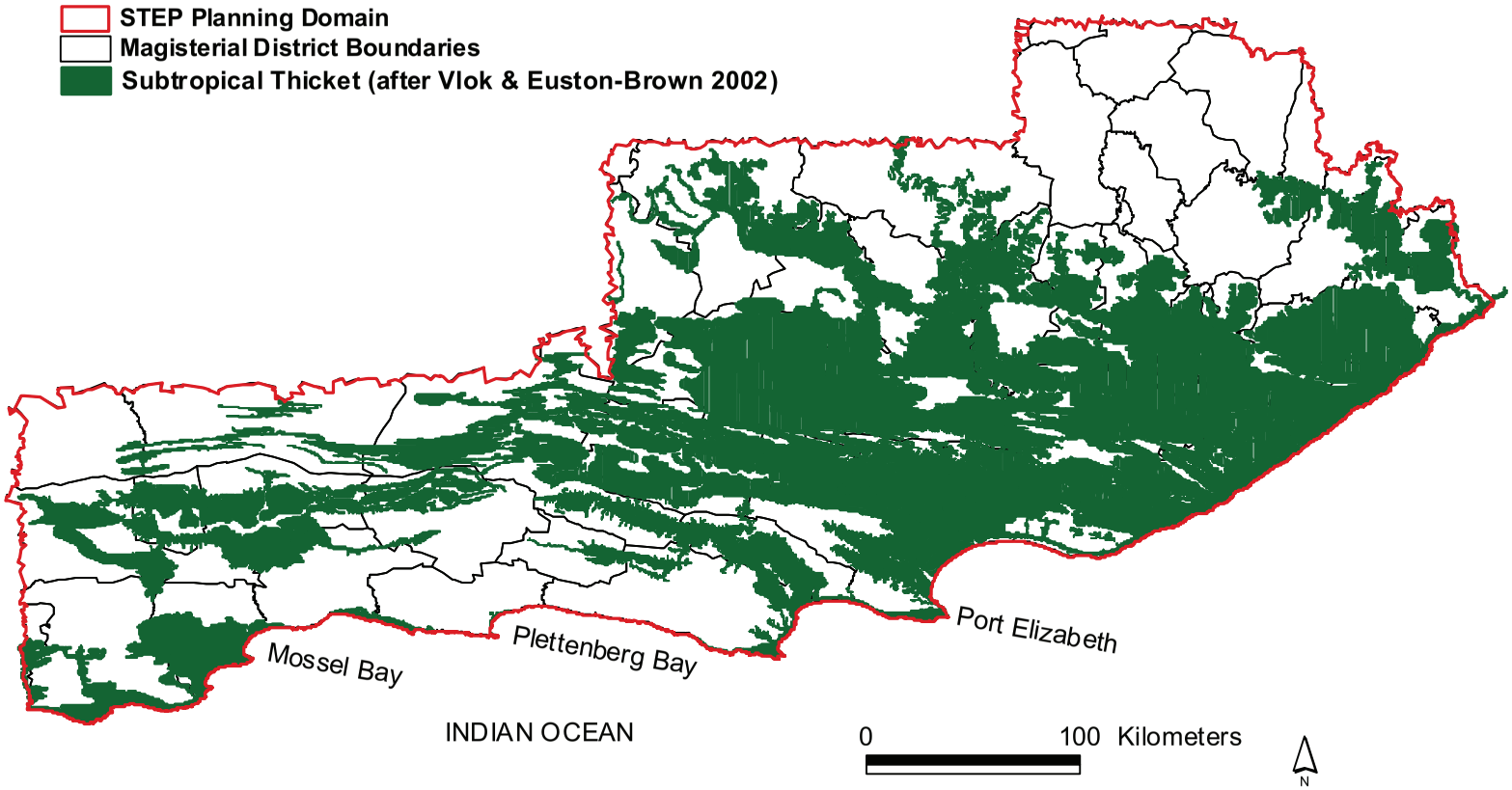

Figure 1: The potential distribution of Subtropical Thicket within the STEP planning domain.

rather than to individuals or corporate entities. *Non-use values (or passive use)* are the amounts people are willing to pay to protect it because it is rare / beautiful / ecologically valuable. *Option value* refers to people's willingness to pay to keep the option of using the Thicket Biome open for future use, even if they do not use it now. *Inherent value* is associated with the existence of aspects of the Thicket Biome, even if the individual never plans to make any use of it. *Bequest value* is derived from the preservation of Thicket for possible use by future generations. It is different from inherent value in that it attaches value to the future use of the resource by descendants, not to the existence of the resource itself (Turner *et al*. 1993).

Some economic activities, both directly and indirectly associated with the Thicket Biome, are listed below.

DIRECT USE VALUE

Direct Consumptive Use Value:

- Agriculture – Small stock farming (e.g. Angora goats & boer goats)
- Game farming (e.g. trophy hunting, live game sales, venison sales, etc)
- Horticulture
- Aloe sap industry
- Medicinal plants
- Fuel wood

Direct Non-consumptive Use Value:

- Eco-tourism & conservation

INDIRECT USE VALUE

- Ecosystem services (e.g. clean air, clean water, soil retention, carbon storage, etc)

4. FINANCIAL INCOMES ASSOCIATED WITH EACH ACTIVITY

4.1 AGRICULTURE

4.1.1 The Mohair Industry

The mohair industry is commercially the most important part of the goat production sector. South Africa is the most important producer of mohair, and in 2000 provided 62.3% of world production. Mohair was exported to 16 countries, the most important of which were the United Kingdom, Italy and France. As mohair is a luxury fibre, the industry tends to go through cycles of good and poor prices for mohair, depending on the vagaries of the fashion industry (Ramsay & Donkin 2000). The Thicket Biome falls within the core production area for mohair, with 18 of the top 20 mohair-producing magisterial districts falling within the STEP planning domain (Figure 2). As a result more than 80 % of national mohair production stems from this area. As the dominant browse vegetation within this area, the thicket vegetation therefore comprises a critical resource base for this industry.

During 2000, the industry generated a gross income of R224 804 000 for the total clip (4.3 million kg mohair), of which 85% was produced within the STEP planning domain, equating to a **total value of R191 757 812** (Source: F.A. Loots, Mohair SA *pers. com*.). Mohair production per district for 2000 is summarized in Appendix 2. It is estimated that 9 000 jobs are directly involved in the production of mohair and that 2 000 producers are operating within the core mohair production area. When secondary processing and brokering is taken into account, it is estimated that between 25 000 and 30 000 jobs are generated through the mohair industry (Source: F.A. Loots, Mohair SA *pers. comm*.).

In order to estimate a 'per hectare' income generated by Angora goat farming in the STEP planning domain, a total gross income per small stock unit (SSU) value of R254.06 was extracted from the Enterprise Budget (Dohne Agricultural Development Institute 2000). As this figure is

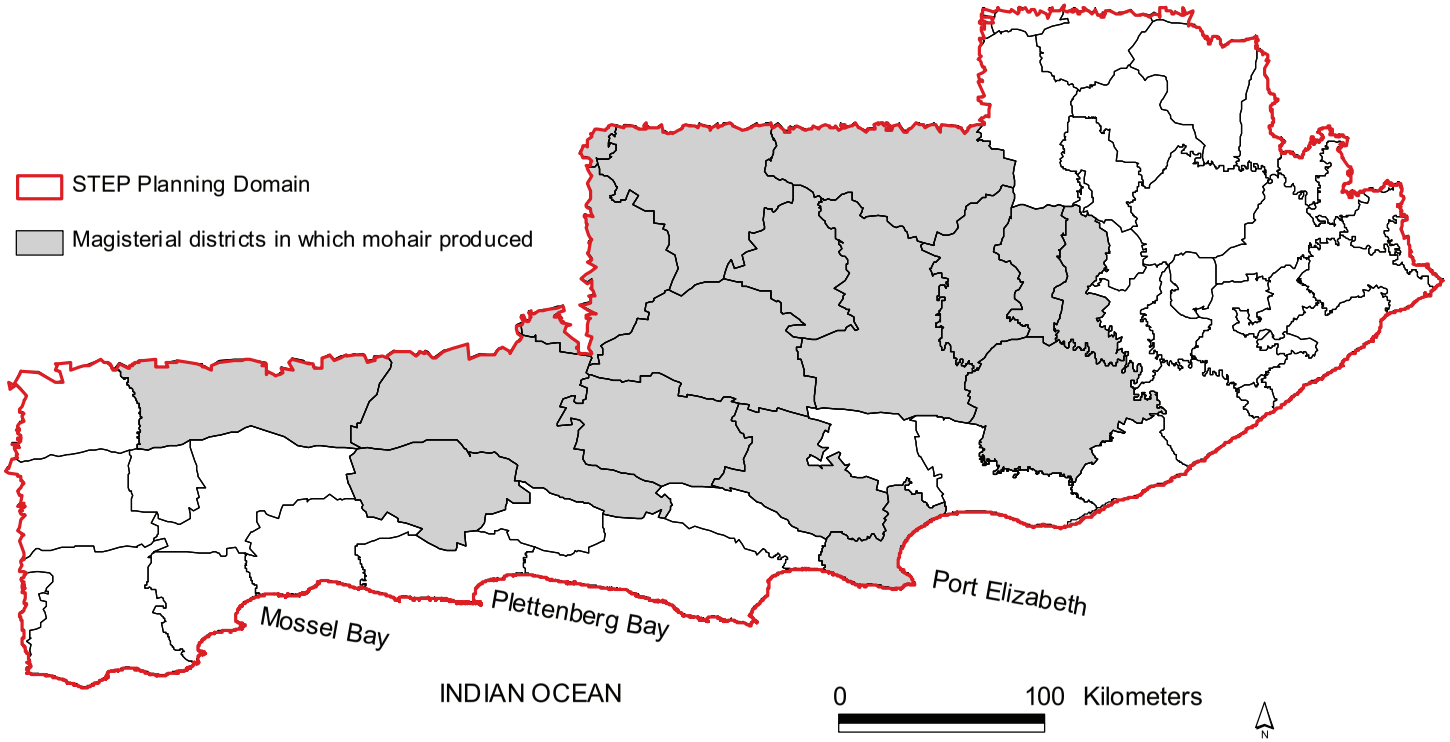

Figure 2: Magisterial district within the STEP planning domain in which mohair production occurs.

based on a single shearing event for all age groups of Angora goat and normally mature animals are shorn twice per annum, the total gross income per SSU was adjusted to R310.37 to reflect the greater product outputs from mature goats (calculations are detailed in Table 1).

Table 1: A complete budget for an Angora breeding ewe flock (based on 100 ewes and 1.22 SSU's per ewe).

	No. of Animals	Mass Each (kg)	Income / Unit	Value / Farm	Value / SSU
GROSS INCOME					
Capital Income					
Old Ewe	21	40	R5.50	4704	
Ewe Lamb	4	25	R6.80	723	
Kapaters	29	25	R6.20	4534	
Ram	1	60	R4.10	246	
Less Purchases:					
Rams	1		600	600	
Total Capital Income				**R9 606**	**R78.96**
Product Income					
Hair: Mature goats	204	4	R16.80	R13 709	
Hair: Kids	124	1	R87.00	R10 788	
Hair: Young goats	59	1.5	R42.20	R3 735	
Total Product Income				**R28 232**	**R231.41**
TOTAL GROSS INCOME				**R37 838**	**R310.37**

Source: Enterprise Budget, Dohne Agricultural Development Institute (2000).

Using the upper Albany (Grahamstown) area as a case study, a value of **R155.18/ha per annum** was calculated, based on a grazing capacity of 12 ha/LSU (using the convention that 1 LSU is equivalent to 6 SSUs) (Table 2). This extrapolates to a value of R387 957 per average farm unit in the upper Albany area (assuming an average farm size of 2 500 ha) (Source: W. Penny, Department of Agriculture, *pers. comm*.).

Table 2: Estimation of per hectare value of Mohair farming.

Grazing Capacity (ha/LSU)	Area (ha)	No. of LSU's	No. of SSU's	Value / ha	Value / Ave Farm Unit
12	239615	19 968	119 807	**R155.18**	R387 957

4.1.2 Boer goats

Other small stock which utilize the Thicket Biome extensively are Boer goats. A number of characteristics make Boer goats very popular in terms small stock farming. Such characteristics include hardiness and adaptability to a wide variety of climatic and pasture conditions, resistance to diseases, high fertility and kidding percentage (twins are common), abundance of milk, longevity (economically productive up to 10 years of age) and their ability to utilize plants normally less palatable to other stock breeds. While their pelts have low leather value, their meat is becoming more and more popular as a food source to the general public. Currently, the meat is much sought after for barbecue and spit roasting purposes, while older goats in good condition yield biltong and dried sausage of good quality (Casey 1986, Coetzee 1998).

Because it was not possible to obtain general statistics on non-Angora goat farming production across the STEP planning domain, gross income per ha generated by Boer goats was calculated using a single case study. The Genl. J.C. Steyn Prison Farm, a 3000 ha pastoralism operation used by the Department of Agriculture for research projects monitoring productivity, income and expenditures, was utilized for this purpose. Based on a conservative stocking rate of 746 SSU's (±537 animals) a per hectare value of R45.92 was obtained for the 3 000 ha farm (see Table 3). However, it should be noted that this value is highly variable, depending on veld condition and

previous rainfall season. In the past, stocking rates have been increased to 1 398 SSU's following good rains (De Kock 1994). In the short term, this would increase the value to R86.01/ha.

Table 3: Estimation of per hectare value of Boer goat farming.

*Gross Income/SSU	Area (ha)	No. of animals	No. of SSU's	Total Value	Value / ha
R184.67	3 000	537	746	R137 764	**R45.92**

*Source: Enterprise Budget, Dohne Agricultural Development Institute (2001).

4.2 GAME FARMING

The Eastern Cape is a major destination for the hunting industry in South Africa. Based on number of exempted[1] game farms, in the 1999/2000 hunting season the Eastern Cape had the third highest number of farms (624 farms) exempted after the Northern Province (2 482) and the Northern Cape (986). While number of exempted farms does not necessarily provide a true picture of the number of farms which cater for overseas and local hunters, it is the only information available at present (P. van Niekerk, Port Elizabeth Technikon, *pers. comm*.). During the same time period, the Eastern Cape also ranked third after the Northern Cape and the Northern Province in terms of total area utilized for game ranching (881 633 ha versus 4 852 053 ha and 3 325 652 ha, respectively) (P. van Niekerk, Port Elizabeth Technikon, *pers. comm*.).

Notably, the Eastern Cape is the most preferred destination for overseas hunters. A total of 1002 foreign hunters hunted in the Eastern Cape in the period 1 November 1999 to 31 October 2000 and hunted a total of 7 915 animals. In the 2000/2001 season, this number increased to 8 943 animals generating funds in excess of R44 million. Downstream economic activities resulting from overseas hunters visiting the Eastern Cape brought the total gross income generated to R118 653 714 (see Table 4 for details) (P. van Niekerk, Port Elizabeth Technikon, *pers. comm*.).

Table 4: Economic statistics for the professional hunting industry in the Eastern Cape province for the period 1 November 2000 to 31 October 2001. These figures only reflect the contribution made by overseas hunters.

INCOME DIRECTLY RELATED TO HUNTING	**ZAR (1$ = R9)**
8 943 animals hunted: Total value	**R 44 951 490**
Daily rates (hunting clients) [9223 days] Total Value ($ 350/day)	**R 34 470 450**
Daily rates (non-hunting clients) [1600days]: Total value ($ 200/day)	**R 2 953 800**
Subtotal	**R 82 375 740**
INTERACTION WITH BUSINESS SECTOR	
South African Airways	R 16 112 570
Car Hire	R 1 587 725
Hotel Accommodation	R 1 587 725
Taxidermy	R 8 950 500
Tips (staff)	R 4 348 988
Fishing and Touring	R 906 039
Curios/shopping	R 1 979 479
Venison	R 804 848
Subtotal	**R 36 277 974**
TOTAL	**R118 653 714**

Source: Newsletter ECGMA

[1] Game-ranching exemption gives the owner authorization to exploit game on the property at his own discretion. An exemption permit is issued after specific fencing and surface area criteria are met. Permits must be renewed after 3 years.

In 1999/2000, the average length of the hunt by overseas hunters in the Eastern Cape was 9.2 days as compared to 10.52 days in the Northern Province. The fractionally shorter stay in the Eastern Cape as compared to the Northern Province resulted in 9 223 hunting days spent in the Eastern Cape as compared to 9 900 in the Northern Province. These figures underline the fact that the Eastern Cape has become an important region in the game and hunting industries in South Africa (P. van Niekerk, Port Elizabeth Technikon, *pers. comm*.).

4.3 ECO-TOURISM & CONSERVATION

The eco-tourism industry is reliant upon an intact environment in order to provide both the means to support the wildlife, which the public wishes to see, as well as to provide a "wilderness experience". Eco-tourism is a service provided by both private- and public-sector driven operations. The former tend to focus on a select portion of society, which can afford to pay a high fee for their experience, while the public operations provide a service to society as a whole and are run by government conservation agencies whose primary goal is protecting and managing the environment, with eco-tourism being a secondary objective. Three case studies are outlined in order to provide some insight into gross incomes generated by the eco-tourism industry, as well as employment opportunities created by these activities.

4.3.1 Private Game Parks

Eco-tourism is increasingly becoming recognized as a viable and potentially profitable land-use option, with foreign investors willing to invest large sums of money into the development of private game parks and eco-tourism enterprises. These operations tend to cater for the more affluent sector of the market with both local and foreign visitors paying relatively high prices to experience the "African adventure". The principal aim of the private game park is to turn a profit. A local up-market game lodge was used as a case study to illustrate the magnitude of gross annual incomes and employment generated by such this type of venture (Table 5). A key point to note is that both income and employment opportunities are significantly higher for this land-use type than the previously mentioned pastoral land-use options.

Table 5: Gross annual income and employment generated by a private game park.

Size of Property (ha)	18 000
Gross Annual Income (2001)	R 35 000 000 (Range: R30 – 40 million)
Estimated Growth	12%
Employment TOTAL NO.	240
Skilled Jobs	*100*
Unskilled Jobs	*140*
Gross Income / ha	**R 1,944.44**
Jobs / 100 ha	1.33

4.3.2 Change of land-use from farming to eco-tourism

Following from the points made in section 3.3.1 with regards to eco-tourism being a potentially lucrative land-use option, an example is provided here where a land owner has changed their principal land-use from commercial livestock farming to that of eco-tourism. The change has resulted in incomes quadrupling from almost R100/ha to over R400/ ha. Furthermore, 16 additional jobs were created, of which 4 were skilled and 12 unskilled (Table 6).

Table 6: Comparison of incomes and employment generated by a change in land-use from livestock farming to eco-tourism.

		LIVESTOCK FARMING	ECOTOURISM
Size of Property (ha)		1 504	1 933
Previous land use		Dairy, beef, merino's (wool), boergoats & chicory	Game viewing & ecotourism
Net Annual Income		150 000	800 000
Estimated Growth		No net change	Positive growth
Employment	**TOTAL NO.**	9	25
	Skilled	*1*	*5*
	Unskilled	*8*	*20*
Net Income / ha		**R 99.73**	**R 413.86**
Jobs / 100 ha		0.60	1.29

Source: G. Fowlds, Amakhala Game Reserve, *pers. comm.*.

4.3.3 Public Conservation Areas – Addo Elephant National Park (AENP)

The public-sector driven eco-tourism example used in this section showed a lower per hectare income (R485/ha) than that of the private-sector driven example (R1 944/ha) in section 3.3.1 (Table 7). However, it is important to acknowledge that the primary goal of national conservation agencies like SA National Parks are to ensure the protection of biodiversity. Because they are unmarketed, and therefore unvalued, the social benefits of maintaining biodiversity and a well-functioning ecosystem are not reflected in the financial incomes generated by entry fees. Another important distinction to be made from the private example is that in the public-driven case, all benefits are shared in an equitable manner for the whole of society to enjoy. In an attempt to quantify such social benefits, Geach (1997) used the Travel Cost Method to estimate the recreation value of AENP. A value of over **R300 million p.a.** (R21 428/ha) (1996 prices) was obtained, indicating that the AENP has a far higher economic potential than its actual earnings suggest. Geach (1997) made the suggestion that this potential be realized by converting some of the consumer surplus (the amount a buyer is willing to pay for a good minus the amount the buyer actually pays for it) into revenue, which would accrue to SANParks.

Table 7: Gross annual income and employment numbers generated by a public conservation agency, using the Addo Elephant National Park as an example.

Size of Property (ha) – Elephant camp	14 000
Gross Annual Income (2001)	R 6 800 000
Employment TOTAL NO.	82
Skilled jobs	*70*
Unskilled jobs	*12*
Gross Income / ha	**R 485.71**
Jobs / 100 ha	0.5

Source: L. Moolman, Addo Elephant National Park, *pers. comm.*

4.4 HORTICULTURE

Questionnaires were sent to two nurseries in Port Elizabeth which are known to sell indigenous plant species. Respondents were given a comprehensive list of thicket plant species and requested to indicate which of these species they sold, at what price the plants were sold and what quantity were sold per annum. They were also asked to state the size of the property and the number of skilled and unskilled staff they employed.

The results of this survey indicated that sales of thicket species for horticultural purposes yield in excess of **R72 000/ha** of nursery p.a. (Table 7) and generate on average 4.9 jobs per hectare of nursery.

Of the 170 species listed, 71 are sold by the two nurseries (see Appendix 3). In the case of both nurseries the listed species are propagated in-house, including the cycads, and no species are collected in the wild.

Table 7: Summary of questionnaire results indicating the number of thicket plant species sold per annum and the gross incomes generated from these sales.

	NURSERY 1	NURSERY 2	AVERAGE
Property Size (ha)	2.25	1	1.625
Skilled staff	3	3	3
Unskilled staff	4	6	5
No. of thicket plant species sold	54	40	71 (total)
Gross income p.a.	R163 485	R71 702.25	R117 593.63
Income / ha	R72 660	R71 702.25	R72 181.13

4.5 ALOE SAP INDUSTRY

Locally, aloe products are generally obtained from a single species of *Aloe*, namely *Aloe ferox,* which is the South African pharmacological equivalent of *Aloe vera*. Products include aloe sap (known as 'bitter sap' or 'bitter aloe'), which is a bitter yellow juice tapped from just below the leaf surface, and aloe gel which originates from the inner fleshy part of the leaf (Van Wyk *et al*. 1997). The aloe sap is converted into a product known in the industry as 'aloe lump', or Cape aloe, which is acquired through a process of boiling and reducing the sap to a thick substance. This aloe lump is then sold to pharmaceutical companies that use it in stomach tonics and laxatives. The aloe gel is a watery mixture which is used in hair and skin care products. A company by the name of Aloe Ferox manufactures and distributes a wide range of such products both locally and abroad.

In the Eastern Cape and the former homelands, the raw aloe products are harvested in an informal manner with casual labourers collecting the products for entrepreneurs who then sell the raw product to the manufacturers and retailers. There is no central controlling agency and the labourers do not work on formal properties, but rather collect on an *ad hoc* basis wherever the plant can be found. During peak periods up to **6 000 tappers** may be active within the Eastern Cape (including the former homelands). This number decreases to 2 000 – 3 000 during slow periods. A good tapper can extract up to 20 liters of bitter sap per day (D. de Villiers, local sap exporter, *pers. comm.*).

The quality of aloe sap is reported of a higher quality as one moves west towards Mossel Bay with an Aloin content of 20 –28% as compared to 14 – 18% in the east (D. de Villiers *pers. comm*.). In this area, aloe is supplied on a more formal basis with farm workers harvesting leaves and bitter sap on their employer's property and selling it to companies. These companies also buy the aloe leaves directly from the farmers (S. Coetzee, Aloe Ferox *pers. comm*.).

Buyers include pharmaceutical companies, cosmetic manufacturers and raw product exporters. The quantity bought by an individual company can vary widely, ranging anywhere from **2 500 kg to 80 000 kg per annum**. Similarly the price paid for raw products can range from **R3.20 to R18 per kg**. Total turnover per annum for a single company is calculated to be in the range of **R23 750 – R256 000 per annum**.

4.6 MEDICINAL PLANT TRADE

The trade in medicinal plants is extensive. Almost every city and town in South Africa has some form of trade in plants for medicinal or cultural purposes, most often through informal street markets or small shops known as *Amayeza* stores (Xhosa) or *Muthi* shops (Zulu). It is estimated

that the medicinal plant trade industry is worth between R750 million and R1 billion per annum nationally in South Africa (Cocks & Dold 2000).

Within the Eastern Cape 166 plant species are exploited for medicinal purposes, of which 38 species are from Thicket (23% of the 166 species traded). In terms of quantities traded annually, 24% is harvested from Thicket with an additional 14% harvested from both Thicket and Forest. Thicket species which are particularly popular include *Rhoicissus digitata*, *Haworthia attenuata*, *Rubia petiolaris, Gasteria bicolor* and *Bulbine alooides*. Typically, *Gasteria bicolor* sells at R29/kg and *Bulbine alooides* at R31/kg.

It is estimated that 435 tonnes of wild-harvested plant material (**165.3 tonnes of Thicket p.a.**) are traded in the six city centers in the Eastern Cape alone every year, generating an income of R19 million per annum, **R7 220 000 p.a.** of which is generated by Thicket species alone. However, despite this high total income value, the average monthly income per capita is between R150 and R500 (Dold & Cocks 2001) (Table 8).

Medicinal plants are harvested regularly with little or no control or management in communal areas and State-owned land in the Eastern Cape. No plants are cultivated and all material is wild harvested. Unfortunately, as yet, there are no management structures in place and the present harvesting rates are uncontrolled and far from sustainable (Cocks & Dold 2000). If certain medicinal plants are not supplemented from alternative sources, such as cultivated plants, in the near future, it is certain that their survival in the wild will be seriously threatened (Dold & Cocks 2001).

Table 8: Gross annual incomes generated by the medicinal plant trade in the Eastern Cape and number of indigenous plant species traded (across all vegetation types).

Sector	Quantity Harvested p.a. (kg)	Annual Income Ranges	No. of Species Used
Street traders / gatherers	167 – 3 106 Average: 761	R6 000 – R35 988	92
Healers (69% collect their own)	54 – 3 900 Average: 100	R2 400 – R24 000	125
Amayeza (Buy from street traders & gatherers)	Average: 882	-	65

Source: Cock & Dold (2000)

4.7 FUEL WOOD

In the past, energy planning in South Africa concentrated on commercial fuels for industry and metropolitan centers. This has resulted in abundant and cheap energy being available in the developed sector of the economy, while other sectors of the population suffer under conditions of energy scarcity (Gandar 1989). Despite the large-scale electrification drive in South Africa since 1994 (Davies 1996), fuelwood is still the primary source of energy for rural communities (Dyer 1996). On a national level, Eberhard (1990) estimated that wood comprises 78.5% of the net domestic energy of rural people and is used as fuel in 99% of rural households.

Generally, households collect most of their fuelwood requirements in the immediate vicinity of their village. If fuelwood becomes locally scarce then inhabitants either travel further to harvest, or purchase fuelwood from vendors that have transport to access more remote harvesting areas. In a study in Peddie District in the Eastern Cape, Ainslie et al. (1996) found that 76% of the household sample gathered wood as the main source of fuel for cooking, with women and children being mainly responsible for this task.

It is estimated that the equivalent of more than 9.8 million tons (dry mass) of fuelwood are used annually in South Africa (DME 1996). Quantities of fuelwood used per household per annum

vary greatly and are dependent on a number of factors (Shackleton et al. in press). Published figures range from 0.6 to 7.7 tonnes per family per annum (Gandar 1981, 1983; Liengme 1983; Bank et al. 1996). Most of these are clustered around a mean of **687 kg per person per year** (Shackleton 1993). While no economic information is available specifically for the Thicket Biome a study in the Eastern Cape estimated the mean gross value of fuel wood consumed directly by households in the province to be **R758 per household per annum** (Hassan & Haveman 1997).

4.8 ECOSYSTEM SERVICES

An ecosystem is a dynamic assemblage of plant, animal, fungal and micro-organism communities. These living components constantly interact with their physical environment. The intricate way in which ecosystems work provide the "services" upon which all life on Earth depends, such as providing clean air and water, maintenance of soil fertility, flood control and so forth.

4.8.1 Clean Water

Thicket provides several valuable services in relation to watershed protection and maintenance of water quality by retaining water in the soil, regulating water flow (reducing it during flood events and maintaining it during drier times), reducing soil erosion and filtering drinking water. Thicket cover affects the total amount of water available in a watershed. When cover is reduced, net runoff increases dramatically resulting in erosion of the soil (Kerley *et al*. 1999). Benefits of this nature provided by the Thicket Biome can be quantified and a monetary value place on them, however it was not within the means of this report to do so.

4.8.2 Carbon Budget

Important economic benefits are accrued by ensuring that the Thicket Biome remains intact, stemming directly from the critical role vegetation plays in the cycling of carbon in the environment, both in the soil and in the atmosphere.

Carbon sequestration, or the locking up of carbon in a solid state, is becoming an increasingly important mechanism to combat present trends in the growth of CO_2, a known greenhouse gas, in the atmosphere. The increasing rate of CO_2 input from human activities such as burning of fossil fuels and destroying vast tracts of vegetation has been identified as a potential cause of global climate and temperature change. For South Africa this means that large parts of the country will become hotter and drier, while other parts will experience more frequent and extreme flooding (http://www.nbi.ac.za/consfarm/intro/cfcseq.htm).

This process is reversed by "fixing" carbon in plant and animal tissues and by returning organic carbon to the soil. These stores of organic carbon are known as "carbon sinks" because they "drain" carbon dioxide from the atmosphere and hold it for a period in a form that does not contribute to global warming. Soil is the ultimate carbon sink: it contains organic matter derived from plants, animals, fungi and bacteria. About 60% of organic carbon in the soil occurs in a form that binds tightly to clay particles and cannot easily be dislodged. Soil enriched with organic matter is therefore a very stable carbon sink as it can store large amounts of carbon for a very long time. It is estimated that soil and its organic layer store about 75% of total terrestrial carbon (Brown 1998).

Further to this, vegetation traps carbon in plant tissues and increases the amount of organic matter that can return to the soil. This increases the populations of soil organisms, the rate of decomposition and the levels of nutrients released into the soil. Soil organic matter also helps to maintain clay aggregates and improve both soil structure and water-holding capacity. It has been demonstrated that when the integrity of the thicket landscape patch is compromised, as in the case of overgrazing by domestic goats, the associated increase in runoff leads to an increase in erosion by wind and water with a subsequent loss of soil nutrients (carbon, nitrogen and phosphorus).

The loss of soil and soil resources results in decreased productivity, which is characteristic of desertification (Kerley *et al*. 1999).
Recognizing the critical importance of carbon sequestration, resource economists have attempted to internalize the benefit of maintaining carbon in the soil / cost of losing it by estimating a monetary value for it. Recent analysis of the possible market value of carbon range from as low as $10 per ton to as high as $100 or more per ton, depending on the particular study's assumptions (Antle *et al*. 1999, McCarl *et al*. 2000).

It was not possible to calculate the total monetary value of carbon within the Thicket Biome for this report as values for carbon content and sequestration rates could not be obtained. However, research is currently being undertaken by the National Botanical Institute to quantify these processes.

5. DISCUSSION & CONCLUSION

Having highlighted the gross incomes associated with economic activities operating in large parts of the Thicket Biome, it is critical to address the issue of sustainability. While a lot of the above activities do generate significant incomes, not all of them utilize the resource sustainably. In particular, it is well documented that pastoralism in the form of goat farming, is ecologically unsustainable. It leads to loss of phytomass and biodiversity, and an increase in soil erosion and unpalatable plant species – ultimately leading to desertification and loss of natural resources. Game ranching, on the other hand, has been shown to be more ecologically sustainable (Kerley *et al.* 1995). Kerley *et al*. (1995) commented that game-farming, while more ecologically sustainable, was not as lucrative as farming with domestic herbivores. However, value could be added through the combination of trophy hunting, tourism and processed meat (like biltong). It is worth noting then that since 1995, at least 27 additional game farms have been established whose incomes are solely derived from hunting (in some cases supplemented by tourism). An additional seven private game parks have been established that only provide ecotourism services. Ecotourism, based on the charismatic indigenous species in conservation areas and private game parks is both ecologically sustainable while also generating a high income and generating a high number of jobs. From an economic perspective, eco-tourism generates a considerable amount of activity from the travel costs spending of tourists. Assuming there is no market-saturation effect, ecotourism therefore offers an economically viable sustainable alternative land use to pastoralism (Kerley *et al*. 1995). However, there is much debate as to whether the increasing number of eco-tourism and game-farming enterprises might negatively impact the mohair industry in the future by competing for a common resource, namely Thicket, effectively preventing the expansion of the industry, in addition to potential buy-outs of existing mohair farms. A more thorough cost-benefit study needs to be conducted to investigate this issue.

The aloe sap and medicinal plant trade industry are two other industries which have the potential to be unsustainable. Given the informal and unregulated nature of these activities, plants are harvested regularly with little or no control or management in communal areas and State-owned land. Also, no plants are cultivated and all material is harvested in the wild. Should harvesting continue in this manner without supplementation from alternative sources, such as through cultivation, numerous plant species will be seriously threatened.

It is the recommendation of this report that in order to better understand the true value of thicket vegetation, that a comprehensive economic study focusing on the social costs (including opportunity costs) and benefits of the intact resource, as well as the economic consequences associated with specific economic activities exploiting this vegetation type be conducted. Such a study would require the valuation of unmarketed goods and services provided by thicket, such as clean air and carbon sequestration, as well as potential externalities associated with specific uses of the biome, such as over-grazing and unsustainable utilization.

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APPENDIX 1

SUBTROPICAL THICKET ECOSYSTEM PLANNING (STEP)

A three year (July 2000-June 2003) project, supported by the Global Environment Facility and implemented by the Terrestrial Ecology Research Unit, University of Port Elizabeth, sets out to:

- conduct, together with key stakeholders, a thorough conservation planning exercise in the Thicket Biome and
- work closely with key stakeholders to ensure the implementation of the outcomes of the planning exercise.

The STEP project aims to:

- provide a detailed spatial analysis of the various thicket types:
- assess the extent of their transformation and develop a better understanding of the threats;
- locate and design conservation areas to achieve explicit representation goals;
- suggest and prioritise explicit conservation actions;
- provide information for incorporation into regional Structure Plans and national Environmental Management Frameworks;
- provide a capacity building service in GIS-based conservation planning;
- guide investors from the public and private sectors in the selection of land for commercial enterprises, e.g. game-based ventures;
- create an awareness of the value and plight of the Thicket Biome.

What is the Thicket Biome ?

- One of South Africa's seven biomes, covering an area of nearly 42 000 km^2.
- A dense and spiny evergreen shrub vegetation, with a tree component of varying proportions.
- A major centre of diversity and endemism for succulents of karroid affinity, especially in the Mesembryanthemeceae, Euphorbiaceae and Crassulaceae, as well as a centre for certain bulb groups.
- A centre of high vertebrate diversity and biomass.

What ecosystem benefits are associated with intact thicket vegetation?

- Conservation of biological diversity.
- Soil retention.
- Clean air provision.
- A sustained yield of good quality water.
- Carbon sequestration.

What economic benefits are associated with intact thicket vegetation?

- extensive commercial and subsistence pastoralism;
- growing wildlife-based industries (ecotourism, game breeding, meat and sport hunting).

Less than 5% occurs in formal conservation areas. The unique Noorsveld subdivision is under serious threat, especially from illegal succulent collectors.

What will the STEP Project outcomes be ?

- ✓ The development and use of a strategic and flexible conservation plan for the protection of globally important biodiversity within the Thicket Biome.
- ✓ Enhanced capacity in GIS-based conservation planning among planners in national, provincial and regional land management authorities.

What is significant in the 200 000 km^2 study area ?

- ❑ The Albany Centre, which overlaps in the west with the Succulent Karoo Centre. Both are centres of diversity and endemism for succulents and bulbs and are floristically the most important parts of the Thicket Biome.
- ❑ The Albany Centre is a recognised WWF-IUCN global centre of plant biodiversity, and nearly all of its plant endemics are components of the Thicket Biome.
- ❑ The Thicket Biome in this region is thought to contain the most species-rich formations of woody plants in South Africa.
- ❑ Overlap with the Cape Floristic Region, which is the subject of a major strategic conservation planning exercise.

What are the main threats to thicket vegetation ?

- Overgrazing by domestic stock,
- Bushclearing for agriculture and urban development
- Coastal resort development
- Invasion by alien vegetation

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APPENDIX 2

MOHAIR PRODUCTION FOR 2000 BY MAGISTERIAL DISTRICT (87.5% OF TOTAL CLIP)

DISTRICT	% CONTRIBUTION	PRODUCTION (KG)	VALUE (R)
Somerset East	11.1%	477300	24,953,244.00
Willowmore	11.1%	477300	24,953,244.00
Jansenville	9.6%	412800	21,581,184.00
Craddock	8.2%	352600	18,433,928.00
Aberdeen	8.0%	344000	17,984,320.00
Albany (Grahamstown)	5.1%	219300	11,465,004.00
Uitenhage	4.4%	189200	9,891,376.00
Bedford	3.9%	167700	8,767,356.00
Graaff-Reinet	3.6%	154800	8,092,944.00
Steytlerville	3.4%	146200	7,643,336.00
Beaufort West	2.8%	120400	6,294,512.00
Murraysburg	2.6%	111800	5,844,904.00
Pearston	2.4%	103200	5,395,296.00
Prins Albert	2.3%	98900	5,170,492.00
Adelaide	2.3%	98900	5,170,492.00
Port Elizabeth	2.1%	90300	4,720,884.00
Fort Beaufort	1.3%	55900	2,922,452.00
Tarkastad	1.1%	47300	2,472,844.00
Uniondale	1.1%	47300	2,472,844.00
Richmond	1.1%	47300	2,472,844.00
	87.5%	3762500	196,703,500.00

Source: Mohair SA (2000)

APPENDIX 3

AVERAGE HORTICULTURAL PRICES PER PLANT FOR THICKET PLANT SPECIES AS DERIVED FROM QUESTIONNAIRE RESULTS.

Plant Species	Avg Price (R)	Plant Species	Avg Price (R)
Trees		*Plumbago capensis*	12.73
Acacia karroo	17.73	*Senecio macroglossus*	14.95
Cussonia spicata	27.73	*Tecomaria capensis*	11.73
Dovyalis caffra	17.73	**Sculptural plants**	
Greyia flanaganii	39.95	*Aloe africana*	15.50
Harpephyllum caffrum	22.48	*Aloe ferox*	40.23
Olea europaea subsp. Africana	17.73	*Aloe lineata*	15.50
Schotia brachypetala	24.95	*Aloe pluridens*	15.50
Sterculia alexandri	15.50	*Encephalartos altensteinii*	50.00
Annuals		*Encephalartos horridus*	80.00
Lobelia erinus	11.95	*Encephalartos lehmannii*	80.00
Ground covers for shady spots		*Encephalartos longifolius*	80.00
Asparagus densiflorus 'Cwebe'	9.73	*Encephalartos princeps*	100.00
Chlorophytum comosum	7.50	*Encephalartos trispinosus*	80.00
Ledebouria socialis	10.00	*Strelitzia juncea*	67.48
Perennials		*Strelitzia reginae*	27.48
Barleria obtusa	12.73	**Bulbs and orchids**	
Cineraria saxifraga	14.95	*Agapanthus praecox*	10.23
Gazania rigens var. rigens	8.95	*Boophane disticha*	25.00
Geranium incanum	10.23	*Brunsvigia grandiflora*	15.00
Helichrysum cymosum	16.95	*Cyrtanthus elatus*	19.98
Helichrysum petiolare	11.23	*Cyrtanthus montanus*	20.00
Hermannia saccifera	14.95	*Cyrtanthus obliquus*	25.00
Leonatis leonuris	13.23	*Cyrtanthus sanguineus*	20.00
Monopsis unidentata	17.95	*Ledebouria concolor*	25.00
Nemesia fruticans	14.95	*Ledebouria socialis*	10.00
Osteospermum ecklonis	16.95	*Ornithogalum longibracteatum*	10.00
Osteospermum fruticosum	7.50	*Tulbaghia violacea*	10.23
Pelargonium panduriforme	10.50	*Veltheimia bracteata*	21.23
Pelargonium papilionaceum	10.50	**Shrubs**	
Pelargonium radens	10.50	*Carissa bispinosa*	12.50
Pelargonium reniforme	10.50	*Euryops virgineus*	11.95
Sutera cordata	7.73	*Grewia occidentalis*	19.95
Climbers		*Pelargonium inquinans*	10.50
Aloe ciliaris	15.50	*Pelargonium zonale*	16.95
Bauhinia galpinii	27.73	*Polygala myrtifolia*	14.73
Dioscorea elephantipes	50.00	*Polygala virgata*	16.95
Fockea edulis	20.00	*Portulacaria afra*	11.73
Pelargonium pelatum	13.73	*Scutia myrtina*	24.95

Source of species list: Van Jaarsveld (2000)

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