

## CHAPTER 8

### AVAILABLE BROWSE

#### INTRODUCTION

Browsing capacity and browse availability can be influenced by the density of woody plants, the amount of leaf material within reach of an animal, the palatability and digestibility of the woody species and the growth potential of the woody species (Pauw 1988). Schmidt (1992) adds the concentration of condensed tannins in the leaves of the woody plants as a factor. According to Rutherford, the terms browse and available browse must not be confused (Rutherford 1979). Von Holdt (1999) defines browse as the sum total of plant material on woody plants that is potentially edible to a specified set of browsing animals, and which is regarded as the current season's growth of leaves and twigs. Available browse refers to a more restricted quantity than the term browse and is determined on the basis of the maximum height above the ground to which an animal can potentially utilise the browse. The figures given here will refer to the available browse as defined by Von Holdt (1999).

Several techniques have been developed and used for estimating the available browse (Rutherford 1979, 1982a, 1982b; Pellew 1983; Pauw 1988; Smit 1989a, 1989b; Peel 1990; Sievers 1991; Schmidt 1992; Smith 1992; Van Heerden 1992; Smit 1994; Orban 1995; Swart 1995; Smit 1996). The Quantitative Descriptive Index and the BECVOL (Browse Estimates from Canopy Volume) method of Smit (1989a, 1989b, 1994, 1996) are used here. Orban (1995) used the Quantitative Descriptive Index (Smit 1989a, 1989b) and the BECVOL method and program (Smit 1996) to survey the woody vegetation of the Lionspruit Game Reserve, of the then Eastern Transvaal. The species composition, size and vertical distribution of live woody plant canopy were surveyed to determine the tree density, percentage cover of woody vegetation at different height levels and the potential productivity of the available browse material. The height levels of Coetzee and Gertenbach (1977) were used to class plants according to their height. The BECVOL program was then used to determine the Evapotranspiration Tree Equivalent, Browse Tree Equivalents and Canopy Sub-habitat Index. Swart (1995) also used the Quantitative Descriptive Index (Smit 1989a, 1989b) and the BECVOL method and program (Smit 1996) to produce a quantitative description of the woody vegetation in the Letaba Ranch, Northern Province, South Africa. Swart (1995) compared the BECVOL method to the Variable Quadrat Method (Coetzee and Gertenbach 1977) and suggested that the two methods are comparable although this has not been verified statistically.

The aim of this study was to:

- Determine the amount of available browse on Sango Ranch which will be used to determine browsing capacity.

## METHODS

The dimension meter of Smit (1989c, 1994) was used to measure the following tree dimensions: maximum canopy height (m), minimum canopy height (m), maximum canopy diameter (m) and minimum canopy diameter (m) (Smit 1994, 1996). Observations were made for all woody plants >0.5 m tall and rooted in the belt transects used in the assessment of the structure of the woody vegetation (Chapter 5). The data were then entered into the BECVOL computer program in order to determine the potential available browse material in the form of leaf dry mass production per ha for each management unit. Because a feeding-height stratification exists at various levels the leaf dry mass per ha was calculated at two lower maximum browse heights of 1.5 m and 2 m, the former being the maximum level at which most smaller animals such as duiker utilise leaves, while the latter is the maximum level at which impala, kudu and eland utilise leaves (Dayton 1978; Du Toit 1990a), and at a third maximum browse height of 5 m at which giraffe and elephant are able to browse (Dayton 1978; Pellew 1983; Du Toit 1990a). However, only bull giraffe utilise browse at heights above 5 m (Pellew 1983). Two maximum browse heights, one of 2 m and one of 5 m were used as the maximum heights at which a kudu and a giraffe can browse, respectively.

A certain percentage of the total browse material in any area is inaccessible to browsers (Von Holdt 1999). This is because of the degree of deciduousness, inaccessibility, spinescence, growth form and secondary compound content of plants. A high percentage of browse material is also utilised by other animals such as insects (Brewer 1994). The total browse must then be reduced by a certain percentage to obtain a realistic estimate of the browse available to browsing ungulates. Von Holdt (1999) discussed the percentage of browse available to browsers. Following Von Holdt (1999) the following percentages of the total available browse will be used here: 5 %, 10 % and 13 %.

Palatability of woody species is difficult to quantify and measure directly (Schmidt 1992). Instead, published literature was used to as far as possible describe these two factors in the herbaceous and woody species of Sango Ranch. The following literature was used to describe the palatability and digestibility of the woody species: Leuthold and Leuthold (1972); Hall-Martin (1974b); Hall-Martin and Basson (1975); Guy (1976); Grunow (1980); Leuthold (1980); Kok and Opperman

(1980); Frost (1981); Pauw (1988); Peel (1990); Macleod, Kerley and Gaylard (1996).

## RESULTS AND DISCUSSION

The total estimated leaf dry mass and the available leaf dry mass at different height levels for the management units of Sango Ranch are presented in Table 41. The leaf dry mass is presented cumulatively for each height class. The total browse and available browse present in two height levels available on Sango Ranch as depicted in Table 42 were calculated from Table 41. Total browse includes palatable and unpalatable browse while available browse includes only palatable browse < 5m above the ground. The total estimated leaf dry mass and leaf dry mass for the woody species of each management unit contributing >1 per cent to the total leaf dry mass are shown in Tables 43 to 48. The acceptability of these browse species to browsing animals is depicted in Table 48 based on information from Leuthold and Leuthold (1972); Hall-Martin (1974b); Hall-Martin and Basson (1975); Guy (1976); Grunow (1980); Leuthold (1980); Kok and Opperman (1980); Frost (1981); Pauw (1988); Peel (1990); Macleod *et al.* (1996).

The greatest amount of total and palatable browse material in all six management units lies in the >5 m height class which is not available to browsers (total browse = 83 %, palatable browse = 85 %) (Table 41), (Dayton 1978; Pellew 1983; Du Toit 1990a). The greatest amount of total and palatable browse in all six management units lies in the >2-5 m height class (total browse = 11 %, palatable browse = 11 %; Table 41), and is only available to the giraffe and elephant (Dayton 1978; Pellew 1983; Du Toit 1990a). Of the total palatable and unpalatable browse on Sango Ranch 16 % is therefore available to browsers. Only 15 % of palatable browse material on Sango Ranch is available to browsers. The *Diospyros mespiliformes* Riverine Management Unit has the greatest amount of leaf dry mass, although it does not have the highest tree density. This is because of the large number of tall trees in this management unit. The *Acacia tortilis* Open Woodland Management Unit has the lowest leaf dry mass and this is because of the low number of woody plants in this management unit. The *Colophospermum mopane* Woodland Management Unit has the greatest leaf dry mass in the 0 to 2 m and >2 to 5 m height categories.

Table 41. The estimated total and palatable leaf dry mass estimates (kg per ha) in four height strata of the management units of Sango Ranch, Save Valley Conservancy, Zimbabwe.

| MANAGEMENT<br>UNIT | ESTIMATED LEAF DRY MASS |           |          |           |        |           |       |                    |         |                   |
|--------------------|-------------------------|-----------|----------|-----------|--------|-----------|-------|--------------------|---------|-------------------|
|                    | All                     | Palatable | All      | Palatable | All    | Palatable | Total | Total              | Total   | Total             |
|                    | 0-1.5 m                 | 0-1.5 m   | >1.5-2 m | >1.5-2 m  | >2-5 m | >2-5 m    | 0-5 m | Palatable<br>0-5 m | >5 m    | Palatable<br>>5 m |
| 1                  | 104                     | 90        | 77       | 72        | 347    | 301       | 528   | 463                | 467     | 455               |
| 2                  | 198                     | 153       | 164      | 139       | 848    | 721       | 1 210 | 1 013              | 4 223   | 4 161             |
| 3                  | 104                     | 76        | 157      | 145       | 224    | 201       | 485   | 422                | 1 105   | 1 091             |
| 4                  | 127                     | 127       | 64       | 64        | 185    | 185       | 376   | 376                | 3 341   | 3 341             |
| 5                  | 120                     | 12        | 73       | 73        | 762    | 752       | 955   | 837                | 7 923   | 7 839             |
| 6                  | 29                      | 29        | 33       | 33        | 351    | 351       | 413   | 413                | 2 877   | 2 877             |
| Total              | 682                     | 487       | 568      | 526       | 2 717  | 2 511     | 3 967 | 3 524              | 19 936  | 19 764            |
| Average            | 113.7                   | 81.2      | 94.7     | 87.7      | 452.8  | 418.5     | 661.2 | 587.3              | 3 322.7 | 3 294             |

Table 42. The estimated total browse and available browse in kg in two height classes present in the management units of Sango Ranch, Save Valley Conservancy, Zimbabwe.

| MANAGEMENT UNIT | AREA IN HA | TOTAL BROWSE  | AVAILABLE BROWSE |              |
|-----------------|------------|---------------|------------------|--------------|
|                 |            |               | 0-2 m            | >2-5 m       |
| 1               | 7 096.7    | 7 061 216.5   | 1 149 966.4      | 2 136 106.7  |
| 2               | 21 769.8   | 118 275 320.0 | 6 356 781.6      | 15 696 602.6 |
| 3               | 1 0731.6   | 17 062 290.0  | 2 371 683.6      | 2 157 051.6  |
| 4               | 1 307.2    | 4 858 862.4   | 249 675.2        | 241 832.0    |
| 5               | 1 975.7    | 17 540 265.0  | 167 934.5        | 1 485 726.4  |
| 6               | 224.8      | 739 592.0     | 13 937.6         | 78 904.8     |
| Total           | 43 105.8   | 165 492 550.0 | 10 309 675.9     | 21 795 644.5 |

| WOODY SPECIES                                | ESTIMATED BROWSE AVAILABLE |         |       |      | TOTAL |
|--|----------------------------|---------|-------|------|-------|
|  | 0-1.5 m                    | 1.5-2 m | 2-3 m | >3 m |       |
| <i>Acacia karroo</i> subsp. <i>robustior</i> | 0.2                        | 0.1     | 54    | 412  | 276   |
| <i>Combretum imberbe</i>                     | 127                        | 48      | 780   | 4437 | 5392  |
| <i>Diophris gularis</i>                      | 5                          | 4       | 75    | 42   | 126   |
| <i>Grassia hirsuta</i>                       | 48                         | 21      | 52    | 30   | 151   |

Table 43. The estimated leaf dry mass in kg per ha of the 10 dominant woody species in the Acacia tomentosa Woodland

Management Unit on Sango Ranch, Save Valley Conservancy, Zimbabwe.

| WOODY SPECIES                                       | ESTIMATED LEAF DRY MASS |          |        |      | Total |
|---|-------------------------|----------|--------|------|-------|
|   | 0-1.5 m                 | >1.5-2 m | >2-5 m | >5 m |       |
| <i>Acacia tortilis</i> subsp. <i>heteracantha</i>   | 30                      | 30       | 128    | 242  | 430   |
| <i>Albizia anthelminthica</i>                       | 0.8                     | 2.2      | 43     | 46   | 105   |
| <i>Boscia mosambicensis</i>                         | 6                       | 5        | 12     | 0    | 23    |
| <i>Cadaba termitaria</i>                            | 15                      | 3        | 4      | 0    | 22    |
| <i>Capparis tomentosa</i>                           | 5                       | 1        | 25     | 4    | 35    |
| <i>Combretum imberbe</i>                            | 0                       | 0        | 0.4    | 21.6 | 22    |
| <i>Dichrostachys cinerea</i> subsp. <i>africana</i> | 3                       | 10       | 39     | 2    | 54    |
| <i>Diospyros quiloensis</i>                         | 0.2                     | 0.2      | 11.6   | 8    | 20    |
| <i>Gardenia volkensii</i>                           | 2                       | 2        | 14     | 3    | 21    |
| <i>Grewia flavescens</i> var. <i>flavescens</i>     | 8                       | 2        | 1      | 0    | 11    |
| <i>Grewia monticola</i>                             | 9                       | 4        | 9      | 0    | 22    |
| <i>Lannea schweinfurthii</i>                        | 0                       | 0        | 0      | 0    | 51    |
| <i>Sclerocarya birrea</i> subsp. <i>caffra</i>      | 0                       | 0        | 1      | 24   | 25    |

Table 44. The estimated leaf dry mass in kg per ha of the four major woody species in the *Colophospermum mopane* Woodland Management Unit on Sango Ranch, Save Valley Conservancy, Zimbabwe.

| WOODY SPECIES                                     | ESTIMATED LEAF DRY MASS |          |        |      | Total |
|---|-------------------------|----------|--------|------|-------|
|   | 0-1.5 m                 | >1.5-2 m | >2-5 m | >5 m |       |
| <i>Acacia tortilis</i> subsp. <i>heteracantha</i> | 0.2                     | 0.1      | 64     | 412  | 476   |
| <i>Colophospermum mopane</i>                      | 127                     | 49       | 780    | 4437 | 5393  |
| <i>Diospyros quiloensis</i>                       | 5                       | 4        | 75     | 42   | 126   |
| <i>Grewia bicolor</i>                             | 40                      | 21       | 52     | 20   | 133   |

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Table 45. The estimated leaf dry mass in kg.ha of the 11 major woody species in the *Combretum apiculatum* Management Unit on Sango Ranch, Save Valley Conservancy, Zimbabwe.

| WOODY SPECIES  | ESTIMATED LEAF DRY MASS |          |        |      | Total |
|--|-------------------------|----------|--------|------|-------|
|  | 0-1.5 m                 | >1.5-2 m | >2-5 m | >5 m |       |
| <i>Acacia erubescens</i>                             | 4                       | 2        | 19     | 22   | 47    |
| <i>Acacia nigrescens</i>                             | 1.2                     | 0.5      | 13.3   | 141  | 156   |
| <i>Acacia tortilis</i> subsp. <i>heteracantha</i>    | 0.2                     | 0        | 1      | 16.8 | 18    |
| <i>Adansonia digitata</i>                            | 0                       | 0        | 0      | 66   | 66    |
| <i>Albizia tanganyicensis</i>                        | 0                       | 0        | 6      | 12   | 18    |
| <i>Brachystegia spiciformis</i>                      | 0                       | 0        | 1      | 54   | 55    |
| <i>Colophospermum mopane</i>                         | 2                       | 2        | 9      | 119  | 132   |
| <i>Combretum apiculatum</i> subsp. <i>apiculatum</i> | 11                      | 12       | 89     | 45   | 157   |
| <i>Commiphora mollis</i>                             | 0                       | 0.5      | 40.5   | 54   | 95    |
| <i>Diospyros quiloensis</i>                          | 1                       | 1        | 9      | 8    | 19    |
| <i>Ficus abutilifolia</i>                            | 1                       | 0        | 11     | 6    | 18    |
| <i>Grewia flavescens</i> var. <i>flavescens</i>      | 14                      | 6        | 2      | 0    | 22    |
| <i>Grewia monticola</i>                              | 14                      | 7        | 2      | 0    | 23    |
| <i>Kirkia acuminata</i>                              | 0                       | 1        | 1      | 254  | 256   |
| <i>Lannea schweinfurthii</i>                         | 0.3                     | 0.4      | 5.3    | 357  | 363   |
| <i>Phyllanthus reticulatus</i>                       | 12                      | 4        | 1      | 0    | 17    |

Table 46. The estimated leaf dry mass in kg per ha of the 11 major woody species in the *Acacia tortilis* Closed Woodland Management Unit on Sango Ranch, Save Valley Conservancy, Zimbabwe.

| WOODY SPECIES                                       | ESTIMATED LEAF DRY MASS |          |        |      | Total |
|---|-------------------------|----------|--------|------|-------|
|   | 0-1.5 m                 | >1.5-2 m | >2-5 m | >5 m |       |
| <i>Acacia galpinii</i>                              | 0                       | 0        | 0      | 475  | 475   |
| <i>Acacia schweinfurthii</i>                        | 30                      | 15       | 5      | 31   | 81    |
| <i>Acacia tortilis</i> subsp. <i>heteracantha</i>   | 2                       | 1        | 19     | 1256 | 1278  |
| <i>Albizia harveyi</i>                              | 0                       | 0        | 0      | 426  | 426   |
| <i>Anisotes formosissimus</i>                       | 42                      | 3        | 0      | 0    | 45    |
| <i>Dichrostachys cinerea</i> subsp. <i>africana</i> | 7                       | 13       | 41     | 3    | 64    |
| <i>Gymnosporia putterlickoides</i>                  | 0                       | 0        | 10     | 27   | 37    |
| <i>Lannea schweinfurthii</i>                        | 0                       | 0        | 0      | 1060 | 1060  |
| <i>Gymnosporia buxifolia</i>                        | 11                      | 11       | 15     | 0    | 37    |
| <i>Strychnos potatorum</i>                          | 2                       | 3        | 35     | 10   | 50    |
| <i>Ziziphus mucronata</i> ssp. <i>mucronata</i>     | 0                       | 2        | 17     | 29   | 48    |



Table 47. The estimated leaf dry mass in kg per ha of the 14 major woody species in the *Diospyros mespiliformis* Riverine

Management Unit on Sango Ranch, Save Valley Conservancy, Zimbabwe.

| WOODY SPECIES                                     | ESTIMATED LEAF DRY MASS |          |        |      | Total |
|---|-------------------------|----------|--------|------|-------|
|   | 0-1.5 m                 | >1.5-2 m | >2-5 m | >5 m |       |
| <i>Acacia galpinii</i>                            | 0                       | 0        | 19     | 51   | 70    |
| <i>Acacia tortilis</i> subsp. <i>heteracantha</i> | 0                       | 0        | 32     | 0    | 32    |
| <i>Albizia glaberrima</i> var. <i>glabrescens</i> | 0                       | 0        | 0      | 1898 | 1898  |
| <i>Dalbergia arbutifolia</i>                      | 8                       | 5        | 21     | 0    | 34    |
| <i>Diospyros mespiliformis</i>                    | 4                       | 1        | 21     | 459  | 485   |
| <i>Faidherbia albida</i>                          | 0                       | 16       | 268    | 3844 | 4128  |
| <i>Grewia inaequilatera</i>                       | 47                      | 19       | 38     | 2    | 106   |
| <i>Hyphaene coriacea</i>                          | 0                       | 0        | 10     | 84   | 94    |
| <i>Lannea schweinfurthii</i>                      | 0                       | 0        | 29     | 124  | 153   |
| <i>Sclerocarya birrea</i> ssp. <i>caffra</i>      | 0                       | 0        | 0      | 109  | 109   |
| <i>Strychnos potatorum</i>                        | 2                       | 2        | 0      | 83   | 87    |
| <i>Syzgium guineense</i>                          | 0                       | 0        | 181    | 1112 | 1293  |
| <i>Trichilia emetica</i>                          | 0                       | 0        | 70     | 102  | 172   |
| <i>Ziziphus mucronata</i> ssp. <i>mucronata</i>   | 0                       | 0        | 0      | 78   | 78    |

Table 48. The available browse per woody species in kg per ha in the *Echinochloa colona* Wetland

Management Unit on Sango Ranch, Save Valley Conservancy, Zimbabwe.

| WOODY SPECIES              | ESTIMATED LEAF DRY MASS |          |        |      | Total |
|----------------------------|-------------------------|----------|--------|------|-------|
|                            | 0-1.5 m                 | >1.5-2 m | >2-5 m | >5 m |       |
| <i>Acacia xanthophloea</i> | 10                      | 11       | 117    | 1947 | 2085  |

Table 49. The acceptability of 42 woody species of Sango Ranch, Save Valley Conservancy, Zimbabwe to browsing ungulates (see text for references).

| WOODY SPECIES  | ACCEPTABILITY CLASS |
|--|---------------------|
| <i>Acacia galpinii</i>                               | A                   |
| <i>Acacia erubescens</i>                             | A                   |
| <i>Acacia nigrescens</i>                             | A                   |
| <i>Acacia schweinfurthii</i>                         | A                   |
| <i>Acacia tortilis</i> subsp. <i>heteracantha</i>    | A                   |
| <i>Acacia xanthophloea</i>                           | A                   |
| <i>Adansonia digitata</i>                            | A                   |
| <i>Albizia anthelminthica</i>                        | A                   |
| <i>Albizia harveyi</i>                               | A                   |
| <i>Albizia glaberrima</i> var. <i>glabrescens</i>    | A                   |
| <i>Albizia tanganyicensis</i>                        | ?                   |
| <i>Anisotes formosissimus</i>                        | ?                   |
| <i>Boscia mosambicensis</i>                          | A                   |
| <i>Brachystegia spiciformis</i>                      | L                   |
| <i>Capparis tomentosa</i>                            | L                   |
| <i>Colophospermum mopane</i>                         | A                   |
| <i>Combretum apiculatum</i> subsp. <i>apiculatum</i> | A                   |
| <i>Combretum imberbe</i>                             | A                   |
| <i>Commiphora mollis</i>                             | L                   |
| <i>Dalbergia arbutifolia</i>                         | A                   |
| <i>Dichrostachys cinerea</i> subsp. <i>africana</i>  | A                   |
| <i>Diospyros mespiliformes</i>                       | A                   |
| <i>Diospyros quiloensis</i>                          | L                   |
| <i>Faidherbia albida</i>                             | A                   |
| <i>Ficus abutilifolia</i>                            | L                   |
| <i>Gardenia volkensii</i>                            | A                   |
| <i>Grewia bicolor</i>                                | L                   |
| <i>Grewia flavescens</i> var. <i>flavescens</i>      | A                   |
| <i>Grewia inaequilatera</i>                          | A                   |
| <i>Grewia monticola</i>                              | L                   |
| <i>Gymnosporia putterlickoides</i>                   | A                   |
| <i>Hyphaene coriacea</i>                             | L                   |
| <i>Kirkia acuminata</i>                              | A                   |
| <i>Lannea schweinfurthii</i>                         | A                   |
| <i>Cadaba termitaria</i>                             | A                   |
| <i>Gymnosporia buxifolia</i>                         | A                   |
| <i>Phyllanthus reticulatus</i>                       | L                   |
| <i>Sclerocarya birrea</i> subsp. <i>caffra</i>       | A                   |
| <i>Strychnos potatorum</i>                           | A                   |
| <i>Syzgium guineense</i>                             | A                   |
| <i>Trichilia emetica</i>                             | A                   |
| <i>Ziziphus mucronata</i> subsp. <i>mucronata</i>    | A                   |

A = Acceptable

B = Limited acceptability

Of the available browse on Sango Ranch there is 10 309 675.9 kg of browse in the 0 to 2 m height level which is available to the kudu and smaller animals (Table 42). This is 6.2 % of the total browse. The browse available in the >2 to 5 m height class is 21 795 644.5 kg and is only available to the giraffe and elephant. This is 13.2 % of the total browse. *Acacia tortilis* subsp. *heteracantha* is an important browse species nutritionally in the *Acacia tortilis* Open Woodland Management Unit, the *Colophospermum mopane* Woodland Management Unit and the *Acacia tortilis* Closed Woodland Management Unit (Tables 43, 44 and 46). The leaves of *Acacia tortilis* subsp. *heteracantha* are palatable and nutritious and are utilised by the elephant, giraffe, eland, waterbuck, kudu, nyala, bushbuck, impala and grey duiker (Venter and Venter 1996). Because of its semi-deciduous nature, *Acacia tortilis* subsp. *heteracantha* is an important browse species during the dry season when browse is at a minimum (Kok and Opperman 1980). However, the greatest amount of browse in this species lies in the >2 to 5 m and >5 m height classes and therefore it is only available to the giraffe and elephant. *Colophospermum mopane* is the dominant browse species in the *Colophospermum mopane* Woodland Management Unit (Table 44). It is a palatable and nutritious browse species and is important food source for many wildlife species in the dry season, being semi-deciduous (Timberlake 1995; Venter and Venter 1996). The mature leaves are mostly eaten during summer and autumn (Venter and Venter 1996). Elephant utilise *Colophospermum mopane* to a great degree as a source of food (Skinner and Smithers 1990; Timberlake 1995). The greatest amount of available *Colophospermum mopane* browse on Sango Ranch is beyond the reach of game species of Sango Ranch (82%; Table 44). In the lower height classes, 2 % of the browse is found in the 0 to 1.5 m class and 15% is found in the >2 to 5 m class (Table 44). The browse of *Colophospermum mopane* is thus fairly limited in the lowest height classes.

*Lannea schweinfurthii* is important as a browse species and food source in the *Combretum apiculatum* Management Unit and the *Acacia tortilis* Open Woodland Management Unit (Tables 45 and 46). However, the greatest proportion of this browse material is unavailable to the game species of Sango Ranch. The leaves are palatable and are utilised by the giraffe, kudu, nyala, bushbuck and grey duiker (Venter and Venter 1996). *Lannea schweinfurthii* is not important during the dry season, being deciduous and bare in winter (Venter and Venter 1996). No browse species dominates in the *Combretum apiculatum* Woodland Management Unit (Table 45). However, *Acacia nigrescens*, *Combretum apiculatum* subsp. *apiculatum*, and *Kirkia acuminata* contribute the most to the total browse of this management unit. *Acacia nigrescens* is an important wet season browse species for elephant, giraffe, kudu, impala and duiker (Venter and Venter 1996). However,

most of the browse is present in the >2-5 m and >5m height classes (Table 45). *Combretum apiculatum* subsp. *apiculatum* is an excellent fodder tree and the leaves are utilised by many herbivore species (Venter and Venter 1996). Because of its semi-deciduous nature, it is an important dry season source of browse (Venter and Venter 1996). The greatest amount of the browse material is, however, only available to giraffe and elephant, but some browse material is available to the other herbivores in the lower height classes (Table 45). *Acacia galpinii*, *Albizia harveyi* and *A. versicolor* contribute greatly to the browse material in the *Acacia tortilis* subsp. *heteracantha*-*Panicum maximum* and the *Diospyros mespiliformes* Riverine Management Unit. However, this is unavailable at >5 m (Tables 46 and 47). *Diospyros mespiliformes* and *Faidherbia albida* are very important browse species in the *Diospyros mespiliformes* Riverine Management Unit while *Acacia xanthophloea* is completely dominant in the *Diospyros mespiliformes* Riverine Management Unit (Tables 47 and 48). *Diospyros mespiliformes*, *Faidherbia albida* and *Acacia xanthophloea* have very nutritious and palatable leaves (Venter and Venter 1996). Most of the browse in these trees is unavailable to the game species of Sango Ranch but some of it is available in the >2 to 5 m height class (Tables 47 and 48). *Diospyros mespiliformes* is semi-deciduous to deciduous and is therefore an important dry season browse species (Venter and Venter 1996).

## CONCLUSION

Data on browse from the savanna areas of southern Africa are generally similar to those obtained for Sango Ranch (Kelly and Walker 1976; Dayton 1978; Scholes 1987; Pauw 1988; Smith 1992; Van Heerden 1992; Swart 1995; Brown 1997; Cauldwell 1998). Sango Ranch has a large amount of palatable browse material, but most of it is out of reach of its browsing herbivores. Only 6.2 % of all the palatable browse material is available to browsers. However, by pushing over and breaking trees the elephant places some of this browse material within the reach of the smaller animals (Skinner and Smithers 1990). Elephants are therefore important in the ecology of Sango Ranch, provided their numbers do not exceed the ecological capacity of the ranch.