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QUANTIFICATION OF BROWSE IN RANGELANDS

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ABSTRACT: *A study was conducted in the rangelands of three selected villages of Mupfurudzi resettlement area in Zimbabwe. The objective of the study was to quantify the browse in the resettlement area rangelands by calculating the total potential browsable units. The rangeland in each village were delineated by physiognomic cover type strata namely a vlei, a tree bush savanna, a bush savanna depending on the vegetation type. Within each village, a belt transect measuring 100m long and 2m wide was laid at random to further divide the rangeland into manageable units which are representative of the whole veld type. Within each transect the following dimensions were measured on all woody plant species by visual estimation: (a) the veld type unit where the transect was laid (b) the transect number (c) the plant species (d) the plant height from the ground (e) the height of the canopy bottom from ground level (f) the canopy radius and (g) palatability of the plant species. It was found that veld type unit had a significant effect on browse units (P< 0.05). The effect of village on the browse unit was not significant but however, the effect of the interaction between village and veld type unit was significant (P< 0.05). Browse units in veld type units showed that the bush savanna was significantly different from the vlei. The average browse units in all the selected villages of Mupfurudzi were 1324 browse units/hectare of land.*

Keywords: *Browse palatability, Physiognomic cover type, Veld type unit*

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INTRODUCTION

Browse is the portion of woody plants that is available for animal consumption (Holecheck et al., 1989) it can also be defined as that part of leaf and current twig growth of shrubs woody vine and trees available for animal consumption (Anderson, 1991). Browse is highly regarded for its relatively minimal seasonal variation in both quality and quantity. In contrast to grasses, browse species such as *Acacia spp*, *combretum spp* and *Albhiza spp* have no seasonal change in digestibility (Wilson and Mulham 1978).

Browse species are particularly important in rangelands that experience low and erratic rainfall because they have deep penetrating roots that make use of water deep down the soil profile (Holecheck et al., 1989). Browse is an important part of rangelands as a feed resource because it provides forage all year round, even in drought years. Not all shrubs are desirable as forage for animals since some of them contain some condensed tannins and other anti-nutritional factors that make the undesirable to some animal species (Sharpe and Bergstron, 1986).

The most desirable are legumes because they have the ability to fix nitrogen and provide a high protein feed as well as improve on soil fertility, examples are *leucaena lecocephala* and *Gauca benth* (Pamo and Pieper, 2000). Fabregues (2003) noted that range ecologists do not put into consideration the contribution of browse to rangeland nutrition when estimating carrying capacities and stocking rates because the quantitative nature of the browse component is practically unknown and difficult to measure.

This study explores a method of quantifying browse to enable the more accurate estimation of carrying capacities and stocking rates. Information herein is key to agricultural extension workers and land use planners as a guide to rangeland management strategies and stocking rates recommendations. The objective of this research was to quantify the browse in the Mupfurudzi resettlement area rangelands as the total potential browsable units. In this study it was hypothesized that the total potential browse units are the same for all physiognomic cover classes in selected villages.

MATERIAL AND METHODS

The study was carried out in the Mupfurudzi resettlement scheme in the Shamva district in Mashonaland central province of Zimbabwe. Three villages namely Tongogara, Takawira and Mukwari were chosen and the rangelands in the villages were delineated into physiognomic cover types depending on the dominant vegetation types in an earlier study by Chinuwo (2002). The following veld type units were adopted: (a) Tree Bush Savanna (b)

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Bush savanna and (c) vlei. A veld type unit is defined as a portion of the rangeland that has uniform vegetation agricultural uses (Ivy, 1991).

Stratification

The rangelands in each village where delineated in to three strata according to the vegetation type in an earlier study by Chinuwo (2002). Each village had a vlei, a tree bush savanna and a bush savanna. Within each village, a belt transect which measures 100m long and 2m wide was used to further divide the range into manageable units which are representative of the whole veld type. The belt transect were laid at random but avoiding places such as water points and road to avoid having inaccurate results.

Laying the transect

Within a chosen veld type unit of a village of choice a physical feature usually a tree was selected and marked (a person remained standing by the tree) to be a starting point at random. Another person then moved a hundred meters by estimation in an assumed strait line to another point, a tree if possible or just stands at a point assumed to be the 100m point from the starting point. The recorder then took records along the transect covering the area within a 1m distance at right angles to the hundred meters. A minimum of two transects and a maximum of four transects were laid in each veld type unit. The number of transects laid in a veld type unit depended on the size of the veld type unit, the bigger the veld type unit the more the number of transects laid in the veld type unit. This procedure was done in all the veld type units in all the village rangelands.

The records

Within each transect the following dimensions were recorded on all woody plant species: (a) the veld type unit where transect is laid. (b) The transect number. (c) The plant species. (d) The plant height from the ground. (e) The height of canopy bottom from ground level. (f) The canopy radius and (g) Palatability of the Tree .All the distances were measured by visual estimation

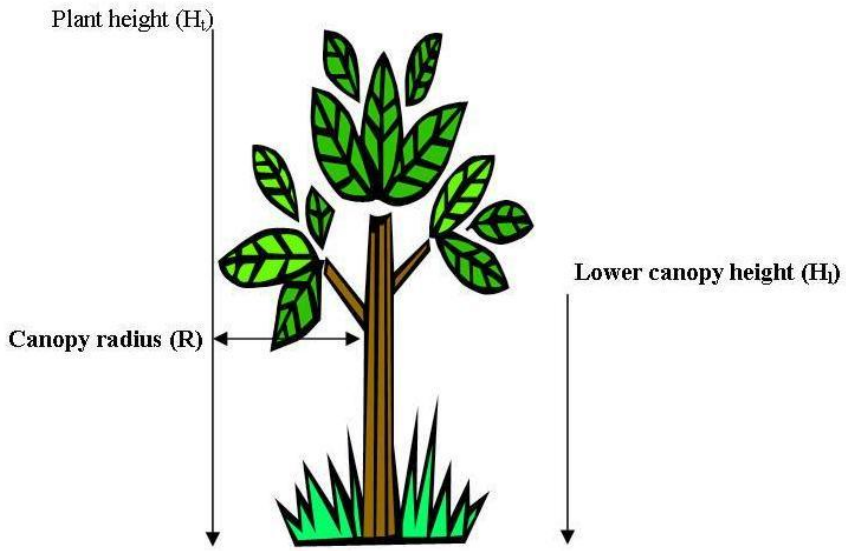

Figure 1 - Shows the dimensions used in the data collection.

Browse units

Browse units are the units used to quantify the forage from palatable woody biomass that is within 1.5 m vertical distance from the ground using the goat as the standard browse animal (Smith and Hardy, 1991; Ivy, 1991). The following steps where followed in calculation of browse units:

Calculation of the mean canopy radius, total canopy volume and browse volume

$RAD = (H_t - H_l) / 2$ where RAD is the mean canopy radius and is given in meters, H_t is the plant height in meters from ground level, H_l is the lower canopy height also in meters (Smith and Hardy, 1991).

$Vol = 4/3 * \prod * RAD^3$ where Vol is the total canopy volume and is given in m^3, $\prod$ is a constant value whose real value is 22/7.If the plant height was less than 1.5 m it means that the whole canopy was available for consumption by the animal as browse and was considered as available browse (Smith and Hardy, 1991).

If the 1.5 meter upper browse height was less than or equal to the mid canopy height of the plant in question the formula below gave the portion of the canopy that was available to the standard browse animal (Smith and Hardy, 1991). $Bv = (\prod * h^2/3) * (3RAD - h)$ where h is $1.5 - H_l$ and is given in metres, 1.5 browse height of the goat which is the standard browse animal. If the 1.5m upper browse height was more than the mid canopy volume then

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the Bv gave the un-browsable volume .In this case the Bv was subtracted from the total canopy volume (Vol.) to get the actual browse volume. The mid canopy level was calculated as follows $H_l + (H_t + H_l)/2$ (Smith and Hardy 1991).

Calculation of browse units

To get the browse volume the value for available browse (Bv) was divided by $0.5m^3$.The value $0.5m^3$ is the average canopy volume of an *Acacia karroo* plant that is 1.5 meters high (Smith and Hardy, 1991).

Statistical analyses

$Y_{ij} = \mu + \beta_i + v_i + \beta_i * v_j + \varepsilon_{ij}$

Where Y_{ij}= browse units, μ = the overall mean, β_i = effect of veld type unit (VTU), v_i = effect of village, $\beta_i * v_j$ = the effect of the interaction between veld type unit and village and ε_{ij} = error. The data were computed as means for a Veld type unit and was compared within villages as least square means (Ls means) in Statistical Analyses system (SAS 1996).

RESULTS AND DISCUSSION

There was no significant difference in the Browse units among villages but the Takawira bush savanna was significantly different from the all the other villages. This was seen when the interaction between veld type unit and village was tested for and they are shown in table 2 below:

Veld type unit had a significant effect on browse units, the Pr.>F value was 0.0109.The effect of village on the browse units was not significant but however, the effect of the interaction between village and veld type unit was significant with a Pr>F value of 0.0232. Tukey studentized Range (HSD) test showed that the bush savanna was significantly different from the vlei. The average browse Units in all the selected villages of Mupfurudzi was $1324.3m^3$/hectare of land

Table 1 - Least square means for browse units /hectare in three villages and within three veld type units.

Village	TBS	BS	VLEI
Mukwari	85.67	1652.34	87.20
Takawira	573.05	6356.77	116.03
Tongogara	2499.97	1066.86	710.27

The physiognomic cover types tree bush savanna, and bush savanna are abbreviated as TBS and BS respectively

Table 2 - Pr>F values for the comparison between the Takawira bush savanna and other villages

Village	TBS	BS	VLEI
Mukwari	0.0004	0.0045	0.0004
Takawira	0.0025		0.0015
Tongogara	0.0162	0.0018	0.0034

The physiognomic cover types tree bush savanna, and bush savanna are abbreviated as TBS and BS respectively.

The village range lands where delineated into plant communities using the dominant tree species by Chinuwo (2002). The bush savanna (BS) is a physiognomic cover mainly comprised of trees and shrubs and bushes but the most dominant plants were the young trees, shrubs and bushes and coppicing stumps. These provided browse for animals as most of them were within the 1.5 m browse height using the goat as the standard browse animal (Smith and Hardy, 1991). Apart from the short vegetation cover in the bush savanna, the plant community was dominated by plant species, which are known to be preferred by cattle, goats and to some extent donkeys as browse. *Brachystegia boehemi (Mupfuti)* showed the greatest abundance in the bush savanna. According to Pooley (1999) *Brachystegia boehemi* is palatable and is an important browse resource in the bush savanna.

The tree bush savanna was classified relative to the bush savanna as having more of tall trees than the bushes and shrubs (Chinuwo, 2002). Well-grown tall trees that can grow up to as tall as 19 m and the lower canopy height averaging1.7m dominate the physiognomic class. The vegetation type was similar to the bush savanna in terms of abundance. The main difference was that the bush savanna had more of the short plants which were reachable for animal consumption as browse whereas the majority of the plants in the tree bush savanna were out of reach of browse animals if the goat is use as the standard browse animal.

A vlei is a wetland, where the water table is naturally situated closer to the ground (Bannister and Struik, 1983). This may be due to the parent material which is proximal to the ground may be impermeable to water. Vleis were mostly dominated by unpalatable tree species and as a result the browse units found in veld type unit was low relative to the others. The most dominant tree species wire the *Syzgium cordatum* and *Ficus cycomorus, which* are known to be unpalatable to most domestic animals (Van Wyk and Van Wyk, 1997).

The vlei had the least average browse units per unit hectare, this was partly due to the fact that most of the trees found there were not palatable. Some of the trees were too tall to be available to animals as browse since they normally have an unlimited water supply. The vlei consisted of mainly grass that further develops into a lawn with moribund tufts, which gave a lot of mulch on the ground. This high density of mulch and moribund tufts inhibits

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tree seed germination and establishment since the conditions are unfavorable for both processes (Ivy, 1991; Holechec Pieper and Herbel, 1989). It is also known that most trees do not grow weld and establish in the damp and in adequately drained soils (Van Wyk and Van Wyk, 1997). This nature of vleis gives a reason why there was a significant difference in the browse units between the vleis and the bush savannas.

Before the resettlement in the pre independence period, the whole area of Mupfurudzi rangelands was part of a vast tract of land which was most probably managed in the same way and resulted in more less the same vegetation patterns. The similar vegetation patterns explain why the villages showed no significant effect on browse units per hectare of the range. Among the villages the range lands were accurately delineated into the three physiognomic cover types by Chinuwo (2002), because of this reason the different vegetation types and the inherent land uses resulted into the differences in the browse units among the different veld type units and as a result the effect of the veld type unit on browse units was significant.

Depending on the nature of resources in different portions of the rangelands, different potions are subject to deferent management practices. The management practice also depends on the kind of benefits derived from the different portions of the rangelands for example, some villagers resort to gold panning and other activities such as brick molding depending on the nature of soil resources. This may be the reason why the effect of the interaction between village and Veld type unit had a significant effect on the browse units per unit hectare o the rangelands.

The diversity in the palatability of trees is affected by the nature of the soil (Melina, 1986). According to Chirara (2001) the soil nutrient composition affects the soil type and plants that grow on poor soils are generally less palatable and are of limited use as browse. Walter's two layer hypothesis (Chirara, 2001) stares that in any given climate three should be characteristic tree- grass ratio where by those soils with a high water holding capacity favor grass growth. Different village veld type units had different kinds of soils with the vleis heaving the heavy types, this also explains why the effect of the interaction between village and veld type unit on browse units was significant.

According to knowledge gathered during the research, new lands were being opened up with time for agronomic uses as some farmers abandoned old fields in pursuit of more fertile virgin lands. The old abandoned fields through time were colonized by plant communities and eventually turned into rangelands, such kinds of range lands gave more browse due to the relative abundance of small shrubs and bushes.

CONCLUSION

In Mupfurudzi resettlement area rangelands the average browse is 1324m^3 of browse per hectare of land in selected villages. Browse production is not the same in different veld type unit sand also that village rangelands were managed in the same way since the effect of village was not significant. Bush savannas produced the more browse and the vleis produce the least browse.

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