Species Composition and Biomass Production in Two Communal Coastal Rangelands of the Eastern Cape Province, South Africa

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Abstract

This study investigated species composition and biomass production of herbaceous plants in two communal rangelands surrounding homesteads areas. In each study area, the rangelands were divided based on the distance from homesteads into near (up to 1 km), middle (> 1–2 km) and far (> 2–3 km) sites. On each site a HVU of 50 m x 20 m was used and six 0.25 m2 quadrants were laid randomly on each HVU. Herbaceous species found within a quadrant were identified, counted and their height and tuft were measured. Herbaceous species were also harvested, bulked and placed into well labelled brown paper bags and oven-dried for 48 hours at 60 oC to determine biomass production. Herbaceous species were also classified according to their palatability ecological status and life form. Data were collected for two seasons over 2014/15 (winter and summer). A total of 20 herbaceous species were identified in the study areas. Of these 17 were grass species. The most common or dominant grass species were T. triandra, C. dactylon, E. capensis, E. plana and S. africanus. At Dyamdyam T. triandra showed the greatest frequency of occurrence at far site than middle and near homesteads sites. The frequency occurrence of S. africanus at Machibi was relatively similar in all the study sites. Density of herbaceous species was significantly lowest on near and bottom sites at Dyamdyam and Machibi, respectively. In both winter and summer, grazing site far and top from homestead had greatest ($P < 0.05$) biomass production at Dyamdyam and Machibi respectively. The biomass production was significantly highest in the summer than the winter across the study sites in both study areas. It can be concluded that composition of herbaceous species and biomass production are significantly dependent on distance and topography from homesteads and seasons. Therefore, any rangeland management practices in communal grazing lands should consider these factors in to consideration during the planning of development progress.

Keywords

Distance Gradient, Livestock, Topography, Summer, Soil, Vegetation, Winter

1. Introduction

Communal rangelands are used mainly as sources of forage for livestock and collection of wood for fire and building (Everson & Hatch, 1999). These rangelands have different species composition and biomass productions (Oztas et al., 2003). Species composition and biomass production on communal rangeland vary according to grazing system (Shackleton, 1993), seasonal variation (Angasa & Oba, 2010), soil type (O' Farrell et al., 2007), topography (Lesoli, 2008) and grazing intensity (Smet & Ward, 2003; Maki et al., 2007).

Species composition is defined as the relative frequency of occurrence of heterogeneous herbaceous species in a rangeland (Trollope et al., 1990). In addition, it is one of the factors that indicate the rangeland condition because herbaceous species differ significantly in their acceptability, ecological status, life form and response to grazing (Abule et al., 2007). It has been reported that, high grazing pressure on natural rangelands causes changes in species composition (Maki et al., 2007). Decreaser species disappear in response to heavy grazing and are replaced by increaser and invader species that are less palatable and adapted to withstand over utilization (Sisay & Baars, 2002). Most rangelands in communal areas of South Africa are continuously grazed due to the absence of fence and this affects distribution of herbaceous species (Shackleton, 1993). In addition, high grazing intensity can alter vegetation from being dominated by perennial species to being dominated by annual species due to the high stocking rate on grazing lands (Smet & Ward, 2003). Other researchersat species composition change is determined more by rainfall rather than by grazing pressure. In summer there is more rainfall that promotes height, diameter and basal cover of grass species.

Biomass production is a total dry matter of living material which is actively and structurally functional in a given area and is normally used as source of energy for livestock and for fuel (Bond-Lamberty et al., 2002). According to Angasa & Oba (2010), biomass production during the dry season is lower than during the wet season. This is allied with high amount of rainfall and availability of moisture during wet season than dry season (Angasa & Oba, 2010). The part of rangelands that is heavily grazed for long period of time has lower biomass production (Shackleton, 1993). In addition, biomass production in silt and clay soil is higher than in sandy soil due to the high organic matter and minerals in clay and silt soils than sandy soils (O' Farrell et al., 2007).

Landscape positions have significant effects on the biomass production with several reports showing bottomlands having higher biomass production than slope and top lands (Coronato & Bertiller, 1996; Lesoli, 2008). In contrast, other researchers reported bottomlands have lower biomass due to the presence of heavy grazing pressure because of easily access by livestock than the plants found on top lands (Senft et al., 1985; Belsky & Blumenthal, 1997; Lesoli, 2008). Studies that are conducted on communal coastal rangelands of South Africa to investigate the change in species composition and biomass production along the gradient distance from homestead are limited. There is also no information regarding the seasonal variations in the above variables along distance gradient from homesteads. The availability of such information would contribute towards of planning management and rehabilitation programs in the communal rangelands to improve fodder production for livestock. Therefore, the objectives of this study were 1) to assess herbaceous species distribution and biomass production along distance gradient from homesteads in two communal rangelands, 2) to investigate the effects of season on biomass production and species distribution.

2. Methods and Materials

2.1. Selection of Study Sites and Layout

Two long transect radiating away from the homesteads in each communal area was established and divided into three main grazing sites. The transects were established in the directions of the main grazing activities. Dyamdyam is situated on relatively plain land and; hence the rangeland was simply divided according to the distance from homesteads into near (up to 1 km), middle (> 1–2 km) and far (> 2–3 km) sites. Machibi is set on a gentle steep slope, and therefore three grazing sites were identified to represent the bottom (near), slope (middle) and top (far) sites from homestead. On each study site a HVU of 20 m x 50 m was marked to record vegetation data from six 0.25 m^2 quadrants that were laid randomly.

2.2. Data Collection

Data on herbaceous species composition, tuft diameter, height, density and biomass were collected from two different directions where the livestock are grazing in each study area. In each 0.25 m^2 quadrants herbaceous species found within a quadrant were identified, counted and recorded. Height and tuft diameter of herbaceous species were measured using 30 cm ruler and recorded. Total density was obtained by adding all the herbaceous species found in each site. Density for each herbaceous species found in study areas were then calculated as the percentage to obtain the frequency of occurrence of each herbaceous species. Herbaceous species found within a quadrant were harvested, bulked and placed into well label brown paper bags. Harvested herbaceous samples were then oven-dried for 24 hours at 60 ^oC. Dried grass samples were weighed to determine dry matter (DM) production. Data was collected in winter and summer in 2014 and 2015.

2.3. Species Classification

Classification of herbaceous species was based on the succession theory described by Dyksterhuis (1994) and on the ecological information for the arid to semi-arid region of South Africa (Vorster, 1982). Herbaceous species were classified according to their ecological status and response to grazing such as: (i) highly palatable: those species occur in rangeland that is in good condition and decrease with heavy grazing (decreaser species); (ii) palatable species: those species occur in rangeland in good and increase with moderate overgrazing (increaser IIa); (iii) less palatable species: those species which occur in rangeland in good condition and increase with high overgrazing (increaser IIb and IIc) and (iv) poorly palatable: those species which occur in rangeland in poor condition and increase with extreme overgrazing (invaders).

Herbaceous species were also grouped according to their life form as annual and perennial (Van Oudtshoon, 1992). Grasses were further identified to species level, while other herbaceous plants belonging to other families were categorised as forbs, sedges and Karoo species.

2.4. Statistical Analyses

Data on biomass and species composition were analysed using General Linear Model (GLM) procedure of SAS (2010). Mean separation was done using PDIFF option of SAS (2010). Data analyses for two study areas were done separately because they had different landscape, geology, altitude and vegetation types. Descriptive statistics such as percentage and means were used where applicable. Species composition, biomass, density and height of herbaceous species show significant interaction between site and seasons in both study areas.

3. Results

3.1. Ecological Status, Life Form, Palatability and Frequency of Occurrence of Herbaceous Species

A total of 20 herbaceous species were identified in the study areas. Three of the identified herbaceous species were categorized as forb, sedge, and Karroo species whereas 17 were grasses. In terms of their life form, all the identified herbaceous species were perennial (Table 1). In terms of their palatability, 6 herbaceous species were highly palatable, 1 was moderately palatable and 13 were low palatable. According to their ecological index, 4 grass species were classified as Decreaser species, 4 Increaser I, 9 Increaser II, 2 Increaser III and 1 invader species (Table 1). Of the total grass species identified, 5 grass species were classified as most common or dominant grass species over the study sites (Table 1). These include *T. triandra, C. dactylon, E. capensis, E. plana* and *S. africanus.* One of the common or dominant species was highly desired by livestock (*T. triandra*).

3.2. Common or dominant species

Common or dominant grass species in this study are defined as those species recorded along the distance gradient from homesteads in each study area and had >15 % (dominant) and >10 %– 15 % (common) frequency occurrence at least in one of the study sites. Results for frequency of occurrence of common or dominant grass species identified at Dyamdyam rangeland are presented in Figure 1. At Dyamdyam frequency occurrence of *T. triandra* was significantly higher on far site than middle and near sites. Along the distance gradient from homestead *C. dactylon* had the greatest occurrence on middle site followed by the far and near sites. The frequency occurrence *E. plana* was relatively similar on middle and far sites however were higher than near site. The proportion occurrence of *S. africanus* was significantly higher on far site followed by the middle and near sites.

Results for frequency occurrence of common or dominant grass species identified at Machibi rangeland are presented in Figure 2. At Machibi the frequency occurrence of *T. triandra* was significantly highest on slope site followed by the top and bottom sites. Along the landscape from homestead *E. plana* had greatest proportion occurrence on top site than slope and bottom sites. On bottom and top sites, the frequency occurrence of *C. dactylon* was greatest and lowest on slope site. Frequency occurrence of *S. africanus* has similar values on slope and top sites but was higher than bottom site.

3.3. Biomass production of herbaceous species

In winter, far grazing site from homesteads at Dyamdyam had the greatest ($P < 0.05$) biomass production followed by middle and near sites. In summer, far and middle grazing sites had higher biomass production than near site (Table 2). In winter, top grazing site at Machibi had highest (P <0.05) biomass production followed by midslope and bottom sites. In summer, top and midslope grazing sites had higher biomass production than bottom site. Biomass production in all the study sites was significantly different between winter and summer season except for far and top sites at Dyamdyam and Machibi respectively (Table 2).

Table 1: Ecological status, life form, palatability and frequency occurrence of herbaceous species identified in the study areas.

				Dyamdyam			**Machibi**		
Grass species	ES	LF	Pa	Near	Middle	Far	Bottom	Slope	Top
Themeda triandra	De	P	HP	LC	LC	C	C	D	D
Cynodon dactylon	Inc II	P	HP	LC	D	C	C	LC	C
Eragrostis plana	Inc II	P	LP	LC	C	C	LC	LC	D
Sporobolus africanus	IncII	P	LP	LC	C	D	C	C	C
Tristachya leacothrix	Inc I	P	LP	LC	LC	LC			
Elulia vilosa	Inc I	P	LP	R	LC	LC			
Hyperrhenia hirta	IncI	P	LP	R	+	+			
Digitaria eriantha	De	P	HP				R	R	D
Paspalum dilatatum	Inv	P	LP	LC	R	R	R	R	R
Setaria megaphylla	De	P	HP	LC	R	R	R	R	LC
Brachiaria serrate	De	P	HP	LC	R	R	R	R	R
Cymbopogon excavatus	IncI	P	LP	LC	R	R	R	R	R
Sedges	IncIII	P	LP	R	R	R			
Forbs	IncII	P	LP	R	LC	R	R	R	LC
Karroo	IncII	P	LP	R	R	R	LC	R	R

ES= ecological status, LF= life form, Pa= palatability, De= decreaser, IncI= increaser I, IncII= increaser II, Inc III= increaser III, Inv= invader, P= perennial, HP= high palatable, MP= moderate palatable, LP= low palatable, D= dominant (>15 %), C= common (10 %-15 %), LC=less common (5 %-10 %), R= rear (1 %-5 %) + = present (<1 %) and – = absence

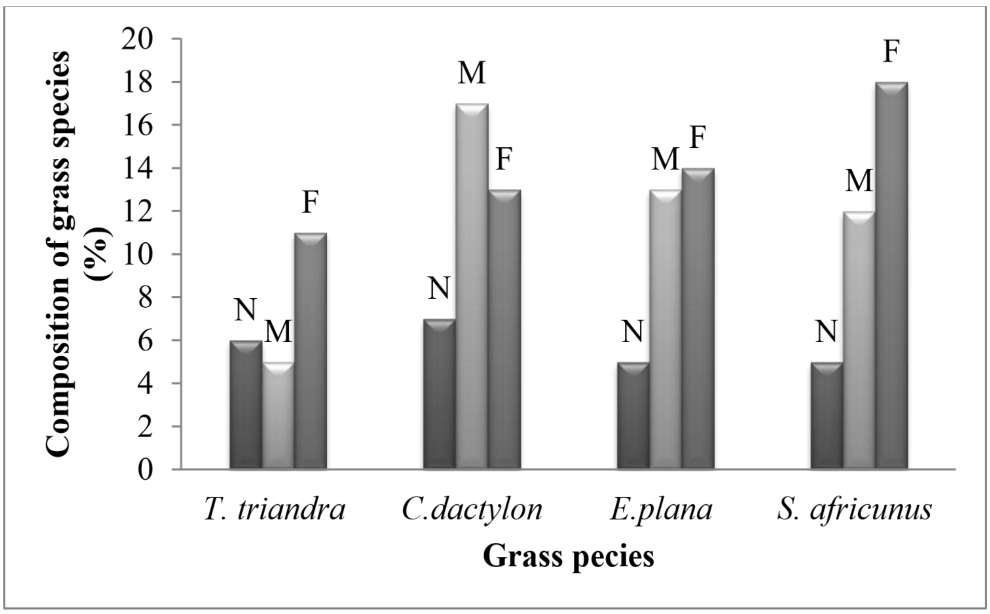

Figure: 1: Species composition (%) of common or dominant grasses based on frequency of occurrence at Dyamdyam. N= near, M= middle and F= far

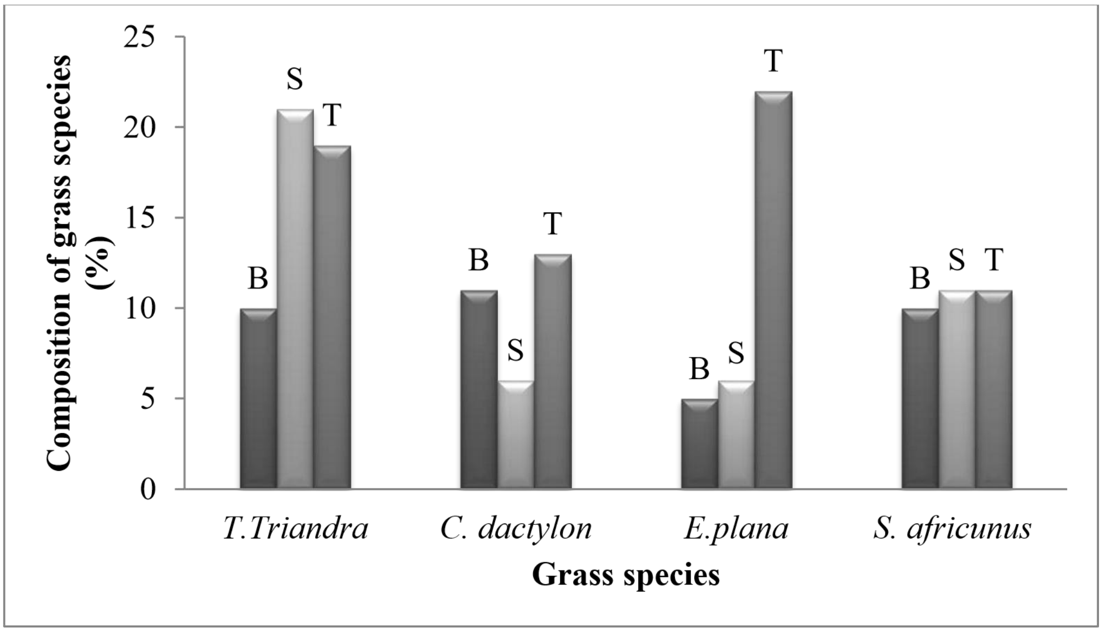

Figure: 2: Species composition (%) of common or dominant grasses based on frequency of occurrence at Machibi. B= bottom, S= slope and T= top

Table 2: Mean biomass production (kg ha^{-1}) of herbaceous species harvested from study areas.

Areas/Sites	Biomass	Biomass
Dyamdyam	Winter	Summer
Near	715.5^{Cb}	1015.0^{Ba}
Middle	1042.1^{Bb}	1127.5^{Aa}
Far	1106.3^{Aa}	1113.0^{Aa}
SE	67.5	67.5
Machibi		
Bottom	405.9^{Cb}	669.6^{Ba}
Slope	780.4^{Bb}	857.8^{Aa}
Top	809.1^{Aa}	840.4^{Aa}
SE	79.6	79.6

Lowercase superscripts are used to compare means between seasons within each site. ^{ABC}Uppercase superscripts are used to compare site averages within each season. Means with different superscript within the columns and rows are significantly different ($P < 0.05$).

3.4. Height and tuft diameter of common or dominant species

The results for plant height and tuft diameter of common or dominant grass species are presented in Table 3 and 4 respectively. The plant height and tuft diameter were significantly different across the study sites in some common or dominant grass species, while in other species they were not significantly different between the study sites. *Themeda triandra* at Dyamdyam had the highest ($P < 0.05$) height in middle site followed by the far and near sites. Highest plant height for *C. dactylon* and *E. plana* at Dyamdyam was recorded in far site. Plant height of *S. africunus* was highest ($P < 0.05$) in middle site followed by the near and far sites.

At Machibi plant height of *T. triandra* was highest ($P < 0.05$) in the slope and top sites than the bottom site. Plant height of *E. plana* was significantly highest in slope site followed by bottom and top sites. Plant height of *S. africanus* was significantly highest in top site followed by slope and bottom sites. Plant height of *C dactylon* was highest ($P < 0.05$) on samples collected from top site followed by bottom and slope sites.

Table 3: Mean height (cm) of common grass species found in study areas

	Dyamdy am				Machibi			
Grass species	Near	Middle	Far	SE	Bottom Slope		Top	SE
T. triandra	11^{c}	18^{a}	12^{b}	2.3	9.0^{b}	11^{a}	11^{a}	2.0
C. dactylon	13^{c}	15^{b}	17^{a}	2.3	12^{b}	9.3^{c}	14^{a}	4.0
E. plana	14^{c}	15^{b}	20^{a}	2.3	11^{b}	13^{a}	9.0^{c}	2.1
S. africanus	13^{b}	20^{a}	11^{c}	2.3	9.0^{b}	9.2^{b}	11^{a}	1.9

^{abc}Different superscripts for each species in a row denote significant differences at $p < 0.05$ between different distances and landscape. SE= Standard Error

At Dyamdyam tufts diameters of *T. triandra* and *E. plana* were not significantly different (P> 0.05) between the sites. Tuft diameter of *C. dactlyon* was slightly highest on near site than middle and far sites. For *S. africunas* tuft diameter was not significant different (P> 0.05) across the study sites. At Machibi tuft diameter of *T. triandra* and *C. dactylon* were not significantly differ (P> 0.05) between slope and top sites however it was slightly highest on bottom sites. For *S. africunus* tuft diameter was not significantly different (P > 0.05) between bottom and slope sites. Tufts diameter of *E. plana* was not significantly different (P > 0.05) between all the study sites.

Table 4: Mean tufts diameter (cm) of common grass species found in study areas

	Dyamdyam				Machibi			
Grass species	Near	Middle	Far	SE	Bottom	Slope	Top	SE
T. triandra	2.1^{a}	2.3^{a}	2.0^{a}	0.3	3.0^{a}	2.0^{b}	2.4^{b}	0.4
C. dactylon	3.0^{a}	2.3^{b}	2.4^{b}	0.4	3.4^{a}	2.1^{b}	2.0^{b}	0.7
E. plana	3.0^{a}	3.4^{a}	3.0^{a}	0.3	2.0^{a}	2.0^{a}	2.2^{a}	0.3
S. africanus	3.1^{a}	4.0^{a}	3.0^{a}	0.7	2.2^{a}	1.2^{b}	2.0^{a}	0.5

^{abc}Different superscripts for each species in a row denote significant differences at $p < 0.05$ between different distances and landscape. SE= Standard Error

3.5. Total density of herbaceous species

The results for total mean density of herbaceous species identified in study areas are presented in (Table 5). Both in summer and winter at Dyamdyam total mean density was highest (P <0.05) in far site followed by middle and near. Similarly, at Machibi the total density of herbaceous species was significantly highest in top site followed by slope and bottom in winter and summer. Total density of herbaceous species was highest (P <0.05) in summer than winter across the study sites in both study areas.

Table 5: Mean density (m^{-2}) of herbaceous species identified in two study areas.

Areas/Sites	Total Density	Total Density
Dyamdyam	Winter	Summer
Near	30^{Cb}	43^{Ca}
Middle	51^{Bb}	63^{Ba}
Far	67^{Ab}	74^{Aa}
SE	1.9	1.9
Machibi		
Bottom	33^{Cb}	50^{Ca}
Slope	57^{Bb}	65^{Ba}
Top	66^{Ab}	72^{Aa}
SE	2.2	2.2

^{abc}Lowercase superscripts are used to compare means between seasons within each site. ^{ABC}Uppercase superscripts are used to compare site averages within each season. Means with different superscript within the columns and rows are significantly different (P < 0.05).

4. Discussion

4.1. Ecological Status, Life Form and Palatability of Herbaceous Species

In the present study herbaceous species in the study areas were dominated more by increaser and less palatable species. Many studies conducted elsewhere in Africa reported similar findings (Danckwerts, 2001; Sisay & Baars, 2002; Hayes & Holl, 2003; Hein, 2006; Gemedo-Dalle *et al*., 2006; Morris & Kotze, 2006; Anderson & Hoffman, 2006; Solomon *et al.,* 2007). These findings could be an indication that communal rangelands are overgrazed (Shackleton, 1993) because palatable and decreaser species decline in numbers when the rangeland is over or selectively grazed and replaced by increaser and less palatable species (Sisay & Baars, 2002). The present study also showed that study sites were dominated by perennial species. Similar results were reported by Morris & Kotze (2006). Ruminants can alter vegetation from being dominated by annual species to being dominated by perennials species due to the high stocking rate on communal grazing lands (Smet & Ward, 2003).

4.2. Composition of Common or Dominant Grass Species

Common or dominant grass species identified in the present study were similar to species recorded in the previous study conducted in the Eastern Cape Province of South Africa (Lesoli, 2008), however, they were different in their frequency of occurrence. As observed in the results of this study, it is clear that the proportion of occurrence of highly palatable species (*T. triandra*) is relatively low on near and bottom sites at Dyamdyam and Machibi, respectively. These findings suggested that these sites were selectively grazed or overgrazed. This is because palatable grass species are very much under pressure from selective grazing and over utilization and are the first species that are removed under heavily grazed rangelands. This view is supported by Quattrocchi (2006) who reported that, *T. triandra* is an indicator of a good rangeland condition and it quickly disappears in part of rangeland where overgrazing and selective grazing occurs. In addition, *T. triandra* is growing well and most commonly occurs in undisturbed open grasslands with an optimum amount of rainfall. *Cynodon dactylon* was found to be slightly higher on bottom and near sites than other sites. This indicates that bottom and near sites were heavily grazed because *C. dactylon* is the dominant key species in rangeland that is heavily grazed (Van Oudtshoorn, 1992). In addition, *C. dactylon* is the perennial grass that grows well in all types of soil, more especial in sandy soil and disturbed areas (Xu *et al.*, 2011). Frequency of occurrence of *E. plana* and *S. africanus* were relatively low on near and bottom sites compared to other grazing sites. However, these species were expected to be high on these sites because they grow well in disturbed soil such as trampled part of rangeland by livestock as well as near the homestead, roads and drinking areas (Van Oudtshoon, 2012).

4.3. Biomass Production

The current study showed that mean biomass production in all the study sites was higher in summer than in winter. High biomass production in summer could partly be explained by high rainfall and optimum temperature that promote tropical and subtropical vegetation growth. These results concur with the reports of Noellemeyer *et al.* (2006) in semi-arid areas of Argentina and as above Angasa & Oba (2010) in southern Ethiopia, who observed seasonal variation in biomass production. This was however not in agreement with the study of McDonald *et al.* (1987) who did not find any seasonal variation in biomass production.

Biomass production at Dyamdyam was low on near site from homesteads than the other sites. The present results correspond with earlier findings by Savadogo *et al.* (2007) in the savanna woodlands of Burkina Faso. This can be explained by the fact that near site was heavily grazed due to easy access by ruminants and availability of the drinking areas. Energy requirement of ruminants is different depending on the distance which livestock walk. Therefore, this might lead to declined movement of livestock which in turn would result in high density of livestock on easily accessible grazing sites (Bailey *et al.,* 1996).

In the current study biomass production at Machibi was higher on top and slope sites than bottom sites. Similar results were reported by Senft *et al*. (1985) and Lesoli (2008) in communal grazing lands of South Africa. This indicates that livestock spend most of the time grazing in bottom lands due to easy access. For grazing sites found on heterogeneous landscape, animal grazing distribution pattern might be impacted by variations in landscape

(Lesoli, 2008). However, the bottom site in the present study was expected to have high biomass production than slope and top positions due to the high accumulation of nutrients on bottomlands (Coronato & Bertiller, 1996) because nutrients promote plant activities.

4.4. Height and diameter of common or dominant grasses

In the current study all common or dominant grass species, except *S. africanus* at Dyamdyam, had the highest mean height in the middle and far sites rather than the near site. As discussed previously near site had been grazed more intensively than other sites. Therefore, this may cause a short grass height on this site due to high grazing pressure. At Machibi all the common or dominant grass species, except *C. dactylon*, had the highest height on top and slope sites than the bottom site. This is associated with physical damage caused by ruminants. *Cynodon dactylon* had highest height on bottomland than slope. This confirms the fact that *C. dactylon* grow well in overgrazed and disturbed areas (Van Oudtshoorn, 1992) and is common in sandy soil (Xu *et al.*, 2011).

Plant height of *S. africanus, T. triandra* and *E. plana* across the study sites and in both study areas was below the maximum growth range of 28–150 cm, 30–150 cm and 40–100 cm respectively suggested by Van Outshoorn (2012). Plant height of *C. dactylon* across the study and in both study areas was within the maximum growth range of 5–40 cm reported by Van Outshoorn (2012).

This study showed that average tuft diameters of *T. triandra* and *E. plana* at Dyamdyam were not significantly different amongst all the sites. This indicates that a tuft diameter of these species in the present study did not influenced by distance from homestead. However, the difference was expected due to differences in grazing intensity and accumulation of nutrients along the distance gradient from homesteads.

In the current study average tufts diameter of *T. triandra* and *C. dactylon* at Machibi did not show the significant difference between slope and top sites. These results contradict with the report of O' Connor & Pickett (1999) in the semi-arid savannas of East Africa who reported that, there is steady change in grass species along grazing gradients usually characterized by a decline in tuft size. Tufts diameter of *T. triandra* and *C. dactylon* was bigger in bottom site than slope and top sites. This can be attributed to the high accumulation of soil nutrients in the bottomlands (Coronato & Bertiller, 1996) because nutrients promote plant activities. Plant tuft size of *C. dactylon, S. africanus, T. triandra* and *E. plana* across the study sites and in both study areas was below the maximum tuft diameter range of 5–10 cm, 10–14 cm, 5–15 cm and 5–10 cm respectively reported by (Van Outshoorn, 2012).

4.5. Density of herbaceous species

The total mean density of herbaceous species in all the study sites and in both study areas was significantly higher in summer than in winter. Similar results were reported by Bailey *et al.* (1996). This can be attributed by a higher amount of rainfall in summer and the availability of soil nutrients. This is because plant density increases with an increase in rainfall and soil nutrients availability (Ahmad *et al.,* 2007). In the current study, total mean density of herbaceous species strongly influenced by the distance gradient from homesteads. Dyamdyam and Machibi plant density was low on near and bottom sites respectively than other sites in both seasons. Similar results were reported by Senft *et al*. (1985) and Lesoli (2008) in South Africa. High grazing intensity and human activities on bottom and near sites can result in bare patches and veld degradation which in turn results in low density of herbaceous species (Senft *et al*., 1985; Lesoli, 2008). Lower plants density on the near and bottom site could also be partially explained by the fact that small stock such as sheep and goats kraaled during night and released in the morning. This could have an effect on plant density during the livestock movement (Lesoli, 2008).

5. Conclusion

The present study showed that most palatable species such as *T. triandra* had low frequency occurrence in near grazing sites than middle and far sites. The study sites were dominated by *T. triandra, C. dactylon, E. capensis, E. plana* and *S. africanus*. The biomass production was significantly higher in summer than in winter season. Density of herbaceous species was low on near grazing site than middle and far. Therefore, it can be concluded that season landscape and distance from homesteads are the most important factors that affect vegetation change and the composition of herbaceous species. Therefore, any veld condition assessment and rangeland management practices in communal rangelands should take into consideration often these factors. In addition, application of suitable grazing systems in communal grazing areas is recommended to inhibit the declining trend of highly palatable species and biomass production near the homestead to improve fodder production for ruminants.

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