A study of the quality and quantity of the grasses and sedges in relation to large herbivores in the Okavango Delta Botswana

Anouschka Hof

790509-348-070

Tropical Nature Conservation and Vertebrate Ecology Group

A buffalo at a drinking site

Supervisors:

I. M. A. Heitkönig

Tropical Nature Conservation and Vertebrate Ecology Group

Wageningen University

E. Veenendaal

Harry Oppenheimer Okavango Research Center

Maun Botswana

C. Bonyongo

Harry Oppenheimer Okavango Research Center

Maun Botswana

WAGENINGEN UNIVERSITY

ENVIRONMENTAL SCIENCES

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H300-729 Afstudeervak Natuurbeheer Tropen
Wageningen University, Tropical Nature Conservation and Vertebrate Ecology Group.
Bornsesteeg 69, 6708 PD Wageningen, The Netherlands

Supervisors:

I. M. A. Heitkönig
Tropical Nature Conservation and Vertebrate Ecology Group
Wageningen University

E. Veenendaal
Harry Oppenheimer Okavango Research Center
Maun Botswana

C. Bonyongo
Harry Oppenheimer Okavango Research Center
Maun Botswana

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Summary

The nutritional quality, the quality in palatable plant parts (green parts and leaves) and the quantity of the grass and sedge sward of the different habitat types in the Okavango Delta, Botswana was studied. Habitat types included *Mopane* woodland, mixed *Acacia* woodland, grassland, and three zones of floodplain. Furthermore, the distribution of several large herbivores species was studied to establish a possible relation between the quality and quantity of the grass and sedge sward and the distribution of these herbivores.

The habitat selection by herbivores changed from scattered throughout the different habitat types in the flooded season to preference for the grassland and the lower floodplain in the non-flooded season. Although both the quality and the quantity of the grass and sedge sward were in generally highest on the dryland areas, the species composition of grassland but also of floodplains might have been more preferred by the selected herbivore species. Furthermore, the nutritional quality and the percentage of green parts and leaves were high on the grassland. Also the decrease of available amount of drinking water might have attracted the herbivores in the direction of the floodplains, near the water. Therefore, the highest habitat selection by herbivores occurred on the grassland and on the lower floodplain in the non-flooded season.

The herbivore species packing of the study site within the Okavango Delta decreased in the non-flooded season compared to the flooded season. The disappearing water barriers and the decreasing amount of water might have caused this. The herbivore species packing was in the flooded season highest on the main landmass of Chief's Island. When the floods receded, the water barriers between the smaller Crocks Island and Chief's Island disappeared, and herbivore species moved towards Crocks Island. This might have been caused by the fact that the palatability (a high nutritional quality and a high percentage of green parts and leaves) and the quantity of the grass and sedge sward were high on Crocks Island compared to Chief's Island, except for The Mopane Transect within Chief's Island. The species composition might have had an impact on the choice of the herbivores. Furthermore the high concentration of salt in the soil of Lions Island within Chief's Island might have caused the preference for another site.

There was no proof for the idea that animals with a high body mass, mainly graze on sites with vegetation of a high biomass and dry weight. The large bodied animals preferred the higher quality food on the grassland and the lower floodplain, which both consisted of a low quantity. This might be caused by the retreating water. The herbivores might have been attracted to it and therefore were encountered more often on areas near the water. Furthermore, the nutritional quality of the surrounding grass and sedge sward was low compared to the mean nutritional quality of tropical grasses given by literature, although many studies state different mean values.

1. Introduction

Both the quality and the quantity of the available vegetation are important factors for habitat selection by herbivores. For instance the percentage of nutrients such as nitrogen and phosphorus but also the percentage of green parts and leaves of the vegetation are factors that influence habitat selection. Furthermore, the amount of available biomass is important for the presence of herbivores. This can be concluded from studies showing that herbivores as the impala (*Aepyceros melampus*) and the red lechwe (*Kobus leche*) graze the more desirable species in a mixed sward and select the most nutritious parts of plants such as leaves and young stems (a. o. Crowder, 1982, Rees 1978). Furthermore, the available biomass has an effect on the selection by herbivores. Several field observations suggest that many grazing herbivores, such as the impala and the blue wildebeest (*Connochaetes taurinus*), rather graze on low biomass grass patches, which is often of a high quality, than on high biomass patches, even when they are available (Wilmshurst et al., 1999 and Skinner and Smithers 1990). Animals with a high body mass, such as the african elephant (*Loxodonta africana*) and the burchell's zebra (*Equus burchelli*), on the other hand, tend to select the grass species that are available in a high quantity rather than to select for the grass species with a high quality (Skinner and Smithers.1990). The question arises whether the quality and quantity of the grass and sedge sward can have a significant effect on the distribution and density of herbivores in an area like the Okavango Delta, Botswana (map 1). The Okavango Delta is subject to flooding, which has a substantial influence on the available amount of vegetation and number of islands. According to Klop and Van Goethem (2001) flooding can have an impact on the distribution of herbivores.

The species richness and the spatial and temporal variation in the herbivore densities and distribution caused by the flooding in the Okavango Delta was studied by Enthoven (2000) and Klop and Van Goethem (2001). These studies suggested clear seasonal differences in habitat use. However, a clear link between the available vegetation was not studied. The fieldwork period of these studies covered the transition of the flooded to the non-flooded period in the seasonal swamps of the Okavango delta. This offered a great possibility to investigate the spatial and temporal variation in herbivore densities and distribution, in relation to the changes in the quality and the quantity of the grass and sedge sward, influenced by the receding water. My study consisted of:

- Description of the quality and the quantity of the grass and sedge sward along the wet-dry catena in the rainy season during the months of February 2001 till May 2001, Chief's Island, Okavango Delta Botswana.
- The situation, density, habitat selection and species richness of large herbivore species
- The relationship between the situation, density, habitat selection and species richness of large herbivores and the quality and quantity of the palatable grass and sedge sward.

2. Methods

2.1. Study site

The research by Enthoven (2000) and Klop and Van Goethem (2001) covered the period from September 2000 till January 2001. To advance this research, fieldwork has been done according to the methods used by Klop and Van Goethem (2001) in the period from January 2001 till May 2001.

The research area was situated within the Okavango Delta. This is an inland delta which is fed by the Okavango River that spreads, due to the smooth surface, the sandy soil and the minor drop of 16 meters over 200 kilometres, into many streams in the northern part of Botswana. When the dry period is severest, the Delta is extensively flooded. In the rainy season the available amount of water decreases what might cause migration of animals. The Delta exists of more than 1000 islands varying in size from only a few square meters to 100 by 15 kilometres (Chief's Island (map 2)). The vegetation of most islands consists of trees, mainly the mokolwane palm (*Hyphaene petersiana*)**,** the mopane (*Colophospermum mopane*), the baobab (*Adansonia digitata*) and different species of the *Acacia*, of which the dominant species is *Acacia erioloba*. The fauna is extensive. (Else, 1997, Vlugt, 1999)

The research area was located on the largest Island within the Okavango Delta, Chief's Island. The bushcamp of the Harry Oppenheimer Okavango Research Centre (HOORC), from where the research took place, was located in the south western area of Chief's Island (19^{o}32'52" S, 23^{o}10'41" E) in Moremi Game Reserve. The camp was situated along the Boro River, upstream from Nxaraga Lagoon, at an elevation of 948 m. Four sites, which each were homogeneous in species composition and representative for the area, were selected for the analyses of the grass and sedge sward and four transects for the herbivore research (Klop and Van Goethem, 2001). The four sites for the analyses of the grass and sedge sward were located within the four transects for herbivore research. The 'Crocks Island' site within the 'Crocks Island' transect, the 'Lions Island' site within the 'Lions Island' transect, 'The Mopane Transect' site within 'The Mopane Transect' transect and 'The Weir' within 'The Bushcamp Transect' transect. Those four transects were located nearby the HOORC's bushcamp. In the research area, seven habitat types were defined, based upon the communities distinguished by Bonyongo et al.(1999) and Klop and Van Goethem (2001):

- Sedge zone: the vegetation nearest to the water mainly consists of sedges such as *Cyperus articulatus* and *Schoenoplectus corymbosus* (Ellery and Ellery 1997)
- Lower floodplain: these areas are dominated by sedges such as those that occur on the sedge zone and grasses such as *Panicum repens* and *Eragrostis inamoena* (McCarthy et al. 1997).
- Upper floodplain: These floodplains are last to receive inundation. Grass species such as *Panicum repens* and *Cynodon dactylon* are dominant (McCarthy et al. 1997).
- Grassland: This is a dryland habitat type that never inundates. Dominant grass species are for example *Brachiaria*, *Aristida* and *Eragrostis* (Bonyongo, 1999).

- Mixed *Acacia* woodland: This habitat type consists of mixed *Acacia* woodland. The dominant acacia species is *Acacia erioloba*.
- *Mopane* low-density woodland: This type of woodland consists of a low density of *Colophospermum mopane*, with undergrowth.
- *Mopane* high-density woodland: This type of woodland consists of a high density of *Colophospermum mopane*, with little undergrowth.

2.2. Grass and sedge sward sampling

The fieldwork consisted of sampling of the grass and sedge sward, during the months of February 2001 until May 2001. This took place on four sites; Crocks Island, Lions Island, The Mopane Transect and The Weir. The latter two were defined as the Mainland. At the first two sites, five habitat types were distinguished; sedge zone, lower floodplain, upper floodplain, grassland and mixed *Acacia* woodland. These habitat types were distinguished along a wet-dry gradient. In these, the sedge zone was nearest to the permanent water, and the woodland was the most far from the permanent water. In Mainland, two different sites were distinguished, namely The Weir with a sedge zone, a lower floodplain and an upper floodplain community, and The Mopane Transect with two habitat types, a high-density *Mopane* woodland, and a low-density *Mopane* woodland community. At each site, per habitat type the co-ordinates were recorded with use of the Global Positioning System (GPS). The Garmin 12-XL GPS device was used to take the UTM co-ordinates during the week of March the 5th till March the 9th. The co-ordinates were taken in the 84 system, and were converted to the Cape system (X + 53 and Y + 296) in order to get uniformity with data of the herbivore studies conducted before. Table 1 shows the sample sites during January 2001 till May 2001 with the represented habitat types and the UTM co-ordinates.

At every site, three samples of the three most abundant grass and/ or sedge species were cut at ground level. Every sample consisted of one tuft or, when non-tufted, of one plant. When the plant was creeping, the origin was localised and, when possible, the whole plant was taken from the field. We made sure to sample individuals that were representative for the overall site. Furthermore, one sample of 23 cm^2 of one of the most abundant species was cut at ground level to estimate the biomass density. In order to be able to determine the amount of biomass of the other two species, the biomass density ratios were visually estimated in the field. The cover percentages of the same three species and the total grass cover percentage were estimated to determine the total biomass of the area. Both estimations were conducted each time by the same four people, who first estimated the percentage of grass cover and the percentage of biomass per species individually, (the overall percentage of biomass per site was set at 100%) and discussed afterwards to reach consensus on the figures. All samples were oven-dried for 24 hours at 80 degrees C. The species were identified afterwards.

The further lab work consisted of measuring of:

1. Length: The total length of the grass, from ground level up to the top of the possible inflorescence.
2. Dry weight: The weight of the sample after being oven-dried for 24 hours at 80 degrees C.
3. Biomass of the three most abundant species: One sample of 25 cm² of the most abundant species was cut at ground level. This biomass is determined by weighing the sample, after being oven dried for 24 hours at 80 degrees C, in the lab. In order to be able to determine the biomass of the other two species the biomass ratio's were estimated in the field as described above.
4. Cover percentages of the three most abundant species: Field estimation as described above.
5. Total cover percentage: Field estimation as described above.
6. Concentration of N, P, Ca and Na: after destruction in H_2SO_4-Se-salicylacid-H_2O_2.

The percentage of nitrogen, phosphorus, calcium and sodium (g/dw) of the grasses and sedges were obtained after destruction in H_2SO_4-Se-salicylacid-H_2O_2 at Wageningen University, The Netherlands, after grinding the oven-dried green leaves of the different grasses. Stems were only used when there were no green leaves or no leaves available, like in sedges. Only data of February and April were available due to logistic constraints.

2.3. Analyses of the grass and sedge sward

First the stem/ leaf ratio and the yellow/ green ratio were determined. The grass samples were individually separated in stem and leaves and in yellow and green parts. The separate amounts were weighed and the ratios were calculated.

To be able to correlate the animal observation data with the data about the quality and the quantity of the grass and sedge sward, the quality and quantity of palatable grasses such as *Panicum repens* and *Cynodon dactylon* were analysed separately.

2.4. Habitat selection and herbivore density

In order to estimate the herbivore density in the area, four transects were laid out Table 2 shows the area size per habitat type per transect. Three transects, Crocks Island, Bushcamp Transect and Lions Island, were more or less triangularly shaped. The Mopane Transect followed a dirt road (map 3). Crocks Island is a genuine island during flooding periods while the other transects were situated on the fringe of Chief's Island. The transects were traversed by foot, when possible in the early morning, to get uniformity in the data and since this is the time of the day that the herbivores are actively grazing. The transects were walked six times, except for Crocks Island, which was sampled for an extra time. Table 3 shows the calendar of the sampling data of the transects. The observers were accompanied by an experienced guide who knew the transects by heart. Still, the routes of the transects might have differed slightly from each other due to factors such as dangerous animals on or near the track or a change in the terrain. The location of the different transects was recorded using a Garmin R 12-XL Global Positioning System device (GPS). About every 100 meters a waypoint was taken. The data was stored in ArcView GIS 3.2. (ESRI, 1992). When the observers encountered herbivores, the location of the animals was estimated by taking the GPS location, the compass direction subtended from the north and by estimating the sighting distance towards the animal or towards the geometric centre of the group. The observers practised distance estimation in different habitats by using an object in the field and a measuring tape. The compass used was a Suunto field compass. Furthermore, data about the herd size, and the habitat type the animals were situated in, were noted.

Many herbivores live in the Okavango Delta; unfortunately we had too few encounters with several species to be able to state significant conclusions. These species were left out. Furthermore, only the predominantly grazers were used, while only the grass and sedge vegetation were analysed. For those reasons only the species mentioned in table 28 were used for analyses.

2.4.1. Population densities

The densities of the main herbivore species were estimated using the transect sampling as mentioned above. The methodology used by Klop and Van Goethem (2001) was used to calculate the densities in ArcView GIS 3.2. (ESRI 1992). First, with help of a script written in Avenue GIS programming language, a line was drawn through the GPS waypoints. A script using the recorded sighting distance and the compass direction determined the actual animal locations. Finally, the perpendicular distances from the actual animal locations to the transect line was calculated by another script. Arcview calculated the length of the transects. The analysis of the transect data, carried out by Van Munster (in prep.) was according to the method carried out by Klop and Van Goethem (2001) using the program DISTANCE 3.5, release 5 (Thomas et al., 1998). DISTANCE fits, with help of the data calculated by ArcView, a detection function trough the data from which the density per, for instance, species per transect or habitat type is calculated (Buckland et al. 1993).

2.4.2. Habitat availability and selection

The habitat availability depends on the observation area. While transect width was not defined in the field, the area was defined using the animal locations. Because of the heterogeneity of the habitat, observation areas were defined per habitat type. Woodland, for instance, has a lower visibility than a floodplain. Due to the fact that the observant has the possibility to look farther, the possibility on observations in a lower floodplain is larger than in the woodland. To overcome this problem, Van Munster (in prep.) used the following method by Klop and Van Goethem (2001). The assumption was made that the possibility to observe species in different habitat types is positively correlated with the effective strip width calculated by DISTANCE. The effective strip width is the estimated area effectively sampled, and can be defined as; "the distance for which unseen animals located closer to the line than half the effective strip width, equals the number of animals seen at distances greater than half the effective strip width" (Klop and Van Goethem 2001). Effective strip widths were calculated by van Munster (in prep.) in DISTANCE for each habitat type and transect. To determine habitat availability, buffers (zones) were created in ArcView around each transect per habitat type. Each habitat type had its distinctive buffer with a certain width. The width of each buffer equals the effective strip width for that particular habitat type. The total amount of area of a specific habitat type present in its distinctive buffer was considered to be the available area of that habitat type in the observation area.

Table 29 shows the numbers of available hectares of land per habitat type and per transect. There was no clear distinction between the ending of the mixed *Acacia* woodland and the beginning of the *Mopane* woodland. Because there were some difficulties determining the difference between the sedge zone and the lower floodplain, without disturbing the animals in the field, the sedge zone was classified as lower floodplain. The *Mopane* low-density and the *Mopane* high-density woodland were both classified as *Mopane* woodland, because the distinction in the analyses of the herbaceaous layer was made after several herbivore observations already took place. Therefore, the buffer used for the Mopane Transect was the general buffer for the whole transect and not per habitat type.

Selection of a habitat type has an impact on the distribution of an animal in time and space. Evidence for selection can therefore be found either from time changes in populations or from spatial variation. If a distribution is largely determined by selection, than strong correlation between distributional and environmental variables should exist (Manly 1985). To test relationships between the animal locations and the habitat type, the chi-square test was used. A habitat map, also used by Klop and Van Goethem (2001), formed the basis for the calculations on habitat availability and selection. The map was derived from a geo-referenced LANDSAT satellite image from January 1998 with a pixel size of 25 by 25 meters. Van Hasselt (2002) interpreted the image by using differences in spectral signature of the habitat types. Van Hasselt defined more habitat types than used in this research. Table 4 shows the classification. Since the habitat map is derived from the satellite image of January 1998, changes in habitat availability over time cannot be derived from the map. Van Munster (in prep.) adjusted obvious mistakes in habitat allocation , caused by, for instance, misinterpretations by Van Hasselt.

Selection of habitat by the different herbivore species was calculated following the methodology of Manly et al. (1993). The analysis is based on differences in proportions of available habitat types and proportions of used habitat types, given that the selecting organism has unrestricted access to the entire distribution of available units. First, a chi-square test was used to determine whether there is significant selection among available habitat types. When there was significant selection, selection ratios were used to distinguish preference or avoidance of a specific habitat type. The selection ratio quantifies the extent to which a habitat was selected. This was calculated with use of the following formula.

$$B_i = W_i / (\sum_{i=1}^{1} W_j)$$

$$W_i = o_i / \pi_i$$

$$o_i = u_i / u_+$$

With:

- B_i : The standardised selection ratio
- W_i : The selection probability for habitat i.
- o_i : The proportion of observations of a species in habitat i.
- π_i : The proportion of the total acreage of available habitat types.
- u_i : The number of observations of a species in a habitat i.
- u_+ : The number of observations of a species in the total acreage of available habitat types.

A selection ratio smaller than 1.0 means avoidance and a selection ratio larger than 1.0 means preference. A selection ratio equal to 1.0 means there is no selection (ns).

2.4.3. Species packing

In order to quantify herbivore diversity in the different sites and the monthly fluctuations, and to get uniformity with the analyses of Klop and Van Goethem (2001), the concept of species packing by Prins and Olff (1998) was used. In this matter the fluctuations in species richness between the period covered by Klop and Van Goethem (2001) October 2000 till January 2001 and the period covered in this research, February 2001 till may 2001, can be analysed. The species packing was determined per transect in order to analyse the species richness along the different transects. The species packing per habitat type was also determined, because not every transect consisted of the same distribution between the different habitat types (table 29).

The research focuses on grazers and not on obligate browsers such as giraffe (*Giraffa camelopardalis*). However, all the herbivores that mainly graze and browse are evaluated in the species packing concept, in order to study the general herbivore diversity. A drawback of the concept is that whenever a species is encountered, it is taken into account. There is no difference between species X that is encountered one time and species Y that is encountered twenty times. The species are selected using Skinner and Smithers (1990). Body mass data were taken from Prins and Olff (1998), Skinner and Smithers (1990), and from the website of the African Wildlife Foundation (2003).

Prins and Olff (1998) suggested, using the theories on competition and facilitation, that the species richness of African grazer assemblages can be explained by means of the weight ratios within these communities. The body mass of a grazer is, after sorting the herbivore species according to body mass (W_i), dependent of it's rank (R_i), the weight ratio (e^a), and the weight of the fictive lightest herbivore (e^b). The lightest species has rank 0. According to this method the degree of species packing is determined by plotting the natural logarithm of body mass against rank number and applying linear regression. A steep slope of the regression line and/ or a high weight ratio means low species richness. The regression line follows the function

$\ln(W_i) = aR_i + b$

A species with rank number x is W_i times as heavy as a species with rank number x-1.

2.5. Statistical analyses

ANOVA was used to test whether the means of, for example, the quality and quantity parameters differed significantly per site or per habitat type. The means were calculated by taking the straight mean among the grass species. The multiple comparisons test of Bonferroni was used to search for significant differences of a parameter within, for example, the sites. When the prerequisites for the ANOVA were not met, due to for instance a lack of normal distribution of the variables, the non-parametric Kruskal-Wallis test was used.

The Student's t-test was used for examining the difference between two means. An example is the difference of the mean nitrogen concentration in the grass and sedge sward between February and April. When the prerequisites to use this test were not met, the non-parametric Mann-Whithey U test was used.

The Chi-Square Test was used to test for a relation between two variables such as whether the frequency a certain herbivore species was observed in a certain habitat type was significantly different from the frequency the same herbivore species was observed in another habitat type (De Vocht 2002).

A Canonical Correspondence Analyses was used to analyse the influences of the used parameters, such as percentage of green parts and the length on the grass and sedge species. Furthermore, the analyses is used to get an idea about which parameters group together, like for instance whether grasses with a high biomass have as well a high percentage of leaves. Therefore all the parameters are placed within one diagram.

3. Results

3.1. The analyses of the grass and sedge sward

3.1.1. The species composition

Three wetland areas were defined; the sedge zone, nearest to the water, followed by the lower floodplain and the upper floodplain. *Cyperus denudatus*, *Panicum repens* and *Schoenoplectus corymbosus* dominated the sedge zone. The lower floodplain was mainly dominated by the same species, but in Lions Island *Cynodon dactylon* occurred in a high percentage. On Crocks Island *Bothriochloa bladhii* was in February the dominant species on the lower floodplain. On the upper floodplain, *Cynodon dactylon* and *Panicem repens* still were represented highly, while *Setaria sphacelata* was a new dominant species. Species like *Urochloa mosambicensis, Eragrostis spp* and *Sporobolus spp* were also common in both the lower and the upper floodplain. Tables 5 -13 give an extensive description of the species composition per habitat type and per site.

In the dryland areas, the grassland and the woodland were distinguished. As mentioned before, three different woodlands were classified: the mixed *Acacia* woodland, the high-density *Mopane* woodland and the low-density *Mopane* woodland. *Chloris virgata, Urochloa mosambicensis* and *Sporobolus* and *Eragrostis* species dominated the grassland. There was a clear difference in the grassland species found in the different woodlands. *Cenchrus ciliaris* and *Urochloa mosambicensis* mostly dominated the mixed *Acacia* woodland. In Lions Island *Sporobolus* species implied salinity. *Aristida* spp., *Eragrostis jeffreysii, Pogonarthia squarrosa* and *Stipagrostis uniplumus* dominated the *Mopane* woodlands. *Sporobolus* and *Urochloa* species were found in the low-density *Mopane* woodland as well. *Sporobolus* species were found in high abundance in Lions Island (see tables 5 –11. Table 13 shows the species composition per site).

Graph 1 shows the ordination diagram between the different species and the quality and quantity parameters. The percentage of leaves showed a stronger separation of the species than the percentage of green parts, the biomass and the dry weight. The length also showed a strong separation but was almost independent from the percentage of leaves. The percentage of leaves axe and the percentage of green axe grouped together and showed a more or less independency from the quantity ordination axes (length, biomass and dry weight). The nutritional parameters had less an effect on the separation of the grass and sedge species. The percentage of sodium seemed more or less independent from the percentage of nitrogen, phosphorus and calcium. The axe of sodium grouped together with the quantity axes while the axes of nitrogen, phosphorus and calcium grouped together with the axes for percentage of green and percentage of leaves.

3.1.2. The quality and quantity of the grass and sedge sward

Table 1 in the appendix shows the means of the quality and quantity parameters per habitat type, per site and per month, as detailed below.

3.1.2.1. The quality and quantity of the grass and sedge sward per habitat type

Table 14, and graph 2a till 10a show the description and the histograms of the quality and quantity of the grass and sedge sward of the different habitat types during the continuation of the season. Table 15 shows the means of the parameters per habitat type. In general, the mineral quality of the grass and sedge sward on the *Mopane* woodlands and the grassland was high compared to the other habitat types, of the mixed *Acacia* woodland and the upper floodplain average and of the lower floodplain and the sedge zone low. Both the percentage of green parts and the percentage of leaves of the grass and sedge sward were in general high to average (the lower floodplain), except for the sedge zone. The grass and sedge sward on the sedge zone consisted of grass and sedges with a low percentage of green parts and leaves. The length of the grasses of the woodlands was average till high, while the length of the grass and sedge sward on the wetlands was average. The length of the grass and sedge sward on the grassland was low. The amount of dry weight was in general average, except for the *Mopane* low-density woodland, which was high and the grassland, which was low. The overall amount of biomass of the grass and sedge sward was high on the mixed *Acacia* woodland, the *Mopane* low-density woodland and the sedge zone. On the other habitat types, the amount of biomass of the grass and sedge sward was low.

The differences found between the habitat types were significant for all the parameters according to ANOVA (table 18). The Multiple Comparisons test of Bonferroni shows that the differences are not significant for all the habitat types (appendix table 4).

3.1.2.2. The quality and quantity of the grass and sedge sward *per site*

Table 16, and graph 2b till 10b show the description and the histograms of the quality and the quantity of the grass and sedge sward of the different sites during the continuation of the season. Table 17 shows the means of the parameters per site.

The grass and sedge sward of The Mopane Transect was in general of the highest mineral quality, followed by Crocks Island and Lions Island. The mineral quality of The Weir was quite low, compared to the other sites. Again the quality in percentage of leaves and in percentage of green parts was, together with the grass and sedge sward on Crocks Island, the highest in The Mopane Transect. The percentage of leaves was also high in the grass and sedge sward of Lions Island, but the percentage of green was lower. Both parameters were the lowest on The Weir. The length of the grass and sedge sward, the amount of dry weight and the biomass were again the highest on the Mopane Transect, followed closely, except for the amount of dry weight, by Crocks Island. The length and the biomass were the lowest on Lions Island. The dry weight of the grass and sedge sward was equally low on the three sites considering the high amount on the Mopane Transect.

The differences found between the sites were significant for all the parameters according to ANOVA (table 19). The Multiple Comparisons test of Bonferroni shows that the differences are not significant for all the sites (appendix table 5).

3.1.2.3. Monthly changes within the quality and quantity of the grass and sedge sward

During the continuation of the season, the mineral quality in percentage of nitrogen and phosphorus decreased. It increased considering the percentage of sodium and calcium. Furthermore, both the percentage of green parts and the percentage of leaves decreased. The length of the grasses on the other hand increased till Aril and started to decrease in May. Both the dry weight and the overall amount of biomass increased from February till March and than started to decrease again. Table 20 shows the output of the ANOVA test and table 21 shows the output of the Student's T test. The differences between the months were, considering the percentage of green parts, the percentage of leaves, the length, the dry weight and the percentage of nitrogen, significant at a 95% confidence interval. Again the Multiple Comparisons test of Bonferroni shows that not all the differences between the months, except for the percentage of green parts, are significant (appendix table 6).

3.1.3. Description of the two most common grass species

Several grasses were found many times, they played an important role in the grass grass and sedge sward and formed possible forage for herbivores. Two of these grasses, *Cynodon dactylon* and *Panicum repens*, were the most common grasses in the research site.

3.1.3.1. Cynodon dactylon

In this study *Cynodon dactylon* was only found on Crocks Island and on Lions Island, where it occurred in each habitat type except in May when there were no samples found on the sedge zone. Table 22 shows the means of the parameters of both sites per habitat type.

The grasses on Crocks Island contained more green parts and more leaves but were shorter with less dry weight than the grasses on Lions Island. None of these differences were, according to the Mann-Whitney U test, significant. The grasses on the floodplain were taller than the grasses on the dryland and the grasses on the grassland had, compared to the grasses on the other habitat types, a low percentage of leaves and of green parts. Furthermore, the amount of dry weight was low. All parameters were significantly different among the habitat types. Amongst which habitat types the differences occurred, was not computed (table 23). The mineral quality was only known for the upper floodplain and the lower floodplain in Lions Island. The quality of *Cynodon dactylon* was higher on the upper floodplain than on the lower floodplain. The differences were significant for nitrogen and phosphorus (Mann-Whitney U: Asymp.sig. 0,046)

The mean length of the samples increased till March and than started to decrease. The mean dry weight increased and started to decrease in May. The mean percentage of green parts was high in February (90%) and dropped quickly to about 25% in May. The mean percentage of leaves on the other hand, was quite stable during the sampling period. The mean amount of biomass shifted from high in February to low in March to high again in April. The mean mineral quality decreased from February to April.

3.1.3.2. Panicum repens

Panicum repens was found to be quite often one of the three most abundant grass species in the sample areas. In total 57 samples of *Panicum repens* were taken from the field. They were only found in wet areas, namely the sedge zone, the lower floodplain and the upper floodplain. At Lions Island, *Panicum repens* only occurred in the sedge zone. At Crocks Island and at the Weir, the species occurred in the upper and the lower floodplain too. In February, only three samples of *Panicum repens* were taken at one site in two different habitat types. The sample size of February was too small for relevant analyses, so these three samples were left out. There was no distinction in *Panicum* low and *Panicum* high, because only three samples were below 15cm. See table 24 for the mean values.

The samples of *Panicum repens* on Crocks Island were of a low mineral quality, of an average length and had a high percentage of green parts and leaves. The amount of dry weight was low, and the total biomass density of *Panicum repens* was average. The samples of Lions Island were long and had a low percentage of green parts and leaves. The biomass density was small, but the dry weight and mineral quality were high. The samples on the Weir were of high mineral quality, dry weight and biomass density, but short, and had an average percentage of green parts and leaves.

In these sites, the *Panicum repens* samples in the upper floodplain were of the lowest mineral quality. Furthermore, these samples were short, of a low dry weight but had a high percentage of green parts and leaves. The overall biomass density of *Panicum repens* was high. The samples on the lower floodplain on the other hand, were of the highest mineral quality. The grasses were short, but with an average percentage of green parts and leaves. The dry weight was average and the biomass density of *Panicum repens* was high. The tallest samples of *Panicum repens* grew on the sedge zone. The dry weight was high, the percentage of green parts and of leaves was on the other hand low, but the mineral quality and biomass density was average.

Table 25, 26 and 27 show the test statistics of the Non-Parametric Kruskal Wallis test computed for the parameters per site, habitat type and per month. Considering the mineral quality, the nitrogen, phosphorus, sodium and calcium analyses were only conducted during the months of February and April. Since there are too few samples from February, a seasonal description of the mineral quality could not be given. The quality in percentage of green parts and of leaves increased during the sampling period. The biomass density increased too, while the average length decreased and the dry weight remained stable.

The means of the parameters of the most abundant grass and sedge species that occurred is given in the appendix, table 2.

3.2. The herbivore situation and density

3.2.1. Population densities

The population densities of grazing herbivores were only available for the total area of the transects. No distinction per habitat type or per transect was available for the individual herbivore species. This lack of data was due to logistic reasons. Impala was the most numerous species with 37 individuals km^{-2}, followed by red lechwe (10 km^{-2}), and burchell's zebra (7 km^{-2}). African elephant, blue wildebeest and warthog occurred at densities below 5 km^{-2} (Graph 11).

3.2.2. Habitat availability and selection

Table 30 shows the cross tabulation of the number of spottings per (group of) herbivore species per habitat type and per dry or wetland, with habitat classes amalgamated to wetland and dryland, in order to meet the prerequisites for the Chi-square test. Herbivore species are differentially associated with wet- or dryland ($P<0.001$). Table 31a and b show the total number of individuals per herbivore species spotted per habitat typeThe frequencies of the total number of herbivores per habitat type are significantly different ($P<0.001$). The african elephant is mainly spotted in the upper floodplain, the impala and the red lechwe in the lower floodplain and the warthog, blue wildebeest and burchell's zebra are mainly spotted in the grassland and in the lower floodplain. Table 32 shows the cross tabulation of the number of spottings per (group of) herbivore species per transect. The total number of animals per herbivore species spotted was significantly different per transect (Table 33). The african elephant mainly occurred in Lions Island and was not seen in the Mopane Transect. The impala was spotted in all transects. Furthermore, red lechwes were only spotted on Crocks Island, and also the warthog, the blue wildebeest and the burchell's zebra were mainly seen on Crocks Island.

The selection ratios were calculated for all transects together and for each transect separately. The selection according to the method of Manly et al. (1993) per habitat type per week is shown in graph 12. The selection by herbivores was positive (above 1.0) for the lower floodplain during the whole period, except for the first week. The herbivores selected also the grassland at start, but started to avoid the habitat in the last sampling weeks. The herbivore species avoided the mixed *Acacia* woodland during the whole sampling period. Furthermore, the selection for the upper floodplain strongly fluctuated throughout the sampling period. During the first weeks there were no observations of herbivore species in the *Mopane* woodland. At the beginning of March, the selection of *Mopane* woodland by herbivores was positive, but negative in April.

Table 34a till 34e show the selection per herbivore species per transect. The upper floodplain and the grassland were preferred by most herbivore species. A different selection occurred per transect. In Crocks Island the grassland and the lower floodplain were favoured. In Lions Island the grassland was preferred too, as well as the mixed *Acacia* woodland. The grassland was again most intensely grazed in the Bushcamp Transect, but in The Mopane Transect, the herbivore species preferred the *Mopane* woodland.

3.2.3. Species packing

Graph 13 shows the species packing per transect. The Mopane Transect showed the lowest species richness followed by Lions Island. The species richness was highest on Crocks Island; the red lechwe and the reedbuck only occurred in Crocks Island. The differences between the species richness were not significant (Kruskal-Wallis $p= 0.939$, $df = 3$) Graph 14 shows the weight ratio per week per transect.

Here it can also be seen that the highest species richness occurred on Crocks Island, followed by the Bushcamp Transect, and that the Mopane Transect had a low, and variable, species richness. The weight ratio on Crocks Island was lower than the weight ratios of the transects on Chief's Island.

Graph 15 shows the species richness per habitat type. The species richness was the lowest in the Mopane woodland and the highest in the mixed acacia woodland. The species richness in the other habitat types was the same. The differences between the species richness were not significant (Kruskal-Wallis p= 0.929, df = 4). The weight ratio per habitat type fluctuated; in general, the highest species richness occurred on the grassland (graph 16).

4. Discussion

4.1. The species composition

The botanical species composition in the wetland areas was quite similar among the different sites, although the dominating species may have differed, due to, for example, soil characteristics. *Sporobolus* species, for instance, grow on soils with a higher salt concentration (Ellery 1997). Because *Sporobolus* species were often among the most abundant species at Lions Island, it is suggested that it's the local soil might have contained a higher salt concentration than the soil of other sites. Common species found in the sedge zone and the lower floodplain were *Cyperus denudatus*, *Panicum repens* and *Schoenoplectus corymbosus,* and on the upper floodplain *Cynodon dactylon, Panicum repens* and *Setaria sphacelata*. These species are in general common for the wetland areas (Bonyongo et al 1999, Mc Carthy et al 1997 and Rattray 1960). *Cenchrus ciliaris* and *Urochloa mosambicensis* mostly dominated the mixed *Acacia* woodland, while species such as *Aristida* spp., *Eragrostis jeffreysii, Pogonarthria squarrosa* and *Stipagrostis uniplumus* dominated the mopane woodlands. *Chloris virgata, Urochloa mosambicensis* and *Sporobolus* and *Eragrostis* species dominated the grassland.

According to McCarthy et al.(1997), the grass *Setaria verticillata* is only found in truly terrestrial situations. Indeed, this species was found in the mixed *Acacia* woodland, but it was also encountered in the wetland surroundings of the upper floodplain. Another difference to the literature was that the *Alternanthera sessilis- Ludwigia stolonifera* community defined by Bonyongo et al. (1999) did not occur on the wetland areas. Furthermore, *Bothriochloa bladhii* is not mentioned as a common species by Bonyongo et al. (1999), nor by McCarthy et al. (1997). This species was found as one of the three most abundant species in the lower floodplain of Crocks Island in February. *Bothriochloa bladhii* is a species that reportedly occurs on riverbanks and on other moist sites (McCarthy et al.1997), and therefore fits well to the environment where it was found in Crocks Island. These observations suggest that only few plant species are real site indicators, while several studies find other common species.

The outcome of the ordination diagram suggests that the species with a higher percentage of leaves and percentage of green parts had a higher percentage of nitrogen, phosphorus and calcium, while the species with a higher length, bigger biomass and dry weight had a higher percentage of sodium.

4.2. The quality and quantity of the grass and sedge sward

The mineral quality was higher in the dryland areas than in the wetland areas. In general the phosphorus and calcium content of floodplains is very low (McCarthy et al., 1997). Furthermore, the species composition, maturation stage and climatic factors might have caused these differences. The quantity of the grass and sedge sward was as well higher in the dryland areas except for a huge amount of dead sedges in the sedge zone. This large amount of death material did not contribute to the percentage of green parts and of leaves, which were lower in the wetland areas than in the dryland areas. A reason for these differences in height and biomass might concern differences in grazing intensity by herbivores caused by for instance habitat selection or avoidance.

The grass and sedge sward of Crocks Island was low in mineral quality (nitrogen, phosphorus, and sodium) compared to the mean average of tropical grasses, tropical grasses as reported by McDowell

(1974) and Whitehead (2000)(appendix table 3), and average compared to the mean of the grass and sedge sward of the whole sampling area. The percentage of green parts and the percentage of leaves of the grass and sedge sward on Crocks Island were relatively high at the end of the season compared to the sampling areas on Chief's Island. The mean quantity was also high compared to the mean quantity of Chief's Island, except for the higher amount of biomass on The Mopane Transect. Differences in visiting of herbivores, soil mineralogy and structure or climatologically differences may explain the differences between the quality and quantity of the grass and sedge sward of Crocks Island and Chief's Island. Furthermore Klop and Van Goethem (2001) found that the mean herbivore density was higher on Crocks Island than on Chief's Island in the period from November 2000 till January 2001. The associated intense grazing might have caused a frequent regeneration of green parts and leaves. Also the faeces of herbivores might have caused an increase of the nutritional value of the soil.
When the wet season progressed, the percentage of nitrogen decreased, this can be due to the fact that the concentration of nitrogen naturally decreases when the grass is maturing. Furthermore, the percentage of green parts and the percentage of leaves decreased, this might be explained by an increase in the herbivory. Unfortunately there is no data available about the herbivore densities. The length of the grasses on the other hand increased till April and started to decrease in May. The dry weight increased from February till March and than started to decrease again. In May, the rainfall was higher than in April (appendix graph 1). The decrease of the growth in length, weight and amount of leaves and green parts was therefore not directly caused by the amount of rainfall. On the other hand, because the amount of rainfall was measured in Maun, a town at the border of the Okavango Delta 50 km away from the study area, there might be a difference with the local amount of rainfall in the Okavango Delta. Data about fluctuations in temperature were not available.

4.3. Habitat selection by herbivores

Part of the differences between the selection ratios in different transects can be attributed to the unequal distribution of the different habitat types along the transects. For example, there was hardly any floodplain in the Mopane Transect, so it appears that for this reason red lechwe was never spotted in the Mopane Transect.
Klop and Van Goethem (2001) found that during October 2000 till January 2001, *Mopane* woodland had a rather constant selection ratio below 1.0, while upper floodplain and mixed *Acacia* woodland both fluctuated between positive and negative selection. This research shows that from February 2001 till May 2001, the selection ratio for the *Mopane* woodland and the upper floodplain both fluctuated, and the herbivores avoided the mixed *Acacia* woodland. The grassland was the only habitat type selected by herbivores throughout the whole period of October 2000 till January 2001, although there were considerable fluctuations in selection ratio (Klop and Van Goethem 2001). At the start of February the selection ratio was still positive for grassland, but showed a trend towards negative selection in May. The selection for the lower floodplain was negative at the start of October, but showed a trend towards positive selection in the weeks after. At the end of January selection for lower floodplain declined again, but remained positive during the whole sampling period. Klop and Van Goethem (2001) stated that there was not one habitat type during the period of October 2000 till January 2001 that most herbivore species

seemed to prefer. A shift occurred during the continuation of the season. The herbivores were scattered throughout the different habitat types in the flooded season and selected for the grassland and the lower floodplain in February 2001 till May 2001. This might be caused by the high mineral quality and the high percentage of green parts and leaves of the grassland. The percentage of green parts and of leaves both increased with about 20% compared to the period covered by Klop and Van Goethem (unpublished data), the length on the other hand stayed the same, while the length on the other habitat types all increased. The herbivores possibly maintained the level of new sprouts and the length of the grasses by grazing. As well on the lower floodplain the grazing was intense, despite the in general lower mineral quality and lower percentage of leaves and green parts. The species composition was favourable on the lower floodplain for herbivores that prefer *Panicum repens* and *Cynodon dactylon* in their daily menu. This might have caused this intense grazing. As well the decrease in amount of available water in the wet season might have attracted the herbivores towards the water. Furthermore, a reason for the intense grazing on the lower floodplain and to a lesser extent on the upper floodplain was the large number of red lechwe. This herbivore prefers a water rich environment, and therefore was mainly found on the lower floodplain.

4.4. The habitat selection of the different herbivore species

The african elephant preferred the upper floodplain and the grassland. According to De Boer (2002), the african elephant prefers the *Mopane* woodland, but the species was not observed in the *Mopane* woodland in this research. The fact that the sighting distance was very low in *Mopane* woodland can be a reason for the lack of encounters.

The blue wildebeest preferred the grassland and the floodplains. According to Skinner and Smithers (1990), the blue wildebeest prefers woodland and savanne, but they as well prefer to graze on short green lawn like grass. Besides they tend to move to areas with an overall good nutritional grass cover. In the research area this type of grass, considering the length and the nutritional status, was mainly found on the grassland and to a lesser extent on the floodplain.

As well the burchell's zebra occurred mainly in the grassland and the lower floodplain. The burchell's zebra is a species that does not forage for specific species only. It eats grasses and sedges, but *Cynodon dactylon* is a favourite species (Skinner and Smithers 1990), what explains the high percentages of encounters on the lower floodplain. It focuses rather on high quantity forage than on high quality forage. It was also stated though, that the burchell's zebra moves to places where the overall nutritional quality is good (Skinner and Smithers 1990). The biomass found on the grassland was low compared to the other habitat types, but the overall nutritional quality and percentage of green parts and leaves was high. Therefore the species did not seem to select for the highest quantity but rather for the highest quality in this research.

The impala prefers the mixed *Acacia* woodland and avoids the floodplains and open grassland according to literature (Skinner and Smithers 1990). The impala was indeed mainly spotted at the mixed *Acacia* woodland but because of the high amount of mixed *Acacia* woodland the overall selection still was negative. Impala showed a positive selection for the *Mopane* woodland and the grassland. Furthermore, they prefer species as *Panicum repens, Cynodon dactylon, Eragrostis spp* and *Uruchloa spp* (Skinner

and Smithers 1990). These species were mainly found on the floodplains, although some of the species were as well found in the grassland, they hardly occurred in the *Mopane* woodland. The species composition together with the high quality of the grassland might have formed a reason for the impala to show a positive selection for the grassland. The preference for the *Mopane* woodland might have been due to, as well, the mineral quality and the percentage of green parts and leaves. The species composition was on the other hand not very palatable and preferable for the impala.
The red lechwe occurred in accordance with literature mainly in the lower floodplain, nearest to the water (Skinner and Smithers 1990). The species avoided the dryer parts. It prefers *Panicum repens*, which indeed was found mostly on the floodplains and the sedge zone.
The warthog was mainly situated in the grassland and the upper floodplain. This was also stated by Skinner and Smithers (1990). This animal prefers to graze just like the blue wildebeest on short green lawn like grass which was found mainly on the grassland and the upper floodplain. The species eats sedges as well, which were found mainly on the floodplains.
There was no proof found for the idea (a.o. Wilmshurst et al., 1999 and Skinner and Smithers 1990) that animals with a high body mass mainly graze on sites with a high biomass and dry weight. The large bodied animals preferred the grassland and the lower floodplain, which both have a lower amount of biomass than the woodlands. The preference for higher quality food in stead of high biomass might have been caused by the fact that the herbivores needed to meet their mineral requirements. The mineral quality of the grasses was low compared to other tropical grasses (appendix table 2), but we should take into account that many studies find different mean values for the nutrient concentration of grasses. The difference in species composition, and/ or the attraction of herbivores towards the retreating water both could form an explanation.

4.5. The species packing

Klop and Van Goethem (2001) found that the resulting weight ratio for study site within the Okavango Delta in the period of October 2000 till January 2001 was 1.32. In the period of February 2001 till May 2001 the weight ratio increased to 1.51, which means that the average increment in body size between species adjacent in size increased from 32% to 51%. In other words, the species packing of the Okavango Delta decreased during the wet season. The smaller herbivore species such as hares and turtoises were not seen, furthermore larger antilope species such as the sitatunga, the roan, the waterbuck and the sable were not seen either. A certain amount of herbivore species moved out of the area. This might be caused by the decreasing amount of water in the delta during the non-flooded season. Furthermore, the number of islands lowered, this might have caused more intense dispersion of herbivores due to lack of water barriers. There were no data available of the number of predators in the area during the sampling period.
Klop and Van Goethem (2001) found that from the end of June 2000 until the end of October 2000 Crocks Island showed a higher weight ratio (i.e. lower species richness) than Chief's Island. From November 2000 till January 2001 the species richness of Chief's Island and Crocks Island were more or less similar. This research shows a lower weight ratio from February 2001 till May 2001 for Crocks Island than for Chief's Island. Species as red lechwe and reedbuck were only seen on Crocks Island.

The preference of water by red lechwe forms a possible reason for the high number of encounter on Crocks Island. The weight ratio of Crocks Island was also lower during this sampling period than the period covered by Klop and Van Goethem. Species as giraffe, warthog and baboon reappeared on Crocks Island. These species (warthog, baboon) might have had problems to cross the water barrier between Chief's Island and Crocks Island in the flooded season, or might have been satisfied with the available amount, the quality or the composition of the forage on Chief's Island (giraffe). Furthermore, there were differences in weight ratio between the different sites situated on Chief's Island (Lions Island, Bushcamp Transect and the Mopane Transect). The low species richness of the Mopane Transect and to a lesser extent of Lions Island, might have been partly caused by the high percentage of *Mopane* woodland that had a low sighting distance in general and had a low species diversity

Although the species richness was equal on Crocks Island and on Chief's Island from October 2000 till January 2001, the mean density of herbivores was higher on Crocks Island during that period. Unfortunately data about the herbivore density per transect was not available for the period from February 2001 till May 2001. Whether the mean density of herbivores in the whole sampling area stayed the same during the dry and the wet season cannot be said, because different herbivore species were taken into account. It was tempting to assume a higher herbivore density on Crocks Island than on Chief's Island, because the species richness was higher as well. But the herbivore density is not equal to species richness. On the other hand, both the number of encounters with herbivores and the total number of herbivores spotted were still significantly higher on Crocks Island. Concluding from both studies the highest species richness changed from Chief's Island in the dry season to Crocks Island in the wet season. Whether the relative densities of herbivores changed between Crocks Island and Chief's Island when the two seasons are compared, remains unclear.

Furthermore, there were differences in weight ratio between the different sites situated on Chief's Island (Lions Island, Bushcamp Transect and the Mopane Transect). The low species richness of the Mopane Transect and to a lesser extent of Lions Island, might have been partly caused by the high percentage of *Mopane* woodland that had a low sighting distance in general and had a low species diversity.

The weight ratio per habitat type fluctuated. In general the highest species richness occurred on the grassland. The most herbivores selected for the grassland because of the relatively high mineral quality and amount of green parts and leaves, which resulted in high species richness on the grassland.

4.6: The situation of herbivores related to the species composition and the quality and quantity of the grass and sedge sward

The grazing intensity on Crocks Island was high both in the flooded and in the non-flooded season. But herbivore species moved from Chief's Island in the flooded season to Crocks Island in the non-flooded season. This might have been caused by the fact that during the flooded season, Crocks Island was, due to the high water in the rivers, a genuine island. When the water started to recede, the herbivores had a free passage to Crocks Island and left Chief's Island. The data of Klop and Van Goethem (2001) show that the quality and quantity (length, dry weight, percentage of green and percentage of leaves) of Crocks Island were average compared to Chief's Island at the end of November 2000. The reason for the migration towards Crocks Island might be because of the higher biomass of grass compared to

Chief’s Island, except for the Mopane Transect. But the herbivores avoided the Mopane Transect, what might have been caused by a perhaps not preferable species composition although the species were palatable (a high mineral quality and a high percentage of green parts and leaves). Furthermore, in Lions Island a large amount of *Sporobolus* species could be found. Those species are an indicator for a high salt concentration and grow on dry soils. The length of the grasses as well as the amount of dry weight and biomass was low. The mineral quality on the other hand was high compared to the rest of the sampling area. The higher quantity and percentage of green parts and leaves, and the average nutritional quality of the grass and sedge sward on Crocks Island therefore seemed to explain, together with the perhaps non-preferred species composition of the Mopane Transect and the higher salt concentration on Lions Island, the intense grazing on and the migration of herbivore species towards Crocks Island when the floods receded and the water barriers disappeared.

5. Conclusions

The species composition in the wetland areas was quite the same at the different sites although the dominating species may have differed. The soil of Lions Island might have contained a higher salt concentration than the soil of other sites, resulting in a high concentration of *Sporobolus* species. Common species, found in the sedge zone and the lower floodplain, were *Cyperus denudatus*, *Panicum repens* and *Schoenoplectus corymbosus*. On the upper floodplain *Cynodon dactylon, Panicem repens* and *Setaria sphacelata*. *Cenchrus ciliaris* and *Urochloa mosambicensis* mostly dominated the mixed *Acacia* woodland, while species as *Aristida* spp., *Eragrostis jeffreysii, Pogonarthia squarrosa* and *Stipagrostis uniplumus* dominated the *Mopane* woodlands. *Chloris virgata, Urochloa mosambicensis* and *Sporobolus* and *Eragrostis* species dominated the grassland. The preferred species for herbivores such as *Cynodon dactylon* and *Panicem repens* mainly occurred on the grassland and the floodplain areas.

The mineral quality and percentage of leaves and green parts were in general higher in the dryland areas than in the wetland areas. The quantity of the grass and sedge sward was as well higher in the dryland areas, except for a huge amount of dead sedges in the sedge zone

The grass and sedge sward of Crocks Island was low in mineral quality compared to the mean average of tropical grasses, and average compared to the mean of the grass and sedge sward of the whole sampling area. The percentage of green parts, the percentage of leaves and the mean quantity of the grass and sedge sward of Crocks Island were relatively high at the end of the season compared to the sampling areas on Chief's Island. The biomass on the Mopane Transect though, was the highest.
When the season was progressing, the percentage of green parts and the percentage of leaves decreased. The length of the grasses on the other hand increased till April and started to decrease in May. The dry weight increased from February till March and than started to decrease again. This might be caused by the grazing activity. There is no obvious influence of the amount of rainfall perhaps except for the decrease of the dry weight.

A shift in habitat selection occurred during the continuation of the season. The herbivores were scattered throughout the different habitat types in the flooded season (October 2000 till January 2001) and selected grassland and lower floodplain in the non-flooded season (February 2001 till May 2001). This might be caused by the high nutritional quality and by the increase of the percentage of green parts and leaves (20%) on the grassland. Furthermore the species composition was, on both the grassland and the lower floodplain, favourable to herbivores that prefer *Panicem repens* and *Cynodon dactylon* in their daily menu. As well the decrease in available amount of water might have attracted the herbivores towards the water. The high palatability of the *Mopane* woodland (high nutritional quality, high percentage of green parts and leaves) did not attract the studied herbivores.

The african elephant preferred the high biomass of the mixed *Acacia* woodland. The blue wildebeest preferred the short, green good nutritional grass cover of the grassland and the floodplains. The burchell's zebra occurred mainly in the high nutritious grassland and the lower floodplain dominated by the preferred *Cynodon dactylon* grass. The impala showed selection for the high quality of the grassland and the lower floodplain, dominated by *Panicum repens*. The red lechwe occurred mainly in the lower floodplain, nearest to the water with a high amount of *Panicum repens*. The warthog was mainly situated in the, to this species preferred, short green grass cover of grassland and upper floodplain.

There was no proof found for the idea that animals with a high body mass mainly graze on sites with a high biomass and dry weight. The large bodied animals preferred the higher percentage of green parts and leaves and high nutritional quality food found on the grassland and the average nutritional quality on the lower floodplain. Both habitat types contained of in general favourable species like *Panicum repens* and/ or *Cynodon dactylon*. This selection might be caused by the in general low nutritional quality of the grasses and sedges compared to the nutritional quality of tropical grasses. The grass cover of the *Mopane* woodlands was, despite their high nutritional quality and high percentage of green parts and leaves, not selected by the herbivores. Furthermore, selection for the lower floodplain might have been caused by the advantageous situation; close to the retreating water. This might have attracted the herbivores.

The species packing of the Okavango Delta decreased during the non-flooded season, probably due to the decreased amount of drinking water caused by the receding floods and the decreasing amount of water barriers. The smaller herbivore species such as hares and tortoises were not seen. Furthermore, larger antelope species such as the sitatunga, the roan, the waterbuck and the sable were not seen either. The high species richness changed from the highest on Chief's Island in the flooded season to the highest on Crocks Island in the non-flooded season. The higher quantity of the grass and sedge sward on Crocks Island seemed to explain, together with the perhaps not preferred species composition on the Mopane Transect and the higher salt concentration on Lions Island, the migration of herbivore species towards Crocks Island when the floods receded and the water barriers disappeared. The most herbivores selected for the grassland, what resulted into a high species richness on the grassland.

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Tables

Table 1: the sample sites during January 2001 till May 2001 with their vegetation types and the UTM coordinates

Sites	*Vegetation types*	*X-coordinates*	*Y-coordinates*
Crocks Island	Sedge Zone	722787	7841814
	Lower Floodplain	722797	7841783
	Upper Floodplain	722816	7841768
	Grassland	722807	7841711
	Woodland	722819	7841477
Lions Island	Sedge Zone	731348	7837600
	Lower Floodplain	731343	7837602
	Upper Floodplain	731330	7837595
	Grassland	731275	7837706
	Woodland	731300	7837554
Mainland			
The Weir	Sedge Zone	729031	7839232
	Lower Floodplain	729022	7839210
	Upper Floodplain	729013	7839178
Mopane Transect	Mopane high	736801	7839605
	Mopane Low	736858	7839526

Table 2: Table 2: Area size (m^2) per habitat type per transect, dependent on buffers.

		Mopane woodland	*Mixed Acacia woodland*	*Grassland*	*Upper floodplain*	*Lower floodplain*
Crocks Island	area	99855	514185	163563	486030	346525
	buffer	74 m	74 m	81 m	139 m	158 m
Lions Island	area	672687	958966	100906	228912	40329
	buffer	74 m	74 m	81 m	139 m	158 m
Bushcamp transect	area	314946	1147515	328798	512121	193364
	buffer	74 m	74 m	81 m	139 m	158 m
Mopane transect	area	285819	752683	93790	22946	11436
	buffer	74 m	91 m	91 m	91 m	91 m

Table 3: Calendar of walked transects.

Transect	*Crocks Island*	*Lions Island*	*Bushcamp Transect*	*Mopane Transect*
1	02/01/01	01/31/01	02/02/01	01/31/01
2	02/15/01	02/16/01	02/14/01	02/13/01
3	02/22/01	X	X	X
4	03/07/01	03/08/01	03/06/01	03/09/01
5	03/22/01	03/22/01	03/21/01	03/21/01
6	04/05/01	04/04/01	04/06/01	04/05/01
7	05/03/01	05/04/01	05/05/01	05/03/01

Table 4: Identified habitat types per type used by Van Hasselt.

habitat types by Van Hasselt	*Identified habitat types*
Sporobolus	Grassland
Water	Water
River and reeds	water
Lower floodplain	Lower floodplain
Upper floodplain	Upper floodplain
Riverine woodland	Woodland
Mopane	Woodland
Grassland	Grassland

Table 5: The main species per site in the mixed *Acacia* woodland

Site	*Date*	*species*	*cover%*	*biomass%*
Crocks Island	01-Feb-01	Cenchrus ciliaris		
		Enteropogon macrostachius		
		Sporobolus pyramidialis		
	07-Mar-01	Cenchrus ciliaris	50	75
		Urochloa mosambicensis	15	10
		unknown	15	15
	05-Apr-01	Cenchrus ciliaris	70	75
		Setaria verticulata	20	20
		Urochloa mosambicensis	5	5
	05-May-01	Cenchrus ciliaris		
		Setaria verticillata		
		Sporobolus fimbricatus		
Lions Island	01-Feb-01	Sporobolus pyramidialis	2	1
		Stetaria sphacellata	10	50
		Urochloa mosambicensis	45	49
	06-Mar-01	Setaria verticulata	30	50
		Sporobolus macranthelus	15	25
		Urochloa mosabicensis	15	25
	04-Apr-01	Digitaria eriantha	5	15
		Sporobolus macranthelus	10	30
		Urochloa mosambicensis	35	55
	05-May-01	Cenchrus ciliaris		
		Cynodon dactylon		
		Sporobolus fimbricatus		

Table 6: The main species per site in the *Mopane* high-density woodland

site	*date*	*species*	*cover%*	*biomass%*
Mopane Transect	01-Feb-01	Schidtia pappophoroides		
		Stipagrostis uniplumus		
	09-Mar-01	Aristida meridionalis	15	15
		Eragrostis jeffreysii	15	35
		Pogonarthia squarrosa	30	50
	05-Apr-01	Aristida meridionalis	20	45
		Eragrostis jeffreysii	20	30
		Pogonarthia squarrosa	15	25
	05-May-01	Aristida stipoides		
		Dactyloctenium giganteum		
		Stipagrostis uniplumus		

Table 7: The main species per site in the *Mopane* low-density woodland

site	*date*	*species*	*cover%*	*biomass%*
Mopane Transect	01-Feb-01	Dactyloctenium aegyptum		
		Stipagrostis uniplumus		
	09-Mar-01	Aristida stipoides	5	15
		Sporobolus macranthelus	5	15
		Urochloa msoabiquensis	20	70
	05-Apr-01	Pogonarthia squarrosa	15	10
		Stipagrostis uniplumis	5	5
		Urochloa mosambicensis	40	85
	05-May-01	Pogonarthria squarrosa		
		Sporobolus fimbricatu		
		Stipagrostis uniplumus		

Table 8: The main species per site in the grassland

site	*date*	*species*	*cover%*	*biomass%*
Crocks Island	01-Feb-01	Eragrostis trichophora		
		Urochloa Trichopus		
	07-Mar-01	Chloris virgata	15	20
		Sporobolus iocladus	30	40
		Urochloa mosambicensis	30	40
	05-Apr-01	Chloris virgata	5	10
		Eragrostis viscosa	10	20
		Sporobolus iocladus	65	70
	05-May-01	Chloris virgata		
		Eragrostis trichloflora		
		Eragrostis viscosa		
Lions Island	01-Feb-01	Sporobolus fimbriatus	2	20
		Tragus berteronianus	1	5
		Urochloa mosambicensis	7	75
	06-Mar-01	Sporobolus iocladus	7	45
		Sporobolus spicatus	7	35
		Tragus berteronianus	7	20
	04-Apr-01	Eragrostis pilgerana	2	5
		Eragrostis trichophora	23	80
		Urochloa mosambicensis	7	15
	05-May-01	Cynodon dactylon		
		Sporobolus ioclados		
		Sporobolus pyramidialis		

Table 9: The main species per site in the upper floodplain

site	date	species	cover%	biomass%
Crocks Island	01-Feb-01	Setaria sphacelata		
		Sporobolus spicatus		
	07-Mar-01	Cynodon dactylon	45	60
		Digitaria ciliaris	15	10
		Setaria sphacelata	15	30
	05-Apr-01	Cyperus articulatus	25	5
		Panicem repens	45	60
		Setaria sphacelata	30	35
	05-May-01	Cynodon dactylon		
		Panicem repens		
		Setaria sphacelata		
Lions Island	01-Feb-01	Cynodon dactylon	35	90
		Eragrostis lehmanniana	1	5
		Urochloa mosambicensis	7	5
	06-Mar-01	unknown	20	40
		Cynodon dactylon	30	40
		Urochloa mosabicensis	15	20
	04-Apr-01	Cynodon dactylon	70	65
		Eragrostis rigidior	25	30
		Setaria sphacelata	3	5
	05-May-01	Cynodon dactylon		
		Setaria sphacelata		
		Sporobolus ioclados		
The Weir	01-Feb-01	Panicem repens	90	100
	08-Mar-01	Cenchrus ciliaris	5	10
		Ergrostis inamoena	10	20
		Panicem repens	80	70
	05-Apr-01	Eragrostis lappula	3	10
		Panicem repens	70	70
		Setaria sphacelata	5	20
	05-May-01	Eragrostis lappula		
		Panicem repens		
		Setaria sphacelata		

Table 10: The main species per site in the lower floodplain

site	date	species	cover%	biomass%
Crocks Island	01-Feb-01	Cyperus denudatus		
		Panicum repens		
		Sporobolus iocladus		
	07-Mar-01	Bothriochloa bladhii	98	95
		Cyperus denudatus	1	3
		Panicum repens	1	2
	05-Apr-01	Cyperus denudatus	15	20
		Sacciolepis typhura	30	50
		Schoenoplectus corymbosus	45	30
	05-May-01	Panicem repens		
		Schoenoplectus corumbosus		
		Setaria sphacelata		
Lions Island	01-Feb-01	Cynodon dactylon	55	94
		eragrostis lehmanniana	1	5
		Urochloa mosambicensis	1	1
	06-Mar-01	Cynodon dactylon	20	35
		Cyperus denudatus	20	50
		unknown	7	15
	04-Apr-01	Cynodon dactylon	45	45
		Cyperus denudatus	30	25
		Sporobolus fimbriatis	18	30
	05-May-01	Cynodon dactylon		
		Eragrostis pallens		
		Schoenoplectus corumbosus		
The Weir	01-Feb-01	Cyperus articulatis	1	2
		Panicum repens	50	98
	08-Mar-01	Cyperus articulatus	1	1
		Eragrostis porosa	1	2
		unknown	73	97
	05-Apr-01	Eragrostis inamoena	2	2
		Panicum repens	85	95
		Schoenoplectus corymbosus	2	3
	05-May-01	Panicem repens		
		Schoenoplectus corumbosus		

Table 11: The main species per site in the sedge zone

site	*date*	*species*	*cover%*	*biomass%*
Crocks Island	01-Feb-01	Cyperus denudatus		
		Schoenoplectus corymbosus		
	07-Mar-01	Cyperus denudatus	10	40
		Panicum repens	35	20
		unknown	20	35
	05-Apr-01	Cyperus denudatus	45	40
		Schoenoplectus corymbosus	45	50
		unknown	10	10
	05-May-01	Fuirena pubescens		
		Miscanthus junceus		
		Panicem repens		
Lions Island	01-Feb-01	Cyperus articulatus	60	85
		Cyperus denudatus		
		Schoenoplectus corimbosus	10	15
	06-Mar-01	Cynodon dactylon	25	50
		Panicum repens	5	10
		Schoenoplectus corymbosus	35	40
	04-Apr-01	Cyperus denudatus	70	6
		Panicum repens	30	4
		Schoenoplectus corymbosus	50	90
	05-May-01	Fuirema pubescens		
		Panicum repens		
		Schoenoplectus corumbosus		
The Weir	01-Feb-01	Cyperus denudatus	1	1
		Panicem porphyrrizos	1	1
		Scoenoplectus corymbosus	98	98
	08-Mar-01	Cyperus denudatus	15	15
		Schoenoplectus corymbosus	60	75
		unknown	25	20
	05-Apr-01	Cyperus denudatus	10	10
		Panicum repens	60	70
		Schoenoplectus corymbosus	25	20
	05-May-01	Cyperus denundatus		
		Panicem repens		
		Schoenoplectus corumbosus		

Table 12: Main occurrence of the species (N) per habitat type. W: Mixed *Acacia* woodland, G: grassland, UF: upper floodplain, LF: lower floodplain, S: sedge zone, Ml: *Mopane* low-density woodland, Mh: *Mopane* high-density woodland.

Habitat type		*W*	*G*	*UF*	*LF*	*S*	*Ml*	*Mh*	*Total*
Species	Aristida spp.	0	0	0	0	0	3	9	12
	Bothriochloa bladhi	0	0	0	3	0	0	0	3
	Cenchrus spp.	16	0	3	0	0	0	0	19
	Chloris virgata	0	9	0	0	0	0	0	9
	Cynodon dactylon	3	3	17	13	3	0	0	39
	Cyperus spp.	0	0	3	21	29	0	0	53
	Dactyloctenium aeg.	0	0	0	0	0	3	0	3
	Dactyloctenium gig.	0	0	0	0	0	0	3	3
	Digitaria spp.	2	0	3	0	0	0	0	5
	Enteropogon macros.	3	0	0	0	0	0	0	3
	Eragrostis spp.	0	16	18	15	0	0	6	55
	Fimbristylis compl.	0	0	0	3	0	0	0	3
	Fuirena pubescens	0	0	0	0	6	0	0	6
	Miscanthus junceus	0	0	0	0	3	0	0	3
	Panicem repens	0	0	17	17	28	0	0	62
	Pogonarthia squarrosa	0	0	0	0	0	6	3	9
	Sacciolepis typhurus	0	0	0	3	0	0	0	3
	Schidtia pappophor	0	0	0	0	0	0	3	3
	Schoenoplectus cor.	0	0	0	15	29	0	0	44
	Setaria spp.	11	0	24	3	0	0	0	38
	Sporobolus spp.	21	21	4	5	0	6	0	57
	Stipagrostis uniplumis	0	0	0	0	0	9	12	21
	Tragus berteronianus	0	5	0	0	0	0	0	5
	Urochloa mosabicencis	17	12	6	3	0	6	0	44
Total		73	66	95	101	98	33	36	502

Table 13 : Main occurrence of the species (N) per site.

Site		*Crocks Island*	*Lions Island*	*Weir*	*Mopane Transect*	*Total*
Species	Aristida spp.	0	0	0	12	12
	Bothriochloa bladhi	3	0	0	0	3
	Cenchrus spp.	13	3	3	0	19
	Chloris virgata	9	0	0	0	9
	Cynodon dactylon	6	33	0	0	39
	Cyperus spp.	21	14	18	0	53
	Dactyloctenium aeg.	0	0	0	3	3
	Dactyloctenium gig.	0	0	0	3	3
	Digitaria spp.	3	2	0	0	5
	Enteropogon macros.	3	0	0	0	3
	Eragrostis spp.	10	24	15	6	55
	Fimbristylis compl.	3	0	0	0	3
	Fuirena pubescens	3	3	0	0	6
	Miscanthus junceus	3	0	0	0	3
	Panicem repens	20	9	33	0	62
	Pogonarthia squarrosa	0	0	0	9	9
	Sacciolepis typhurus	3	0	0	0	3
	Schidtia pappophor.	0	0	0	3	3
	Schoenoplectus cor.	12	13	19	0	44
	Setaria spp.	21	11	6	0	38
	Sporobolus spp.	17	34	0	6	57
	Stipagrostis uniplumis	0	0	0	21	21
	Tragus berteronianus	0	5	0	0	5
	Urochloa mosabicencis	12	26	0	6	44
Total		162	177	94	69	502

Table 14: a summary and a description of the quality and quantity parameters per habitat type per month. Mineral quality parameters have been only obtained in February and April. Whether a parameter was low, average or high was determined compared to the mean of the sites of that particular month. The differences are not necessarily significant.

Habitat type	*Mineral Quality*	*Percentage of leaves and green parts*	*Length*	*Amount of dry weight*	*Amount of biomass*
Mixed *Acacia* woodland	average	high	high	average	high
Mopane high-density woodland	high	high	average	average	low
Mopane low-density woodland	high	high	high	high	high
Grassland	high	high	low	low	low
Upper floodplain	average	high	average	average	low
Lower floodplain	low	average	average	average	low
Sedge zone	low	low	average	average	high

Habitat type	*February*	*March*	*April*	*May*
Mixed *Acacia* woodland	The grass is of a average to high mineral quality, with an average percentage of green parts and a high percentage of leaves. The grass is of an average length, with an average dry weight. The overall biomass is low.	The percentage of green part is decreasing but average, the percentage of leaves is increasing and high. The length of the grass is increasing and high instead of the decreasing low dry weight. The overall biomass is increasing and high.	The mineral quality of the grass was decreasing till average. The percentage of green parts is decreasing more but still average. As well the percentage of leaves is decreasing but also average. The length is further increasing and high with an increasing and average dry weight.	The percentage is green parts is further decreasing and is low, the percentage of leaves is as well further decreasing but is still average. Even so the length of the grass is decreasing more but remains high. The dry weight is still average but decreasing as well.
Mopane high-density woodland	The mineral quality is high with a high percentage of green parts and a high percentage of leaves. The grass is short but has a high dry weight.	The percentage of green parts is decreasing, but remains high, while the percentage of leaves stays at a stable high level. The length of the grass is increasing and is high. While the dry weight is increasing and low. The biomass of the overall woodland is high.	The mineral quality is declining but still high. Both the percentage of green parts and the percentage of leaves were decreasing but stay at an average level. As well the length of the grass is decreasing and is average; the dry weight is further decreasing and is low. The overall percentage of biomass is decreasing and of an average level.	The percentage of green parts as well as the percentage of leaves were decreasing more and were low. The length on the other hand is increasing and high as well as the increasing percentage of dry weight but this was at an average level.
Mopane low-density woodland	The mineral quality was average, but both the percentage of green parts and the percentage of leaves were high. The grasses were of an average length with a high dry weight.	The percentage of green parts was decreasing and drops to average, as well the percentage of leaves was decreasing but remains high. The length was increasing and was high as well as the dry weight the overall biomass was high.	The mineral quality was decreasing but still average. Both the percentage of green parts and the percentage of leaves were decreasing and average. As well the length, the dry weight and the overall biomass were decreasing but remain high.	The percentage of green parts and the percentage of leaves drop further to a low level. The length of the grass as well was decreasing but was still high. The dry weight was decreasing and average.

Grassland	The grassland was of a high mineral quality with a high percentage of green parts and a high percentage of leaves. The length of the grass was short though, as well was the dry weight and the overall biomass.	Both the percentage of green parts and the percentage of leaves were decreasing but both percentages remain high. The length as well as the dry weight and the overall biomass were increasing but remain low.	The mineral quality was declining till an average level. As well the percentage of green parts was decreasing but remains high. The percentage of leaves stays at high stable level while the length of the grass was decreasing and low. Both the dry weight and the overall biomass were decreasing and low.	The percentage of green parts was decreasing till a low level but the percentage of leaves still remains at a high level but was as well decreasing. The length of the grass was decreasing and was low, as well as the dry weight.
Upper floodplain	The mineral quality was average. The percentage of green parts and the percentage of leaves were both high. The length of the grasses was low as well as the dry weight and the overall biomass.	Both the percentage of green parts and the percentage of leaves were decreasing to an average level. The length on the other hand was increasing and was average while the dry weight was decreasing and low. The overall biomass was increasing but remains low.	The mineral quality was declining but remains average. Bot the percentage of green parts and the percentage of leaves were stable and average. The length was increasing and high while the dry weight was low, but increasing. The overall biomass was increasing and average.	The percentage of green parts was decreasing and was low, while the percentage of leaves was increasing and high. The length was average and decreasing. The dry weight was at a stable low level.
Lower floodplain	The grass was of a low mineral quality with an average percentage of green parts and a high percentage of leaves. The length was average while both the dry weight and the overall biomass were low.	The percentage of green parts remains at a stable average level, while the percentage of leaves was decreasing and average. The length was as well average but increasing. The dry weight was increasing and low. The overall biomass was increasing and average.	The mineral quality was increasing and average, while the percentage of green parts was decreasing but as well average. The percentage of leaves was stable and average. The length was increasing and average, while the dry weight was stable and low.	The percentage of greens was further decreasing till a low level while the percentage of leaves stay stable at an average level. The length was decreasing but stays average. The dry weight was still low and stable.
Sedge zone	The grasses were of a low mineral quality with an average percentage of green and a low percentage of leaves. The grasses were average of length and dry weight. The overall biomass was high.	The percentage of green parts was decreasing but stays average while the percentage of leaves was increasing till an average level. As well the length of the grasses was increasing and was high. Both the dry weight and the biomass were high while the first was increasing and the latter was decreasing.	The mineral quality was increasing and average. Both the percentage of green parts and the percentage of leaves were decreasing. The percentage of green parts was average and the percentage of leaves was low. The length of the grasses was still high but decreasing. The dry weight and the overall biomass were increasing, to an average and a high level.	The percentage of green parts was low and decreasing, while the percentage of leaves was average and increasing. The length was as well average and still decreasing. The dry weight was stable and average.

Table 15: The means of the quality and quantity parameters per habitat type. W: Mixed *Acacia* woodland, G: grassland, UF: upper floodplain, LF: lower floodplain, S: sedge zone, Ml: *Mopane* low-density woodland, MH: *Mopane* high-density woodland.

Habitat type		*Length (cm)*	*Dry weight (g)*	*% leaves*	*% green parts*	*Biomass (g/m2)*	*% Nitrogen*	*% Phosphorus*	*% Sodium*	*% Calcium*
W	Mean	98.01	11.59	21.83%	43.12%	522.8	2.25	0.19	0.07	0.6
	N	71	71	71	69	27	30	30	30	30
	Std. Dev.	44.27	10.54	10.38%	29.90%	1195.45	0.79	0.06	0.14	0.24
G	Mean	32.02	1.73	27.35%	51.81%	46.34	1.65	0.22	0.18	0.62
	N	65	66	66	65	44	14	14	14	14
	Std. Dev.	16.96	1.36	15.82%	32.06%	66.36	0.95	0.12	0.23	0.31
UF	Mean	71.6	6.77	23.71%	45.62%	85.93	1.49	0.12	0.25	0.41
	N	96	96	96	96	54	28	28	28	28
	Std. Dev.	38.15	8.3	14.38%	28.00%	104.16	0.42	0.05	0.22	0.11
LF	Mean	69.55	7.02	16.44%	44.44%	147.59	1.28	0.08	0.1	0.41
	N	99	99	99	93	67	32	32	32	32
	Std. Dev.	33.39	7.58	15.56%	29.33%	247.13	0.46	0.04	0.11	0.13
S	Mean	80.18	16.83	8.34%	35.77%	382.56	1.08	0.06	0.12	0.37
	N	98	98	98	80	60	25	25	25	25
	Std. Dev.	44.45	31.99	12.66%	27.19%	454.81	0.47	0.03	0.08	0.14
MH	Mean	71.14	12.98	21.20%	54.37%	180.35	2.57	0.21	0.03	0.8
	N	36	36	36	36	18	14	14	14	14
	Std. Dev.	37.89	13.93	16.59%	35.25%	258	1.03	0.12	0.02	0.17
ML	Mean	104.06	35.1	21.87%	44.29%	589.38	1.96	0.12	0.03	0.63
	N	36	36	36	36	18	18	18	18	18
	Std. Dev.	41.78	31.92	12.29%	28.31%	643.36	0.44	0.03	0.02	0.3
Total	Mean	73.78	11.28	19.18%	44.78%	234.35	1.69	0.13	0.12	0.52
	N	501	502	502	475	288	161	161	161	161
	Std. Dev.	42.44	19.73	15.29%	29.89%	498.99	0.8	0.08	0.16	0.24

Table 16: summary and description of the quality and quantity parameters per site per month. Mineral quality parameters have been obtained in February and April. Whether a parameter was low, average or high was determined compared to the mean of the sites of that particular month. The differences are not necessarily significant.

Site	*Mineral Quality*	*Percentage of leaves and green parts*	*Length*	*Amount of dry weight*	*Amount of biomass*
Crocks Island	average	high	high	low	high
Lions Island	average	average	low	low	low
The Weir	low	low	average	low	average
Mopane Transect	high	high	high	high	high

Site	*February*	*March*	*April*	*May*
Crocks Island	The mean length and the dry weight were average. The percentage of green parts and leaves, and the mineral quality was average till low, except for the high percentage of sodium	The length, dry weight and the percentage of green parts and leaves increased, compared to February. The percentage of green parts was high, whether the other parameters were average. The percentage of biomass was average also.	The length of the grasses and the mineral quality increased to a high level, except for an average percentage of calcium. The other parameters decreased. The percentage of leaves and the dry weight were average while the percentage of green parts was high and the percentage of biomass was low.	The mean length, dry weight and percentage of green decreased compared to April. The percentage of leaves was stable. Only the percentage of green was still high compared to the other sites. The rest was average.
Lions Island	The mean length and the dry weight were low. The percentage of green parts and leaves were high, and the mineral quality and the percentage of biomass were average	The quantity increased in March, while the quality decreased. The length, the biomass and the percentage of green parts were still below average, but the dry weight and the percentage of leaves was average.	All the parameters decreased compared to March except for the high percentage of biomass and the slightly increase in the still average percentage of calcium. Both the percentage of leaves and of phosphorus were average while the other parameters were below average.	The length and the percentage of green parts decreased and were low, while the dry weight and the percentage of leaves slightly increased and were average.
The Weir	The mean length was high. The dry weight, the percentage of green parts and leaves were low, as well was the mineral quality, except for the high percentage of sodium. The percentage of biomass was high also.	Only the percentage of biomass decreased while the other parameters increased. All the parameters, except for the average length, were low.	The length, dry weight and percentage of green parts decreased and the percentage of leaves increased. All the parameters were average. Percentage of biomass was high and increased compared to March. The mineral quality increased but was still low, except for the high sodium percentage.	The length and the dry weight increased and were below average compared to the other sites. The percentage of leaves was as well average but increased slightly compared to April. The percentage of green parts decreased but was high.
Mopane Transect	The mean length was average and the dry weight was high. The percentage of green parts and leaves, and the mineral quality was high, except for the low percentage of sodium	The quantity parameters increased and were high. The percentage of leaves and green parts on the other hand decreased but were still high.	All the parameters decreased compared to March. The length, dry weight and percentage of nitrogen and calcium were high, while the percentage of green parts and leaves was average and the other parameters were low.	The length, dry weight, percentage of green parts and the percentage of leaves all decreased compared to April. The first to parameters were high compared to the other sites while the latter two parameters were low.

Table 17: The means of the quality and quantity parameters per site.

Site		*Length (cm)*	*Dry weight (g)*	*% leaves*	*% green parts*	*Biomass (g/m2)*	*% Nitrogen*	*% Phosphorus*	*% Sodium*	*% Calcium*
Crocks Island	Mean	81.41	10.70	17.98%	48.39%	325.18	1.54	0.14	0.17	0.48
	N	164	165	165	155	78	46	46	46	46
	Std. Dev.	44.33	19.88	14.67%	27.44%	738.16	0.76	0.08	0.20	0.19
Lions Island	Mean	60.06	8.04	21.42%	42.48%	100.47	1.69	0.14	0.07	0.53
	N	173	173	173	165	107	54	54	54	54
	Std. Dev.	41.33	18.70	16.29%	31.40%	201.78	0.83	0.09	0.12	0.24
The Weir	Mean	75.15	8.43	15.27%	38.64%	261.53	1.31	0.08	0.20	0.33
	N	92	92	92	83	67	29	29	29	29
	Std. Dev.	33.08	7.05	14.23%	28.12%	427.97	0.40	0.03	0.18	0.10
Mopane Transect	Mean	87.60	24.04	21.53%	49.33%	384.86	2.23	0.16	0.03	0.70
	N	72	72	72	72	36	32	32	32	32
	Std. Dev.	42.93	26.87	14.50%	32.15%	525.74	0.80	0.09	0.02	0.26
Total	Mean	73.78	11.28	19.18%	44.78%	234.35	1.69	0.13	0.12	0.52
	N	501	502	502	475	288	161	161	161	161
	Std. Dev.	42.44	19.73	15.29%	29.89%	498.99	0.80	0.08	0.16	0.24

Table 18: The output of the ANOVA with the habitat types as the independent variable and the quality and quantity parameters as the dependent variables.

Parameter		*Sum of Squares*	*df*	*Mean Square*	*F*	*Sig.*
Length (cm)	Between Groups	194575.66	6	32429.28	22.69	.000
	Within Groups	706068.21	494	1429.29		
	Total	900643.88	500			
Dry weight (g)	Between Groups	33333.87	6	5555.65	17.00	.000
	Within Groups	161762.14	495	326.79		
	Total	195096.00	501			
% Leaves	Between Groups	19537.19	6	3256.20	16.50	.000
	Within Groups	97662.19	495	197.30		
	Total	117199.37	501			
% Green parts	Between Groups	13290.27	6	2215.05	2.53	.020
	Within Groups	410148.03	468	876.39		
	Total	423438.30	474			
Biomass (g/m2)	Between Groups	9134956.76	6	1522492.79	6.86	.000
	Within Groups	62324589.32	281	221795.69		
	Total	71459546.08	287			
% Nitrogen	Between Groups	37.60	6	6.27	15.16	.000
	Within Groups	63.65	154	.41		
	Total	101.25	160			
% Posphorus	Between Groups	.52	6	8.72E-02	21.71	.000
	Within Groups	.62	154	4.02E-03		
	Total	1.14	160			
% Sodium	Between Groups	.87	6	.15	7.09	.000
	Within Groups	3.16	154	2.05E-02		
	Total	4.04	160			
% Calcium	Between Groups	2.94	6	.49	12.13	.000
	Within Groups	6.22	154	4.04E-02		
	Total	9.16	160			

Table 19: The output of the ANOVA with the sites as the independent variable and the quality and quantity parameters as the dependent variables.

Parameter		*Sum of Squares*	*df*	*Mean Square*	*F*	*Sig.*
Length (cm)	Between Groups	56018.92	3	18672.97	10.99	0.000
	Within Groups	844624.96	497	1699.45		
	Total	900643.88	500			
Dry weight (g)	Between Groups	14344.57	3	4781.52	13.17	0.000
	Within Groups	180751.44	498	362.96		
	Total	195096.00	501			
% of Leaves	Between Groups	2905.44	3	968.48	4.22	0.006
	Within Groups	114293.93	498	229.51		
	Total	117199.37	501			
% Green parts	Between Groups	7522.22	3	2507.41	2.84	0.038
	Within Groups	415916.07	471	883.05		
	Total	423438.30	474			
Biomass (g/m2)	Between Groups	3426357.31	3	1142119.10	4.77	0.003
	Within Groups	68033188.77	284	239553.48		
	Total	71459546.08	287			
% Nitrogen	Between Groups	14.39	3	4.80	8.67	0.000
	Within Groups	86.86	157	0.55		
	Total	101.25	160			
% Phosphorus	Between Groups	0.11	3	0.04	5.40	0.001
	Within Groups	1.04	157	0.01		
	Total	1.14	160			
% Sodium	Between Groups	0.69	3	0.23	10.71	0.000
	Within Groups	3.35	157	0.02		
	Total	4.04	160			
% Calcium	Between Groups	2.18	3	0.73	16.37	0.000
	Within Groups	6.98	157	0.04		
	Total	9.16	160			

Table 20: The output of the ANOVA with the date as the independent variable and the quality and quantity parameters as the dependent variables, except for the mineral quality parameters.

Parameter		*Sum of Squares*	*df*	*Mean Square*	*F*	*Sig.*
Length (cm)	Between Groups	43151.41	3	14383.80	8.34	0.000
	Within Groups	857492.47	497	1725.34		
	Total	900643.88	500			
Dry weight (g)	Between Groups	3053.45	3	1017.82	2.64	0.049
	Within Groups	192042.55	498	385.63		
	Total	195096.00	501			
% Leaves	Between Groups	1904.96	3	634.99	2.74	0.043
	Within Groups	115294.42	498	231.52		
	Total	117199.37	501			
% Green parts	Between Groups	178855.42	3	59618.47	114.81	0.000
	Within Groups	244582.87	471	519.28		
	Total	423438.30	474			
Biomass (g/m2)	Between Groups	1019177.06	3	339725.69	1.37	0.252
	Within Groups	70440369.02	284	248029.47		
	Total	71459546.08	287			

Table 21: Output of the student's T test with the date as the independent variable and the mineral quality parameters as the dependent variables.

Parameters	*t*	*df*	*Sig. (2-tailed)*
% Nitrogen	2.397	159	.018
% Phosphorus	1.283	159	.201
% Sodium	-1.202	159	.231
% Calcium	-.455	159	.650

Table 22: means of the parameters per habitat type and per site for *Cynodon dactylon*, Spring 2003. Habitat types: W: Mixed *Acacia* woodland, G: Grassland, UF: Upper floodplain, LF: Lower floodplain, S: Sedge zone.

Site	*Habitat type*		*Length (cm)*	*Dry weight (g)*	*% leaves*	*% green parts*	*Biomass (g/m2)*	*% N*	*% P*	*% Na*	*% Ca*
Crocks Island	UF	Mean	22.8	2.4	47.3	42.4	120.3				
		N	6	6	6	6	3				
		Std. Dev.	13.9	1.0	23.7	17.8	0.0				
	Total	Mean	22.8	2.4	47.3	42.4	120.3				
		N	6	6	6	6	3				
		Std. Dev.	13.9	1.0	23.7	17.8	0.0				
Lions Island	W	Mean	16.7	2.0	31.3	21.6					
		N	3	3	3	3					
		Std. Dev.	3.5	0.6	2.6	1.4					
	G	Mean	19.3	0.4	8.2	0.9					
		N	3	3	3	3					
		Std. Dev.	0.6	0.1	0.6	1.6					
	UF	Mean	24.9	4.1	36.0	50.2	124.0	1.8	0.1	0.1	0.5
		N	10	10	10	10	6	2	2	2	2
		Std. Dev.	11.1	4.9	17.4	37.0	13.8	0.3	0.0	0.1	0.1
	LF	Mean	31.2	3.2	28.9	39.7	202.0	1.3	0.1	0.0	0.4
		N	12	12	12	12	9	6	6	6	6
		Std. Dev.	5.8	2.1	7.0	31.9	124.8	0.1	0.0	0.0	0.1
	S	Mean	37.0	1.3	36.1	47.5	56.6				
		N	3	3	3	3	3				
		Std. Dev.	5.0	0.4	5.0	6.1	0.0				
	Total	Mean	27.2	2.9	30.1	38.3	151.7	1.4	0.1	0.0	0.5
		N	31	31	31	31	18	8	8	8	8
		Std. Dev.	9.3	3.2	13.2	31.8	102.9	0.2	0.0	0.0	0.1
Total	W	Mean	16.7	2.0	31.3	21.6					
		N	3	3	3	3					
		Std. Dev.	3.5	0.6	2.6	1.4					
	G	Mean	19.3	0.4	8.2	0.9					
		N	3	3	3	3					
		Std. Dev.	0.6	0.1	0.6	1.6					
	UF	Mean	24.1	3.4	40.2	47.3	122.8	1.8	0.1	0.1	0.5
		N	16	16	16	16	9	2	2	2	2
		Std. Dev.	11.8	3.9	20.0	30.7	11.0	0.3	0.0	0.1	0.1
	LF	Mean	31.2	3.2	28.9	39.7	202.0	1.3	0.1	0.0	0.4
		N	12	12	12	12	9	6	6	6	6
		Std. Dev.	5.8	2.1	7.0	31.9	124.8	0.1	0.0	0.0	0.1
	S	Mean	37.0	1.3	36.1	47.5	56.6				
		N	3	3	3	3	3				
		Std. Dev.	5.0	0.4	5.0	6.1	0.0				
	Total	Mean	26.5	2.8	32.9	39.0	147.3	1.4	0.1	0.0	0.5
		N	37	37	37	37	21	8	8	8	8
		Std. Dev.	10.1	3.0	16.3	29.8	95.6	0.2	0.0	0.0	0.1

Table 23: the Output of the Kruskal-Wallis test for *Cynodon dactylon*. The parameters are tested for significant differences per habitat type. Significance at the 95% level.

	Length (cm)	*Dry weight (g)*	*Percentage of leaves*	*Percentage of green parts*	*Biomass (g/m^2)*
Chi-Square	10,663	9,925	10,941	10,859	8,571
df	4	4	4	4	2
Asymp. Sig.	,031	,042	,027	,028	,014

Table 24: means parameters per habitat type, per site for *Panicum repens*. Habitat types: W: Mixed *Acacia* woodland, G: Grassland, UF: Upper floodplain, LF: Lower floodplain, S: Sedge zone.

	Habitat type		*Length (cm)*	*Dry weight (g)*	*% leaves*	*% green parts*	*Biomass (g/m2)*	*% N*	*% P*	*% Na*	*% Ca*
Crocks Island	UF	Mean	79.7	8.1	55.2	70.3	223.3	0.9	0.1	0.1	0.3
		N	6	6	6	6	3	2	2	2	2
		Std. Dev.	11.3	2.6	42.0	23.5	180.3	0.0	0.0	0.0	0.0
	LF	Mean	54.5	3.7	50.4	73.6	0.2				
		N	6	6	6	6	3				
		Std. Dev	11.3	3.1	43.4	14.4	0.0				
	S	Mean	74.0	6.5	56.8	72.7	474.4				
		N	6	6	6	6	3				
		Std. Dev	18.1	3.4	38.0	14.6	0.0				
	Total	Mean	69.4	6.1	54.1	72.2	232.6	0.9	0.1	0.1	0.3
		N	18	18	18	18	9	2	2	2	2
		Std. Dev	17.2	3.4	38.8	17.0	224.4	0.0	0.0	0.0	0.0
Lions Island	S	Mean	85.3	13.6	19.3	20.9	16.9	1.7	0.1	0.1	0.3
		N	9	9	9	9	6	3	3	3	3
		Std. Dev	16.8	6.9	7.6	18.6	16.0	0.4	0.0	0.0	0.0
	Total	Mean	85.3	13.6	19.3	20.9	16.9	1.7	0.1	0.1	0.3
		N	9	9	9	9	6	3	3	3	3
		Std. Dev	16.8	6.9	7.6	18.6	16.0	0.4	0.0	0.0	0.0
The Weir	UF	Mean	42.0	3.3	35.2	31.8	268.3	1.5	0.1	0.3	0.4
		N	9	9	9	9	6	3	3	3	3
		Std. Dev	11.5	1.0	5.8	11.3	28.9	0.0	0.0	0.0	0.0
	LF	Mean	56.0	11.6	25.6	14.6	650.6	1.9	0.1	0.2	0.3
		N	9	9	9	9	6	2	2	2	2
		Std. Dev	14.3	5.5	7.7	7.5	239.0	0.2	0.0	0.1	0.1
	S	Mean	50.6	14.4	28.1	25.0	700.9	1.5	0.1	0.2	0.4
		N	9	9	9	9	6	2	2	2	2
		Std. Dev	38.1	11.0	12.2	26.8	664.4	0.0	0.0	0.0	0.0
	Total	Mean	49.5	9.8	29.6	23.8	540.0	1.6	0.1	0.2	0.3
		N	27	27	27	27	18	7	7	7	7
		Std. Dev	24.2	8.3	9.5	18.1	431.7	0.2	0.0	0.1	0.1
Total	UF	Mean	57.1	5.2	43.2	47.2	253.3	1.3	0.1	0.2	0.3
		N	15	15	15	15	9	5	5	5	5
		Std. Dev	22.0	2.9	27.4	25.5	95.7	0.3	0.0	0.1	0.1
	LF	Mean	55.4	8.4	35.5	38.2	433.8	1.9	0.1	0.2	0.3
		N	15	15	15	15	9	2	2	2	2
		Std. Dev	12.8	6.1	29.4	31.6	376.1	0.2	0.0	0.1	0.1
	S	Mean	69.5	12.1	32.0	35.4	382.0	1.6	0.1	0.1	0.3
		N	24	24	24	24	15	5	5	5	5
		Std. Dev	30.3	8.5	24.8	30.0	510.2	0.3	0.0	0.0	0.0
	Total	Mean	62.1	9.2	36.1	39.5	361.0	1.5	0.1	0.2	0.3
		N	54	54	54	54	33	12	12	12	12
		Std. Dev	24.8	7.2	26.7	29.2	395.6	0.4	0.0	0.1	0.1

Table 25: the Output of the Kruskal-Wallis test for *Panicum repens*. The parameters are tested for significant differences per site. Significance at the 95% level.

	Length (cm)	*Dry weight (g)*	*% leaves*	*% green parts*	*Biomass (g/m²)*	*% N*	*% P*	*%Na*	*% Ca*
Chi-Square	17.597	5.771	7.006	29.878	10.909	4.698	1.484	6.339	4.185
df	2	2	2	2	2	2	2	2	2
Asymp. Sig.	.000	.056	.030	.000	.004	.095	.476	.042	.123

Table 26: the Output of the Kruskal-Wallis test for *Panicum repens*. The parameters are tested for significant differences per habitat type. Significance at the 95% level.

	Length (cm)	*Dry weight (g)*	*Percent-age of leaves*	*Percent-age of green parts*	*Biomass (g/m²)*	*Percentage N*	*Percentage P*	*Percentage Na*	*Percentage Ca*
Chi-Square	4.731	6.776	6.215	3.580	.146	5.177	4.808	3.123	1.669
df	2	2	2	2	2	2	2	2	2
Asymp. Sig.	.094	.034	.045	.167	.929	.075	.090	.210	.434

Table 27: the Output of the Kruskal-Wallis test for *Panicum repens*. The parameters are tested for significant differences per month. Significance at the 95% level.

	Length (cm)	*Dry weight (g)*	*Percent-age of leaves*	*Percent-age of green parts*	*Biomass (g/m²)*
Chi-Square	12.599	2.324	18.362	5.773	4.274
df	2	2	2	2	1
Asymp. Sig.	.002	.313	.000	.056	.039

Table 28: Numbers per herbivore species

species	*number of encounters*	*total number of animal spottings*	*mean number of animals per encounter*
African elephant	15	270	18
Blue wildebeest	33	116	3.5
Burchell's zebra	34	308	9
Impala	157	1325	8.4
Red lechwe	42	1145	27.3
Warthog	22	50	2.3

Table 29: Available number of hectares habitat per transect.

Habitat type	*Mopane Transect*	*Crocks Island*	*Lions Island*	*Bushcamp transect*	*total hectares per habitat type*
Mopane woodland	29	10	67	31	137
mixed Acacia woodland	75	51	96	115	337
grassland	9	16	10	33	69
upper floodplain	2	49	23	51	125
lower floodplain	1	35	4	19	59
total hectares per transect	117	161	200	250	728

Table 30: The cross tabulation showing the total number of spottings of (a group of) herbivores species per A: habitat type and B: wet- or dryland, and C: the results of the Chi-Square test.

A

	Mopane woodland	*mixed Acacia woodland*	*grassland*	*upper floodplain*	*lower floodplain*	*total*
Elephant	0	5	6	2	1	14
Impala	25	77	45	3	7	157
Lechwe	0	0	4	5	33	42
Warthog	2	2	11	1	6	22
Wildebeest	1	3	12	4	13	33
Zebra	4	5	11	3	11	34
Total	32	92	89	18	71	302

B

	Dryland	*Wetland*	*Total*
Elephant	11	3	14
Impala	147	10	157
Lechwe	4	38	42
Warthog	15	7	22
Wildebeest	16	17	33
Zebra	20	14	34
Total	213	89	302

C

Chi-Square Tests	*Value*	*df*	*Asymp. Sig. (2-sided)*
Pearson Chi-Square	125.963	20	0.000
Likelihood Ratio	131.514	20	0.000
N of Valid Cases	302		

Table 31: The cross tabulation showing A: the total number of individuals per herbivore species spotted per habitat type and B: the Chi-square test. W: mixed Acacia woodland, G: grassland, UF: upper floodplain, LF: lower floodplain, M: Mopane woodland.

A

	W	*G*	*UF*	*LF*	*M*
Elephant	14	15	40	1	0
Impala	539	394	3	2008	325
Lechwe	0	44	10	1091	0
Warthog	7	20	2	17	4
Wildebeest	21	34	22	37	2
Zebra	43	92	11	134	28

B

Chi-Square Tests	*Value*	*df*	*Asymp. Sig. (2-sided)*
Pearson Chi-Square	3070.992	20	0.000
Likelihood Ratio	2996.513	20	0.000
N of Valid Cases	3011		

Table 32: The cross tabulation showing the total number of spottings of (a group of) herbivores species per transect.

	Crocks Island	*Lions Island*	*Bushcamp Transect*	*Mopane Transect*	*Total*
Elephant	6	4	4	0	14
Impala	37	38	43	39	157
Lechwe	42	0	0	0	42
Warthog	17	2	1	2	22
Wildebeest	28	2	2	1	33
Zebra	24	2	2	6	34
Total	154	48	52	48	302

Table 33: The cross tabulation showing A: the total number of individual animals per herbivore species spotted per transect, and B: the Chi-square test.

A

	Crocks Island	*Lions Island*	*Bushcamp Transect*	*Mopane Transect*	*Total*
Elephant	15	48	7	0	71
Impala	275	346	346	358	1325
Lechwe	1139	0	0	0	1142
Warthog	39	4	2	5	50
Wildebee	108	3	2	3	116
Zebra	248	15	8	37	308
Total	1824	417	366	405	3012

B

Chi-Square Tests	*Value*	*df*	*Asymp. Sig. (2-sided)*
Pearson Chi-Square	1913.292	15	0.000
Likelihood Ratio	2248.943	15	0.000
N of Valid Cases	3012		

Table 34: The habitat selection per herbivore species per transect. A: all the transects, B: Crocks Island, C: Lions Island, D: Bushcamp Transect, E: Mopane Transect. W: mixed Acacia woodland, G: grassland, UF: upper floodplain, LF: lower floodplain, M: Mopane woodland. +: preference, -: avoidance, X: no data.

A

All transects	*M*	*W*	*G*	*UF*	*LF*
Elephant	X	-	+	+	-
Impala	-	-	+	-	+
Lechwe	X	X	-	-	+
Warthog	-	-	+	-	+
Wildebeest	-	-	+	+	+
Zebra	-	-	+	-	+

B

Crocks Island	*M*	*W*	*G*	*UF*	*LF*
Elephant	X	-	+	X	-
Impala	X	-	+	-	+
Lechwe	X	X	-	-	+
Warthog	X	-	+	X	+
Wildebeest	X	-	+	-	+
Zebra	X	-	+	-	+

C

Lions Island	*M*	*W*	*G*	*UF*	*LF*
Elephant	X	+	X	X	X
Impala	+	+	+	-	X
Lechwe	X	X	X	X	X
Warthog	-	X	X	+	X
Wildebeest	-	+	+	X	X
Zebra	X	X	+	X	X

D

Bushcamp transect	*M*	*W*	*G*	*UF*	*LF*
Elephant	X	+	+	X	X
Impala	X	-	+	-	-
Lechwe	X	X	X	X	X
Warthog	X	X	+	X	X
Wildebeest	X	X	X	X	+
Zebra	X	X	+	X	X

E

Mopane Transect	*M*	*W*	*G*	*UF*	*LF*
Elephant	X	X	X	X	X
Impala	+	X	X	X	X
Lechwe	X	X	X	X	X
Warthog	+	-	X	X	X
Wildebeest	X	+	X	X	X
Zebra	+	-	X	X	X

Graphs

Graph 1: The ordination diagram between the species and the parameters. Biomass in g/m^2, length in cm, dry weight in g.

Graph 2a: The mean percentage of nitrogen in the green leaves of the grass and sedge vegetation per habitat type per month. *Mopane* high-density woodland: N February: 8, N April: 6. *Mopane* low-density woodland: N February: 8, N April: 6. Mixed *Acacia* woodland: N February: 15, N April: 15. Grassland: N February: 4, N April: 10. Upper floodplain: N February: 7, N April: 21. Lower floodplain: N February: 17, N April: 15. Sedge zone: N February: 20, N April: 5.

Graph 2b: The mean percentage of nitrogen in the green leaves of the grass and sedge vegetation per site per month. Crocks Island, N February: 24, N April: 22, Lions Island N February: 26, N April: 28, Mopane Transect N February: 17, N April: 15, The Weir N February: 13, N April: 16

Graph 3a: The mean percentage of phosphorus in the green leaves of the grass and sedge vegetation habitat type per month. *Mopane* high-density woodland: N February: 8, N April: 6. *Mopane* low-density woodland: N February: 8, N April: 6. Mixed *Acacia* woodland: N February: 15, N April: 15. Grassland: N February: 4, N April: 10. Upper floodplain: N February: 7, N April: 21. Lower floodplain: N February: 17, N April: 15. Sedge zone: N February: 20, N April: 5.

Graph 3b: The mean percentage of phosphorus in the green leaves of the grass and sedge vegetation per site per month Crocks Island, N February: 24, N April:22, Lions Island N February: 26, N April: 28, Mopane Transect N February: 17, N April: 15, The Weir N February: 13, N April: 16

Graph 4a: The mean percentage of sodium in the green leaves of the grass and sedge vegetation per habitat type per month. *Mopane* high-density woodland: N February: 8, N April: 6. *Mopane* low-density woodland: N February: 8, N April: 6. Mixed *Acacia* woodland: N February: 15, N April: 15. Grassland: N February: 4, N April: 10. Upper floodplain: N February: 7, N April: 21. Lower floodplain: N February: 17, N April: 15. Sedge zone: N February: 20, N April: 5.

Graph 4b: The mean percentage of sodium in the green leaves of the grass and sedge vegetation per site per month. Crocks Island, N February: 24, N April:22, Lions Island N February: 26, N April: 28, Mopane Transect N February: 17, N April: 15, The Weir N February: 13, N April: 16

Graph 5a: The mean percentage of calcium in the green leaves of the grass and sedge vegetation per habitat type per month. *Mopane* high-density woodland: N February: 8, N April: 6. *Mopane* low-density woodland: N February: 8, N April: 6. Mixed *Acacia* woodland: N February: 15, N April: 15. Grassland: N February: 4, N April: 10. Upper floodplain: N February: 7, N April: 21. Lower floodplain: N February: 17, N April: 15. Sedge zone: N February: 20, N April: 5.

Graph 5b: The mean percentage of calcium in the green leaves of the grass and sedge vegetation per site per month. Crocks Island, N February: 24, N April: 22, Lions Island N February: 26, N April: 28, Mopane Transect N February: 17, N April: 15, The Weir N February: 13, N April: 16

Graph 6a: The mean percentage of green parts of the grasses and sedges per habitat type per month. *Mopane* high-density woodland: N February: 9, N March: 9, N April: 9, N May: 9. *Mopane* low-density woodland: N February: 9, N March: 9, N April: 9, N May: 9. Mixed *Acacia* woodland: N February: 16, N March: 18, N April: 17, N May: 18. Grassland: N February: 12, N March: 17, N April: 18, N May: 18. Upper floodplain: N February: 17, N March: 27, N April: 25, N May: 27. Lower floodplain: N February: 15, N March: 17, N April: 17, N May: 24. Sedge zone: N February: 3, N March: 27, N April: 24, N May: 26.

Graph 6b: The mean green percentage of the grasses and sedges per site per month. Crocks Island N February: 23, N March: 45, N April: 42, N May: 45. Lions Island N February: 34, N March: 44, N April: 42, N May: 45. Mopane Transect N February: 18, N March: 18, N April: 18, N May: 18. The Weir N February: 6, N March: 27, N April: 27, N May: 23.

Graph 7a: The mean percentage of leaves of the grasses and sedges per habitat type per month. *Mopane* high-density woodland: N February: 9, N March: 9, N April: 9, N May: 9. *Mopane* low-density woodland: N February: 9, N March: 9, N April: 9, N May: 9. Mixed *Acacia* woodland: N February: 18, N March: 18, N April: 17, N May: 18. Grassland: N February: 13, N March: 17, N April: 18, N May: 18. Upper floodplain: N February: 17, N March: 27, N April: 25, N May: 27. Lower floodplain: N February: 21, N March: 17, N April: 17, N May: 24. Sedge zone: N February: 21, N March: 27, N April: 24, N May: 26.

Graph 7b: The mean leaf percentage of the grasses and sedges per site per month. Crocks Island N February: 33, N March: 45, N April: 42, N May: 45. Lions Island N February: 42, N March: 44, N April: 42, N May: 45. Mopane Transect N February: 18, N March: 18, N April: 18, N May: 18. The Weir N February: 15, N March: 27, N April: 27, N May: 23.

Graph 8a: The mean length (cm) of the grasses and sedges per habitat type per month. *Mopane* high-density woodland: N February: 9, N March: 9, N April: 9, N May: 9. *Mopane* low-density woodland: N February: 9, N March: 9, N April: 9, N May: 9. Mixed *Acacia* woodland: N February: 18, N March: 18, N April: 17, N May: 18. Grassland: N February: 13, N March: 17, N April: 18, N May: 18. Upper floodplain: N February: 17, N March: 27, N April: 25, N May: 27. Lower floodplain: N February: 21, N March: 17, N April: 17, N May: 24. Sedge zone: N February: 21, N March: 27, N April: 24, N May: 26.

Graph 8b: The mean length (cm) of the grasses and sedges per site per month. Crocks Island N February: 33, N March: 45, N April: 42, N May: 45. Lions Island N February: 42, N March: 44, N April: 42, N May: 45. Mopane Transect N February: 18, N March: 18, N April: 18, N May: 18. The Weir, N February: 15, N March: 27, N April: 27, N May: 23.

Graph 9a: The mean dry weight (g) of the grasses and sedges per habitat type per month. *Mopane* high-density woodland: N February: 9, N March: 9, N April: 9, N May: 9. *Mopane* low-density woodland: N February: 9, N March: 9, N April: 9, N May: 9. Mixed *Acacia* woodland: N February: 18, N March: 18, N April: 17, N May: 18. Grassland: N February: 13, N March: 17, N April: 17, N May: 18. Upper floodplain: N February: 17, N March: 27, N April: 25, N May: 27. Lower floodplain: N February: 21, N March: 17, N April: 17, N May: 24. Sedge zone: N February: 21, N March: 27, N April: 24, N May: 26.

Graph 9b: The mean dry weight (g) of the grasses and sedges per site per month. Crocks Island N February: 33, N March: 45, N April: 42, N May: 45. Lions Island N February: 42, N March: 44, N April: 42, N May: 45. Mopane Transect N February: 18, N March: 18, N April: 18, N May: 18. The Weir N February: 15, N March: 27, N April: 27, N May: 23.

Graph 10a: The mean biomass (g/m2) of the grasses and sedges per habitat type per month. *Mopane* high-density woodland: N February: 9, N March: 9, N April: 9, N May: 9. *Mopane* low-density woodland: N February: 9, N March: 9, N April: 9, N May: 9. Mixed *Acacia* woodland: N February: 9, N March: 8. Grassland: N February: 9, N March: 17, N April: 18. Upper floodplain: N February: 9, N March: 27, N April: 28. Lower floodplain: N February: 15, N March: 27, N April: 27, N May: 24. Sedge zone: N February: 3, N March: 27, N April: 24, N May: 26.

Graph 10b: The mean biomass (g/m2) of the grasses and sedges per site per month. Crocks Island, N March: 45, N April: 33. Lions Island N February: 36, N March: 44, N April: 27. Mopane Transect N March: 18, N April: 18. The Weir N February: 13, N March: 27, N April: 27.

Graph 11: Mean overall density of the herbivore species in the sampled area of the Okavango delta per km^2. Error bars show one standard error around the mean.

Graph 12: The selection ratio of the herbivore species per week per habitat type. W: mixed *Acacia* woodland, G: grassland, UF: upper floodplain, LF: lower floodplain, M: *Mopane* woodland

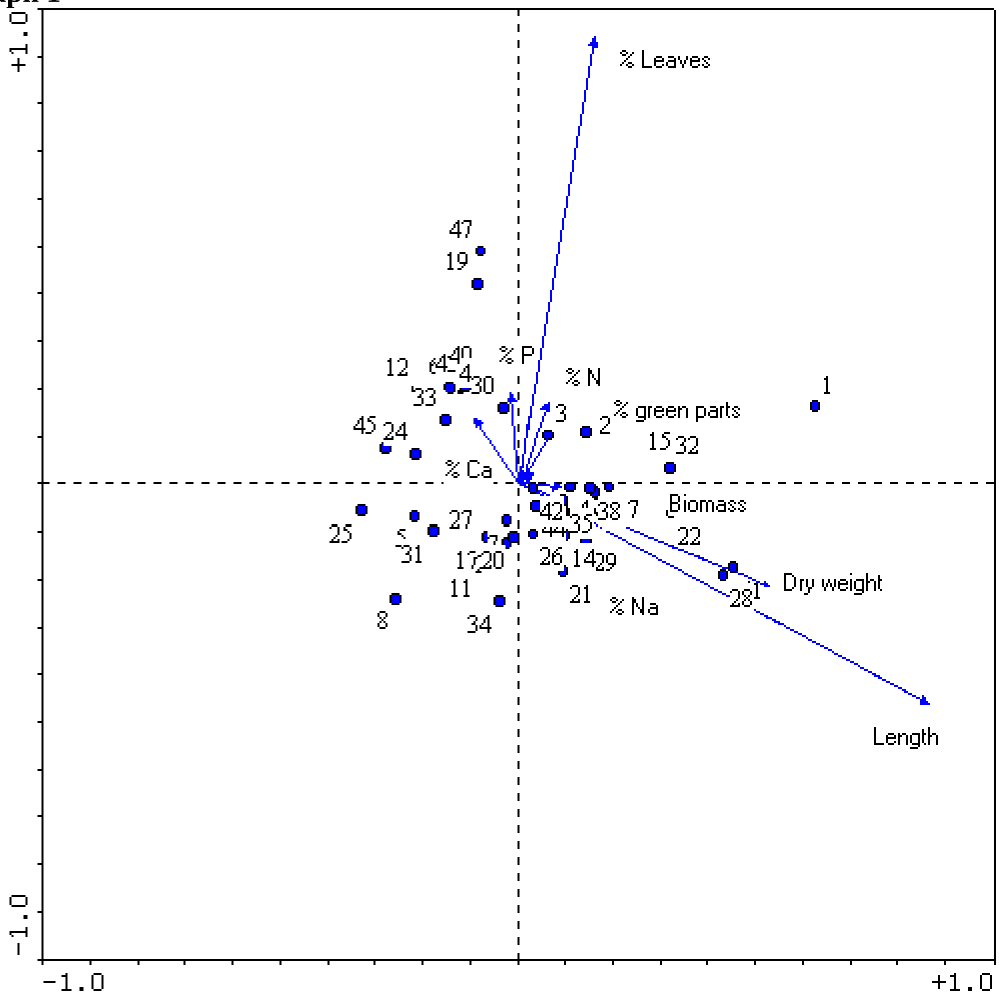
Graph 13: The species packing per transect

Graph 14: The weight ratios of the herbivores per transect per week starting from the first week of February (1) till the first week of May (15).

Graph 15: The species packing per habitat type. W: mixed *Acacia* woodland, G: grassland, UF: upper floodplain, LF: lower floodplain, M: *Mopane* woodland

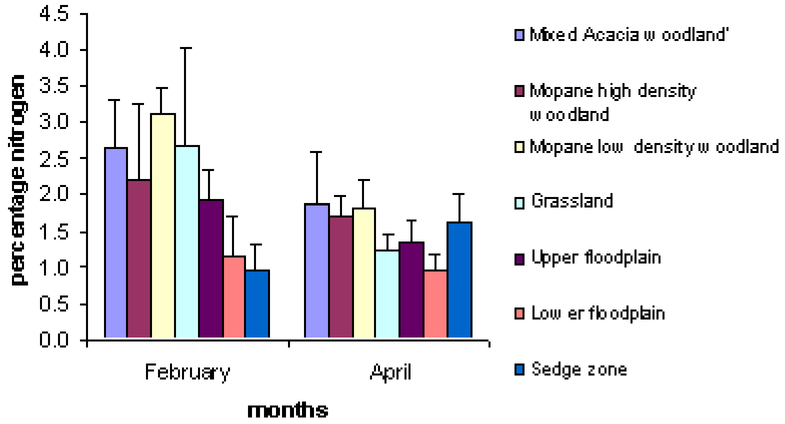
Graph 16: The weight ratios of the herbivores per habitat type per week starting from the first week of February (1) till the first week of May (15).

Graph 1

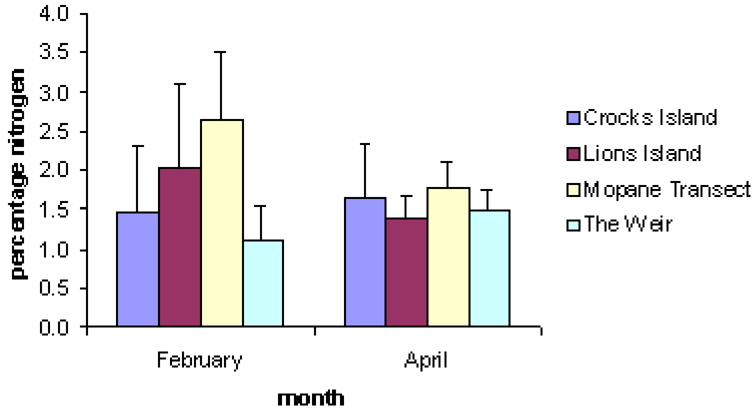


+1.0
-1.0
-1.0
+1.0
% Leaves
% P
% N
% green parts
% Ca
Biomass
Dry weight
% Na
Length

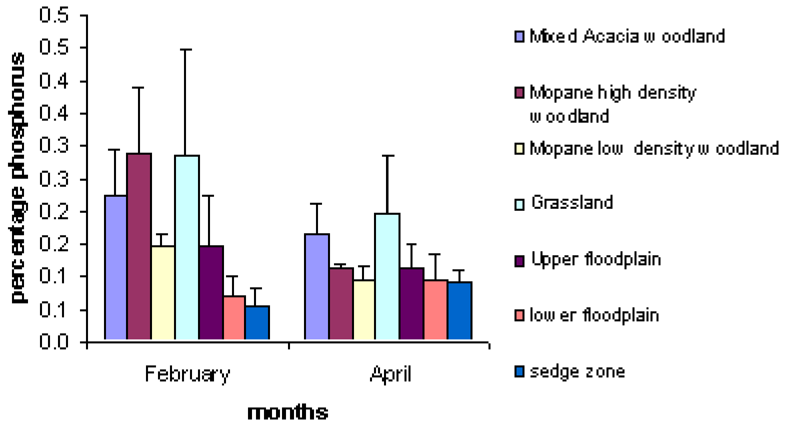
Graph 2a



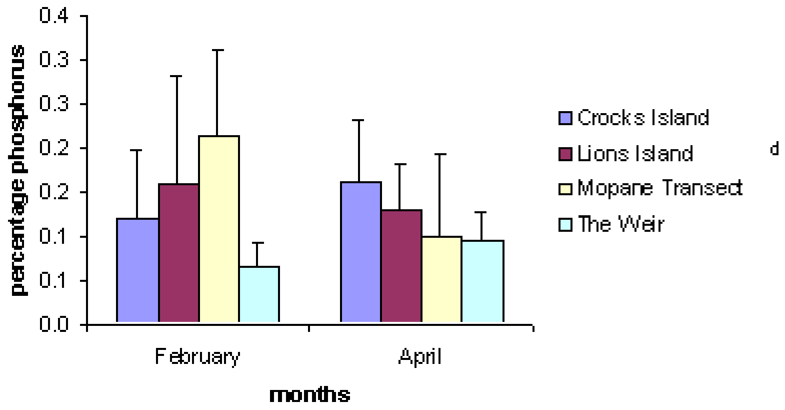
Graph 2b



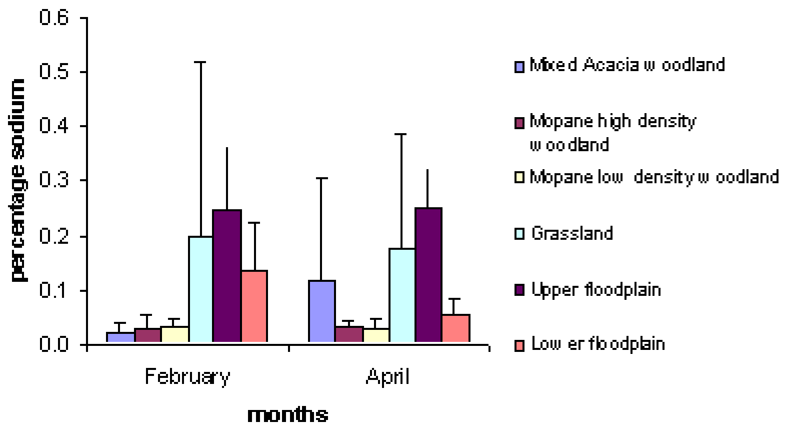
Graph 3a



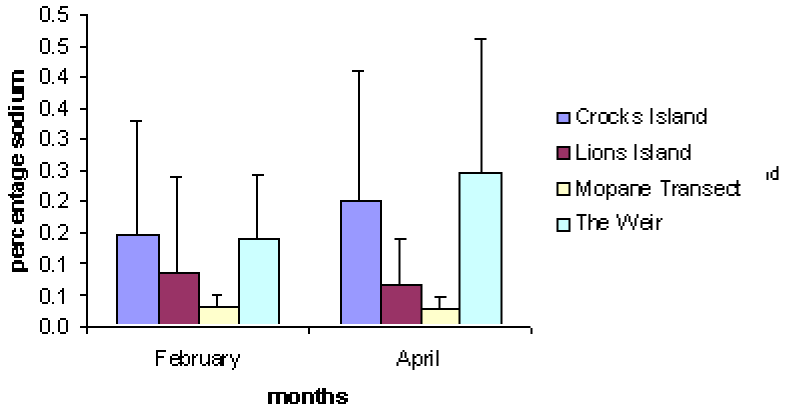
Graph 3b



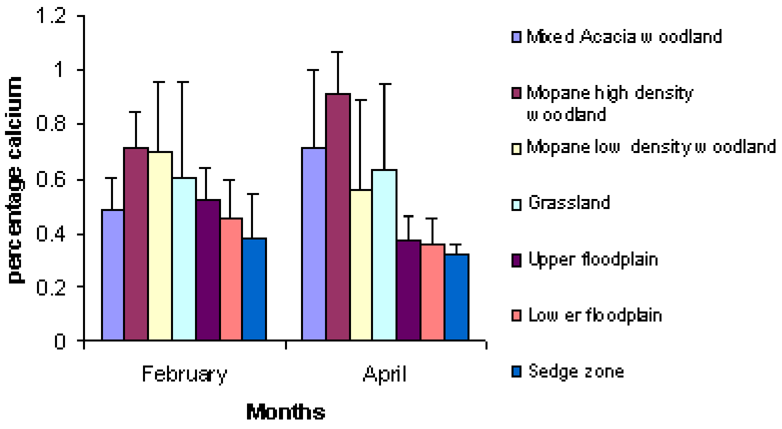
Graph 4a



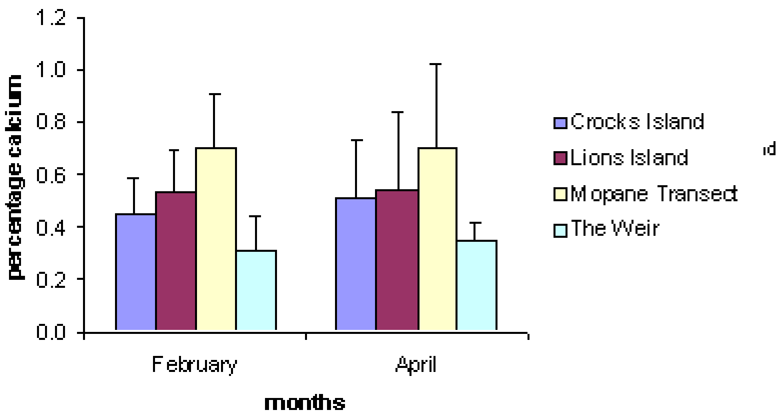
Graph 4b



Graph 5a



Graph 5b



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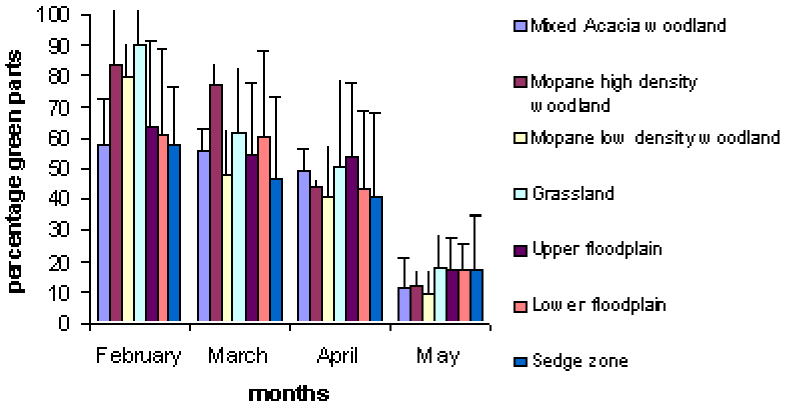
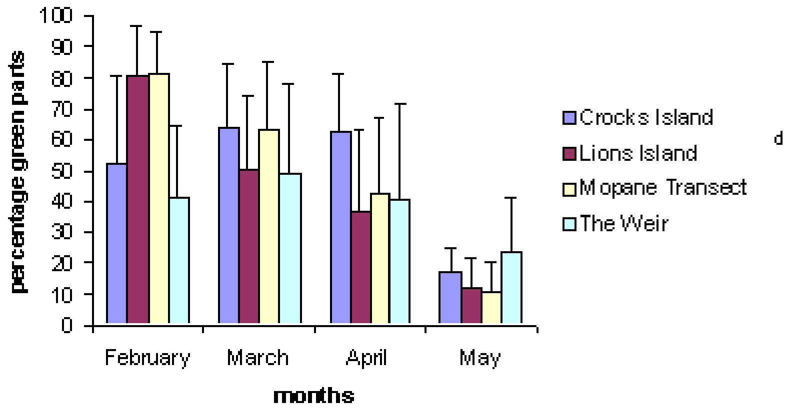


Graph 6b



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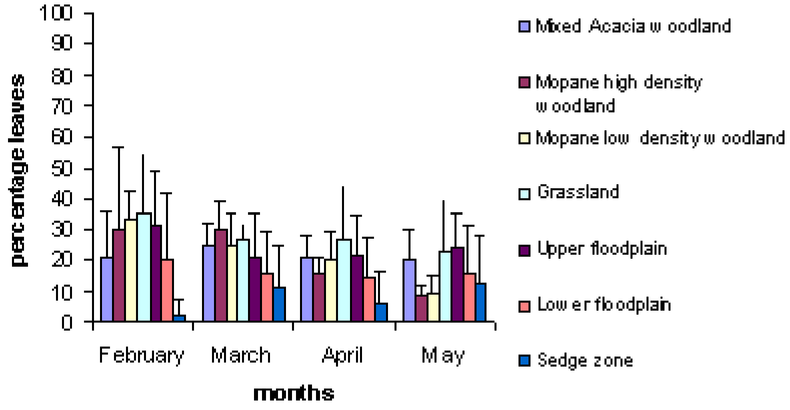

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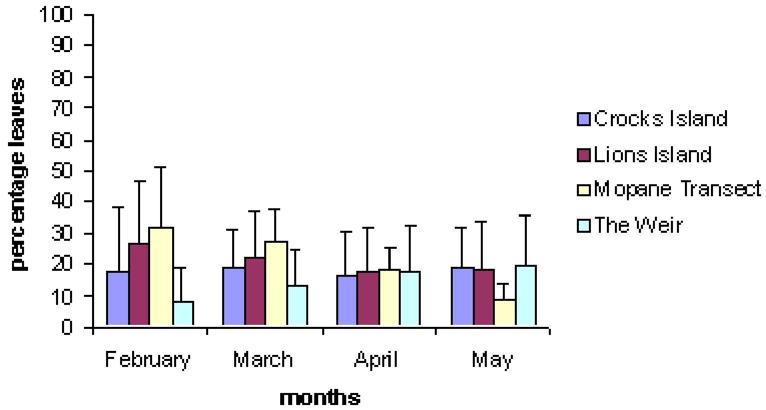
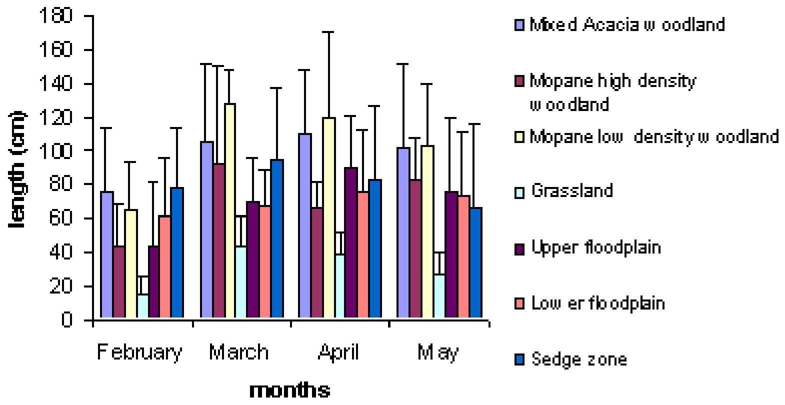


Graph 8a



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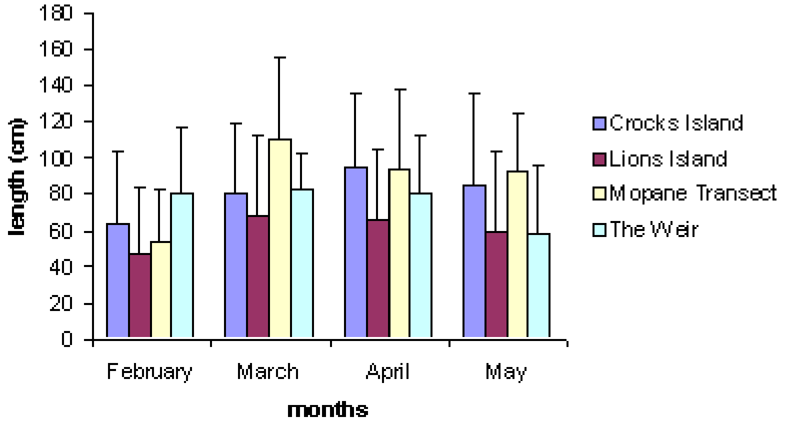
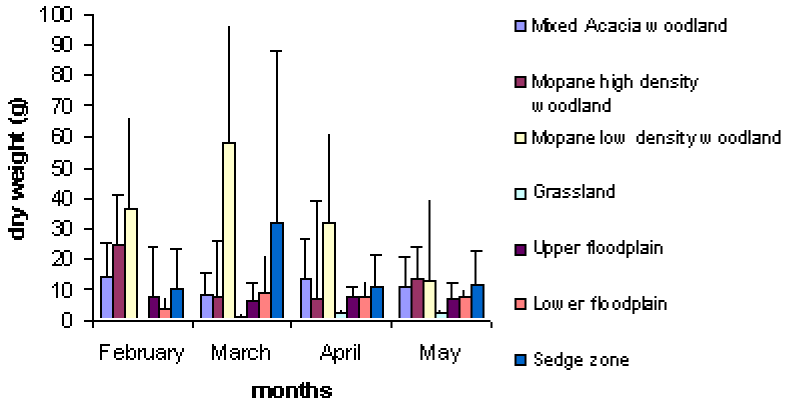
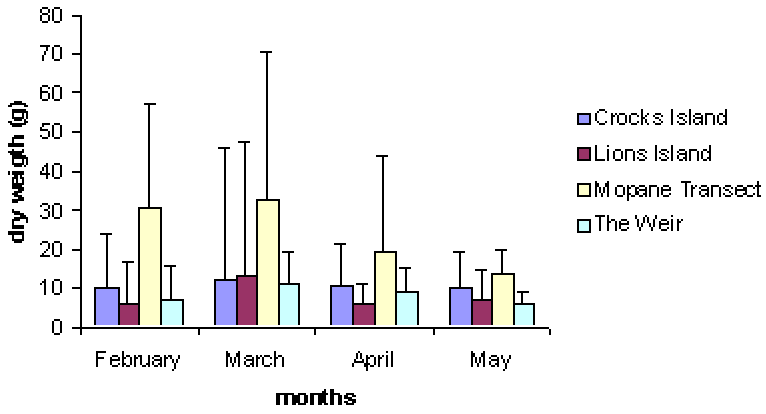


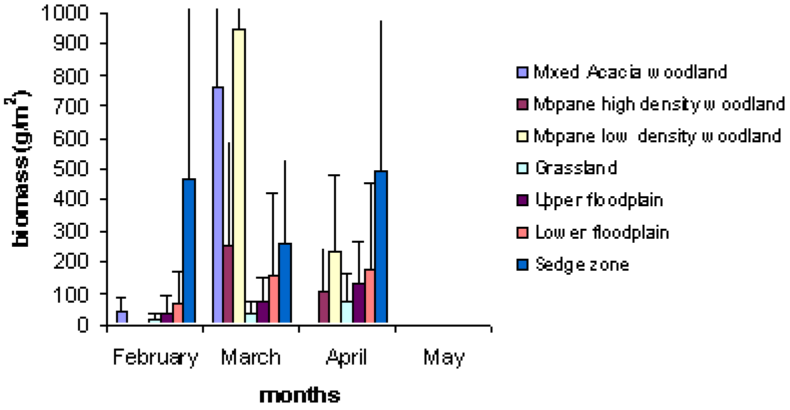
Graph 9a



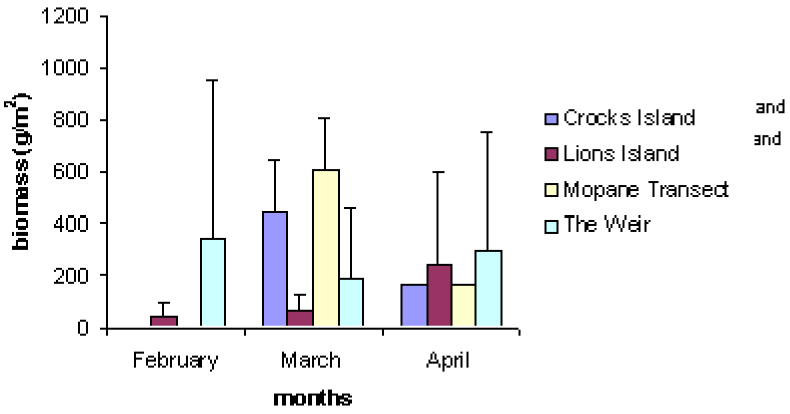
Graph 9b



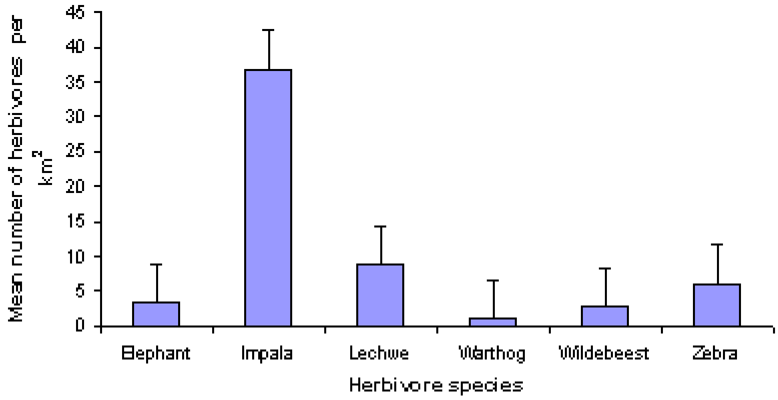
Graph 10a



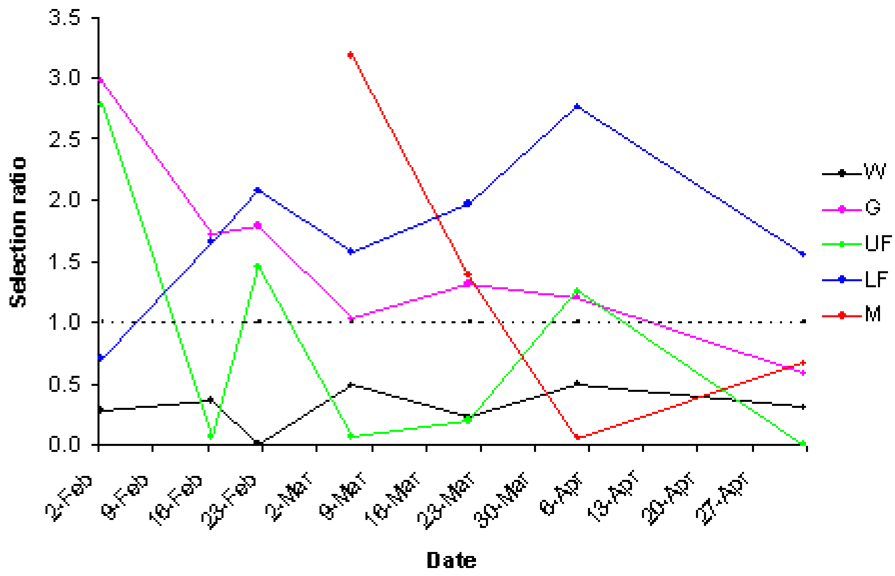
Graph 10b



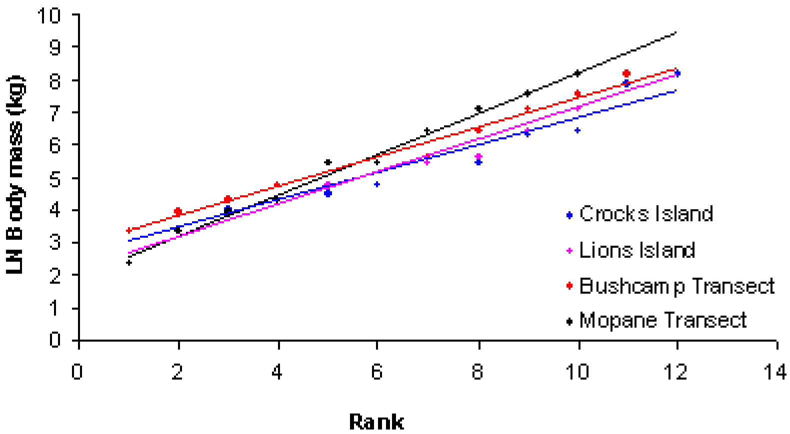
Graph 11



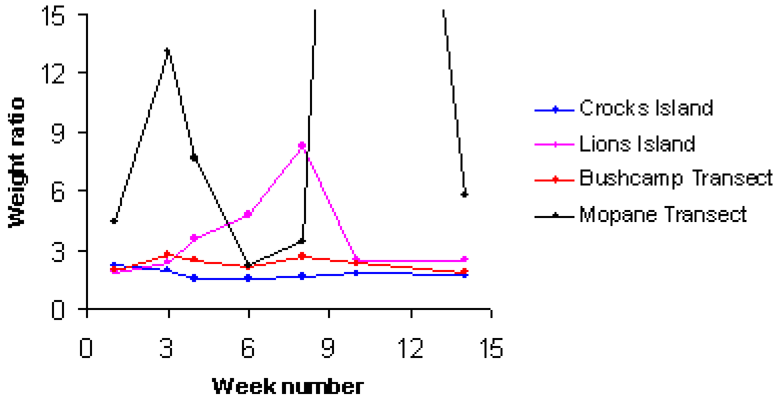
Graph 12



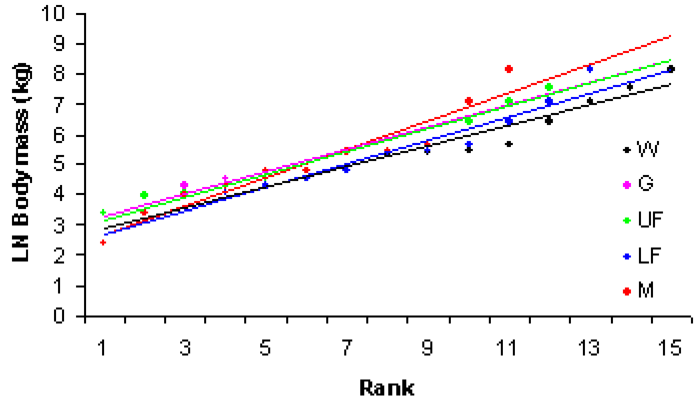
Graph 13



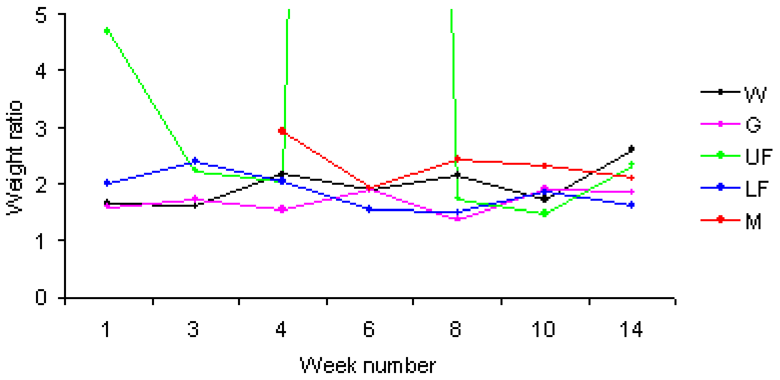
Graph 14



Graph 15



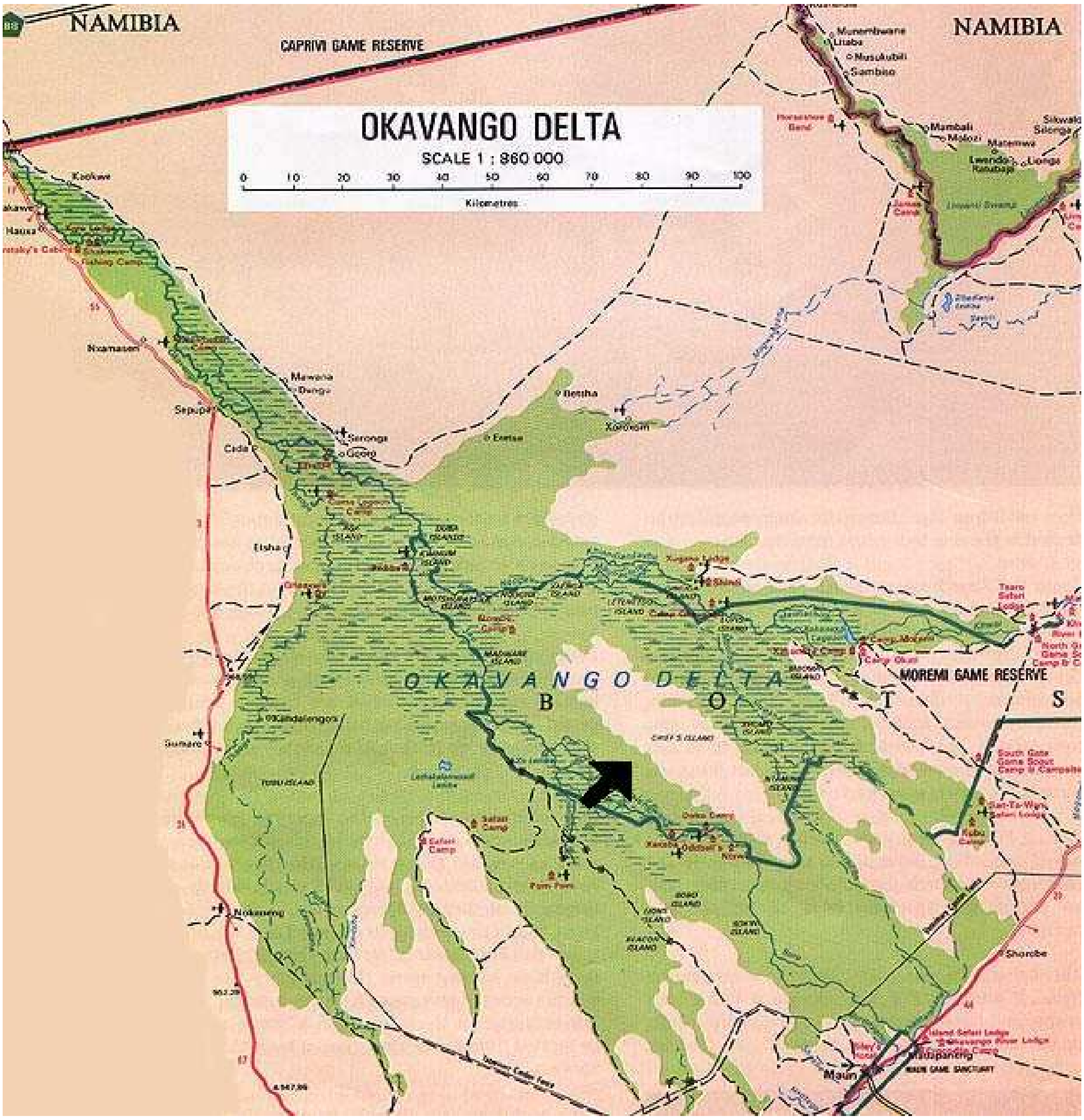
Graph 16



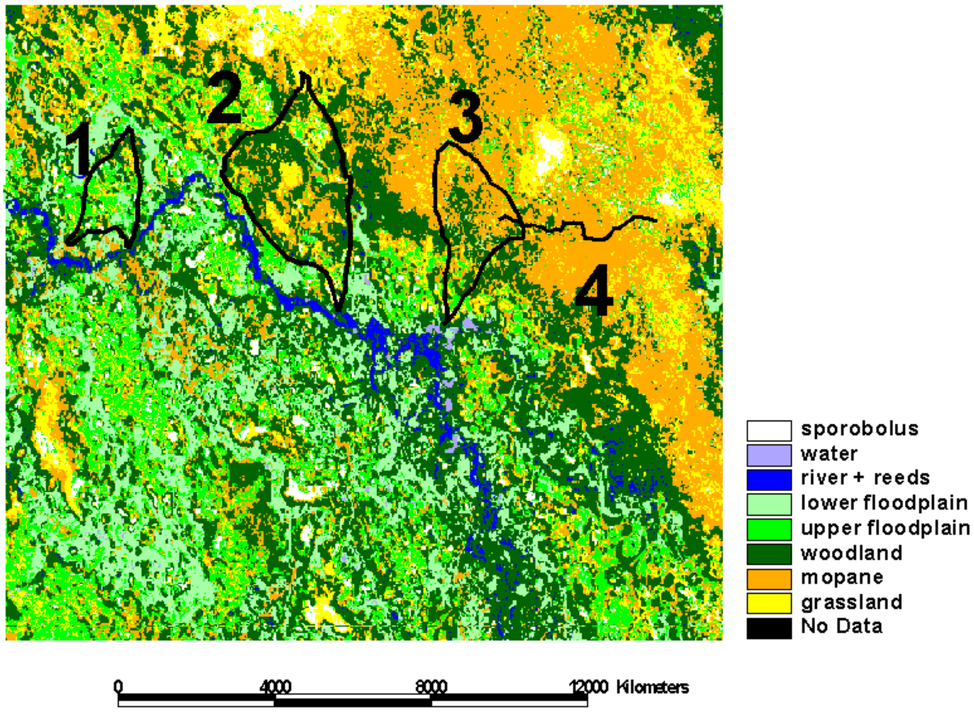
Maps

Map 1: The location of the Okavango delta within Botswana

Map 2: The Okavango Delta. Chief's Island is located near the arrow



Map 3: the overview of the transects. 1: Crocks Island, 2: Bushcamp Transect, 3: Lions Island, 4: Mopane Transect.



Appendix

Table 1: Means of the quality and quantity parameters per month, per site and per vegetation type. Site: 1: Crocks Island, 2: Lions Island, 3: The Weir, 4: Mopane Transect. Vegetation type: W: mixed *Acacia* woodland, G: grassland, UF: upper floodplain, LF: lower floodplain, S: sedge zone, MH: high-density *Mopane* woodland, ML: low-density *Mopane* woodland.

Month	Site	Vegetation type		Length (cm)	Dry weight (g)	Biomass (g/m^2)	% leaves	% green parts	% N	% P	% Na	% Ca
February	1	W	Mean	80.33	18.49		18.77	46.89	2.28	0.18	0.03	0.52
			N	9	9		9	9	9	9	9	9
			Std. Dev.	36.07	10.23		13.15	22.87	0.37	0.04	0.02	0.12
		G	Mean	10.75	0.23		42.16	90	0.95	0.1	0.1	0.23
			N	4	4		4	3	1	1	1	1
			Std. Dev.	8.26	0.17		29.01	17.32	.	.	.	.
		UF	Mean	61.75	18.1		28.4	53.97	1.97	0.2	0.54	0.42
			N	6	6		6	6	3	3	3	3
			Std. Dev.	51.56	25.1		18.32	31.04	0.66	0.1	0.23	0.13
		LF	Mean	64.38	5.05		10.05	37.28	0.76	0.06	0.2	0.4
			N	8	8		8	5	6	6	6	6
			Std. Dev.	32.95	4.07		16.04	26.77	0.27	0.03	0.06	0.11
		S	Mean	72.17	3.14		0		0.66	0.04	0.07	0.45
			N	6	6		6		5	5	5	5
			Std. Dev.	34.42	2.53		0		0.1	0.01	0.05	0.16
		Total	Mean	63.17	10.16		17.83	52.27	1.47	0.12	0.15	0.45
			N	33	33		33	23	24	24	24	24
			Std. Dev.	40.15	13.73		20.02	28.72	0.82	0.08	0.18	0.14
	2	W	Mean	72.56	9.82	42.33	23.6	71.39	3.18	0.29	0.01	0.42
			N	9	9	9	9	7	6	6	6	6
			Std. Dev.	38.22	10.71	46.94	17.18	21.85	0.71	0.05	0.01	0.11
		G	Mean	17	0.42	16.38	31.99	90.27	3.21	0.35	0.23	0.73
			N	9	9	9	9	9	3	3	3	3
			Std. Dev.	10.2	0.36	21.7	15.08	16.37	0.96	0.13	0.38	0.3
		UF	Mean	34	1.46	37.61	33.94	78.86	1.92	0.1	0.03	0.59
			N	9	9	9	9	9	4	4	4	4
			Std. Dev.	26.98	2.06	55.36	20.68	15.23	0.14	0.02	0.06	0.04
		LF	Mean	43.22	2.34	61	35.27	79.02	1.65	0.1	0.02	0.57
			N	9	9	9	9	9	7	7	7	7
			Std. Dev.	28.95	2.53	91.34	19.34	9.41	0.41	0.02	0.03	0.11
		S	Mean	74.5	20.74		0		0.74	0.04	0.2	0.44
			N	6	6		6		6	6	6	6
			Std. Dev.	41.35	16.74		0		0.23	0.02	0.09	0.12
		Total	Mean	46.38	5.97	39.33	26.74	80.38	2.01	0.16	0.08	0.53
			N	42	42	36	42	34	26	26	26	26
			Std. Dev.	36.21	10.39	58.97	19.97	16.56	1.07	0.12	0.15	0.16
	3	UF	Mean	31.5	2.63		25.5	27.1				
			N	2	2		2	2				

			Std. Dev.	0.71	0.62		5.07	17.66				
		LF	Mean	92.75	5.99	72.54	6.59	20	0.79	0.05	0.25	0.31
			N	4	4	4	4	1	4	4	4	4
			Std. Dev.	36.31	3.25	144.84	13.19	.	0.45	0.01	0.08	0.07
		S	Mean	85.11	8.46	468.42	4.97	57.66	1.24	0.07	0.09	0.31
			N	9	9	9	9	3	9	9	9	9
			Std. Dev.	33.35	10.64	702.41	7.55	19.05	0.39	0.03	0.07	0.16
		Total	Mean	80	7.02	346.61	8.14	41.2	1.1	0.07	0.14	0.31
			N	15	15	13	15	6	13	13	13	13
			Std. Dev.	36.3	8.45	608.55	11.04	23.23	0.45	0.03	0.1	0.13
	4	MH	Mean	43.44	24.63		30.17	83.45	3.13	0.29	0.03	0.72
			N	9	9		9	9	8	8	8	8
			Std. Dev.	24.26	23.14		26.44	16.1	1.04	0.1	0.02	0.13
		LH	Mean	65.11	36.54		33.12	79.45	2.2	0.15	0.03	0.69
			N	9	9		9	9	9	9	9	9
			Std. Dev.	27.87	29.9		9.57	11.53	0.35	0.02	0.02	0.26
		Total	Mean	54.28	30.58		31.64	81.45	2.64	0.21	0.03	0.7
			N	18	18		18	18	17	17	17	17
			Std. Dev.	27.69	26.65		19.35	13.74	0.87	0.1	0.02	0.2
	Total	W	Mean	76.44	14.16	42.33	21.18	57.61	2.64	0.22	0.02	0.48
			N	18	18	9	18	16	15	15	15	15
			Std. Dev.	36.27	11.1	46.94	15.05	25.05	0.68	0.07	0.02	0.12
		G	Mean	15.08	0.36	16.38	35.12	90.2	2.65	0.28	0.2	0.61
			N	13	13	9	13	12	4	4	4	4
			Std. Dev.	9.77	0.32	21.7	19.64	15.79	1.38	0.16	0.32	0.35
		UF	Mean	43.5	7.47	37.61	30.99	63.98	1.94	0.14	0.25	0.52
			N	17	17	9	17	17	7	7	7	7
			Std. Dev.	37.26	16.27	55.36	18.21	27.73	0.39	0.08	0.3	0.12
		LF	Mean	60.71	4.07	64.55	20.2	61.17	1.13	0.07	0.13	0.45
			N	21	21	13	21	15	17	17	17	17
			Std. Dev.	35.51	3.52	104.1	21.12	28.02	0.57	0.03	0.12	0.15
		S	Mean	78.38	10.45	468.42	2.13	57.66	0.95	0.06	0.12	0.38
			N	21	21	9	21	3	20	20	20	20
			Std. Dev.	34.72	12.9	702.41	5.4	19.05	0.4	0.03	0.09	0.16
		MH	Mean	43.44	24.63		30.17	83.45	3.13	0.29	0.03	0.72
			N	9	9		9	9	8	8	8	8
			Std. Dev.	24.26	23.14		26.44	16.1	1.04	0.1	0.02	0.13
		LH	Mean	65.11	36.54		33.12	79.45	2.2	0.15	0.03	0.69
			N	9	9		9	9	9	9	9	9
			Std. Dev.	27.87	29.9		9.57	11.53	0.35	0.02	0.02	0.26
		Total	Mean	57.5	11.5	120.85	22.25	69.73	1.84	0.14	0.1	0.51
			N	108	108	49	108	81	80	80	80	80
			Std. Dev.	37.55	17.22	337.5	20.12	25.33	1.01	0.11	0.14	0.2
March	1	W	Mean	99.33	7.63	1405.32	28.23	64.63				
			N	9	9	9	9	9				
			Std. Dev.	29.33	5.01	1820.84	7.82	18.37				

	G	Mean	51.56	1.19	62.27	24.82	67.49
		N	9	9	9	9	9
		Std. Dev.	13.31	0.61	31.13	5.15	23.47
	UF	Mean	68	3.42	49	16.61	53.55
		N	9	9	9	9	9
		Std. Dev.	26.5	1.51	53.77	7.3	20.67
	LF	Mean	65.67	6.17	267.1	17.41	67.8
		N	9	9	9	9	9
		Std. Dev.	25.68	10.67	400.32	15.52	17.41
	S	Mean	115.78	42.96	406.62	7.38	67.39
		N	9	9	9	9	9
		Std. Dev.	54.85	68.93	101.65	11.13	22.34
	Total	Mean	80.07	12.27	438.06	18.89	64.17
		N	45	45	45	45	45
		Std. Dev.	39.48	33.7	944.42	12.06	20.38
2	W	Mean	109.78	8.68	120.75	22.47	46.92
		N	9	9	9	9	9
		Std. Dev.	60.49	9.26	95.84	4.83	17.53
	G	Mean	33.88	1.49	11.69	28.55	54.87
		N	8	8	8	8	8
		Std. Dev.	18.13	0.73	3.46	5.86	18.13
	UF	Mean	55.67	4.64	87.25	27.27	59.1
		N	9	9	9	9	9
		Std. Dev.	25.78	5.42	44.44	22.23	31.11
	LF	Mean	54	10.88	58.82	14.23	59.07
		N	9	9	9	9	9
		Std. Dev.	18.55	18.54	38.57	12.72	26.81
	S	Mean	82.22	38.85	40.73	20.91	30.59
		N	9	9	9	9	9
		Std. Dev.	41.61	69.85	29	16.41	15.37
	Total	Mean	67.86	13.17	65.03	22.55	50
		N	44	44	44	44	44
		Std. Dev.	44.06	34.31	62.65	14.44	24.25
3	UF	Mean	82.11	9.46	84.26	17.88	50.91
		N	9	9	9	9	9
		Std. Dev.	24.35	9.12	118.32	10.19	19.14
	LF	Mean	81.22	9.74	144.22	15.74	55.17
		N	9	9	9	9	9
		Std. Dev.	14.7	6.72	216.19	13.52	37.14
	S	Mean	83.33	12.9	328.97	5.58	41.63
		N	9	9	9	9	9
		Std. Dev.	24.01	10.54	391.4	8.41	29.18
	Total	Mean	82.22	10.7	185.82	13.07	49.23
		N	27	27	27	27	27
		Std. Dev.	20.66	8.73	277.65	11.82	28.85
4	MH	Mean	92.44	7.8	256.48	29.91	77.74
		N	9	9	9	9	9

			Std. Dev.	57.26	6.79	328.87	9.34	18.44				
		LH	Mean	128.22	58.28	946.98	24.85	47.76				
			N	9	9	9	9	9				
			Std. Dev.	19.39	38.64	728.93	10.62	14.63				
		Total	Mean	110.33	33.04	601.73	27.38	62.75				
			N	18	18	18	18	18				
			Std. Dev.	45.37	37.4	653.56	10.04	22.33				
	Total	W	Mean	104.56	8.15	763.04	25.35	55.78				
			N	18	18	18	18	18				
			Std. Dev.	46.43	7.24	1414.69	6.96	19.65				
		G	Mean	43.24	1.33	38.47	26.57	61.55				
			N	17	17	17	17	17				
			Std. Dev.	17.75	0.67	34.16	5.65	21.48				
		UF	Mean	68.59	5.84	73.5	20.58	54.52				
			N	27	27	27	27	27				
			Std. Dev.	26.91	6.51	78.22	14.96	23.54				
		LF	Mean	66.96	8.93	156.71	15.79	60.68				
			N	27	27	27	27	27				
			Std. Dev.	22.46	12.61	267.84	13.48	27.71				
		S	Mean	93.78	31.57	258.77	11.29	46.53				
			N	27	27	27	27	27				
			Std. Dev.	43.45	56.4	276.23	13.83	27.11				
		MH	Mean	92.44	7.8	256.48	29.91	77.74				
			N	9	9	9	9	9				
			Std. Dev.	57.26	6.79	328.87	9.34	18.44				
		LH	Mean	128.22	58.28	946.98	24.85	47.76				
			N	9	9	9	9	9				
			Std. Dev.	19.39	38.64	728.93	10.62	14.63				
		Total	Mean	80.56	15.04	286.73	20.06	56.32				
			N	134	134	134	134	134				
			Std. Dev.	40.79	31.64	636.8	13.25	24.57				
April	1	W	Mean	115.11	20.96		24.44	71.61	2.28	0.17	0.16	0.71
			N	9	9		9	9	9	9	9	9
			Std. Dev.	20.23	14.41		5.38	16.6	0.63	0.02	0.24	0.2
		G	Mean	40.25	2	65.24	24.06	70.5	1.2	0.28	0.39	0.43
			N	8	9	9	9	9	4	4	4	4
			Std. Dev.	17.52	0.7	90.26	14.9	18.01	0.19	0.07	0.16	0.14
		UF	Mean	102.33	7.91	156.64	18.6	60.1	1.08	0.12	0.23	0.37
			N	9	9	9	9	9	6	6	6	6
			Std. Dev.	16.59	2.24	136.99	15.35	16.62	0.21	0.02	0.15	0.11
		LF	Mean	91.78	5.87	40.05	8.53	55.44	1.35	0.07	0	0.31
			N	9	9	9	9	9	3	3	3	3
			Std. Dev.	41.9	3.9	21.6	13.1	20.6	0.2	0	0	0.1
		S	Mean	123.7	16.6	548.9	0	50.2				
			N	6	6	6	6	6				
			Std. Dev.	57.39	14.06	66.81	0	17.1				

	Total	Mean	93.83	10.25	171.24	16.21	62.38	1.63	0.16	0.2	0.51
		N	41	42	33	42	42	22	22	22	22
		Std. Dev.	42.19	10.96	205.79	14.48	18.86	0.7	0.07	0.21	0.23
2	W	Mean	103.5	4.16		16.6	24.12	1.26	0.16	0.05	0.73
		N	8	8		8	8	6	6	6	6
		Std. Dev.	53.55	3.62		7.66	32.88	0.3	0.07	0.02	0.4
	G	Mean	37.11	2.87	72.25	29.94	30.77	1.27	0.14	0.03	0.76
		N	9	9	9	9	9	6	6	6	6
		Std. Dev.	8.04	1.09	102.09	19.65	22.98	0.23	0.05	0.01	0.34
	UF	Mean	86.71	9.44		17.33	44.95	1.55	0.12	0.14	0.39
		N	7	7		7	7	6	6	6	6
		Std. Dev.	26.51	4.85		7.45	30.49	0.35	0.04	0.13	0.11
	LF	Mean	55.67	5.73	205.33	18.78	32.96	1.33	0.11	0.03	0.41
		N	9	9	9	9	9	7	7	7	7
		Std. Dev.	33.71	3.96	120.26	11.17	17.05	0.07	0.05	0.02	0.07
	S	Mean	55.44	7.23	441.65	6.98	50.72	1.7	0.1	0.12	0.3
		N	9	9	9	9	9	3	3	3	3
		Std. Dev.	21.7	7.21	557.05	10.76	23.93	0.41	0.02	0.02	0.02
	Total	Mean	65.93	5.76	239.74	17.99	36.61	1.39	0.13	0.06	0.54
		N	42	42	27	42	42	28	28	28	28
		Std. Dev.	38.7	4.92	356.89	14.11	26.24	0.3	0.05	0.08	0.3
3	UF	Mean	80.33	5.24	100.84	28.55	54.37	1.38	0.11	0.34	0.37
		N	9	9	9	9	9	9	9	9	9
		Std. Dev.	41.63	3.54	145.4	11.12	26.54	0.23	0.03	0.24	0.06
	LF	Mean	80.56	10.8	289.96	16.66	41.27	1.65	0.08	0.12	0.31
		N	9	9	9	9	9	5	5	5	5
		Std. Dev.	24.52	5.89	434.13	13.01	33.56	0.29	0.03	0.11	0.09
	S	Mean	80.67	11.65	498.06	8.68	24.89	1.51	0.08	0.16	0.36
		N	9	9	9	9	9	2	2	2	2
		Std. Dev.	32.22	6.53	609.4	13.26	30.31	0.04	0.01	0.03	0.02
	Total	Mean	80.52	9.23	296.28	17.96	40.18	1.48	0.09	0.25	0.35
		N	27	27	27	27	27	16	16	16	16
		Std. Dev.	32.21	6	453.98	14.61	31.57	0.26	0.03	0.21	0.07
4	MH	Mean	66.33	6.4	104.22	16.07	44.13	1.83	0.11	0.03	0.91
		N	9	9	9	9	9	6	6	6	6
		Std. Dev.	14.43	2.33	142.33	4.86	32.19	0.27	0.01	0.01	0.15
	LH	Mean	119.67	32.17	231.78	20.39	40.74	1.71	0.09	0.03	0.56
		N	9	9	9	9	9	9	9	9	9
		Std. Dev.	50.71	29.38	246	9.08	17	0.39	0.02	0.02	0.33
	Total	Mean	93	19.28	168	18.23	42.44	1.76	0.1	0.03	0.7
		N	18	18	18	18	18	15	15	15	15
		Std. Dev.	45.4	24.18	205.71	7.4	25.03	0.34	0.02	0.02	0.32
Total	W	Mean	109.65	13.06		20.75	49.26	1.87	0.16	0.12	0.72
		N	17	17		17	17	15	15	15	15
		Std. Dev.	38.67	13.57		7.51	34.75	0.72	0.05	0.19	0.28
	G	Mean	38.59	2.43	68.75	27	50.63	1.24	0.2	0.17	0.63
		N	17	18	18	18	18	10	10	10	10

			Std. Dev.	13.01	1	93.55	17.19	28.62	0.21	0.09	0.21	0.32
		UF	Mean	90.04	7.38	128.74	21.82	53.8	1.34	0.11	0.25	0.38
			N	25	25	18	25	25	21	21	21	21
			Std. Dev.	30.66	3.85	140.01	12.66	24.43	0.31	0.03	0.2	0.09
		LF	Mean	76	7.47	178.45	14.66	43.22	1.44	0.09	0.05	0.36
			N	27	27	27	27	27	15	15	15	15
			Std. Dev.	36.2	5.09	271.6	12.8	25.6	0.23	0.04	0.08	0.1
		S	Mean	81.96	11.24	489.62	5.87	40.91	1.62	0.09	0.14	0.33
			N	24	24	24	24	24	5	5	5	5
			Std. Dev.	44.39	9.48	489.82	10.68	27.25	0.31	0.02	0.03	0.03
		MH	Mean	66.33	6.4	104.22	16.07	44.13	1.83	0.11	0.03	0.91
			N	9	9	9	9	9	6	6	6	6
			Std. Dev.	14.43	2.33	142.33	4.86	32.19	0.27	0.01	0.01	0.15
		LH	Mean	119.67	32.17	231.78	20.39	40.74	1.71	0.09	0.03	0.56
			N	9	9	9	9	9	9	9	9	9
			Std. Dev.	50.71	29.38	246	9.08	17	0.39	0.02	0.02	0.33
		Total	Mean	81.75	9.83	220.45	17.44	46.56	1.54	0.13	0.13	0.52
			N	128	129	105	129	129	81	81	81	81
			Std. Dev.	40.99	12.22	325.8	13.5	27.31	0.46	0.06	0.17	0.27
May	1	W	Mean	125.11	16.13		17.55	11.28				
			N	9	9		9	9				
			Std. Dev.	27.66	10.3		10.69	7.15				
		G	Mean	32.56	3.17		15.17	17.26				
			N	9	9		9	9				
			Std. Dev.	9.53	1.98		12.43	5.05				
		UF	Mean	65.89	8.74		30.11	25.78				
			N	9	9		9	9				
			Std. Dev.	46.78	8.63		9.84	5.01				
		LF	Mean	89.56	7.7		12.92	19.14				
			N	9	9		9	9				
			Std. Dev.	39.48	4.22		14.57	4.97				
		S	Mean	111	14		18.42	14.47				
			N	9	9		9	9				
			Std. Dev.	56.44	11.9		11.55	7.12				
		Total	Mean	84.82	9.95		18.83	17.59				
			N	45	45		45	45				
			Std. Dev.	50.25	9.19		12.87	7.52				
	2	W	Mean	79	6.03		22.44	12.33				
			N	9	9		9	9				
			Std. Dev.	57.88	4.46		8.86	8.41				
		G	Mean	22.33	1.59		30.43	19.11				
			N	9	9		9	9				
			Std. Dev.	12.9	1.02		18.21	15.15				
		UF	Mean	78.78	6.27		17.1	10.4				
			N	9	9		9	9				
			Std. Dev.	50.99	3.52		12.58	10.07				

	LF	Mean	60.78	5.39	18.66	9.72
		N	9	9	9	9
		Std. Dev.	39.36	2.46	15.72	7.05
	S	Mean	57.78	16.1	4.04	8.23
		N	9	9	9	9
		Std. Dev.	18.21	12.06	4.84	4.59
	Total	Mean	59.73	7.07	18.53	11.96
		N	45	45	45	45
		Std. Dev.	43.49	7.57	15.1	10.04
3	UF	Mean	81	5.1	24.82	16.58
		N	9	9	9	9
		Std. Dev.	39.71	2.64	8.63	8.49
	LF	Mean	66.17	8.23	16.15	25
		N	6	6	6	6
		Std. Dev.	30.67	3.42	17.91	7.69
	S	Mean	24.25	4.65	15.6	30.79
		N	8	8	8	8
		Std. Dev.	15.86	3.63	22.13	25.67
	Total	Mean	57.39	5.76	19.35	23.72
		N	23	23	23	23
		Std. Dev.	38.93	3.42	16.61	16.99
4	MH	Mean	82.33	13.09	8.63	12.16
		N	9	9	9	9
		Std. Dev.	25.81	5.57	3.35	10.65
	LH	Mean	103.22	13.42	9.13	9.19
		N	9	9	9	9
		Std. Dev.	35.69	7.86	6.08	8.15
	Total	Mean	92.78	13.25	8.88	10.67
		N	18	18	18	18
		Std. Dev.	32.07	6.61	4.77	9.33
Total	W	Mean	102.06	11.08	20	11.81
		N	18	18	18	18
		Std. Dev.	49.99	9.29	9.86	7.6
	G	Mean	27.44	2.38	22.8	18.19
		N	18	18	18	18
		Std. Dev.	12.2	1.73	17.04	11
	UF	Mean	75.22	6.7	24.01	17.59
		N	27	27	27	27
		Std. Dev.	44.77	5.59	11.45	10.13
	LF	Mean	72.92	6.97	15.88	17.07
		N	24	24	24	24
		Std. Dev.	38.25	3.53	15.36	8.83
	S	Mean	65.88	11.85	12.58	17.33
		N	26	26	26	26
		Std. Dev.	50.07	10.97	15.13	17.27
	MH	Mean	82.33	13.09	8.63	12.16
		N	9	9	9	9

			Std. Dev.	25.81	5.57		3.35	10.65				
		LH	Mean	103.22	13.42		9.13	9.19				
			N	9	9		9	9				
			Std. Dev.	35.69	7.86		6.08	8.15				
		Total	Mean	72.48	8.68		17.45	15.78				
			N	131	131		131	131				
			Std. Dev.	45.74	7.84		13.96	11.6				
Total	1	W	Mean	104.97	15.8	1405.32	22.25	48.6	2.28	0.17	0.1	0.61
			N	36	36	9	36	36	18	18	18	18
			Std. Dev.	32.52	11.28	1820.84	10.27	28.85	0.5	0.03	0.18	0.19
		G	Mean	37.4	1.88	63.76	24.04	55.57	1.15	0.24	0.33	0.39
			N	30	31	18	31	30	5	5	5	5
			Std. Dev.	18.02	1.51	65.52	16.1	30.99	0.2	0.1	0.19	0.15
		UF	Mean	75.65	8.77	102.82	22.97	47.84	1.38	0.15	0.33	0.39
			N	33	33	18	33	33	9	9	9	9
			Std. Dev.	38.56	11.98	115.14	13.62	22.98	0.58	0.07	0.22	0.11
		LF	Mean	78.23	6.23	153.58	12.29	45.87	0.96	0.06	0.13	0.37
			N	35	35	18	35	32	9	9	9	9
			Std. Dev.	36.43	6.24	298.8	14.57	25.92	0.37	0.02	0.11	0.12
		S	Mean	107.2	21.04	463.54	7.74	43.25	0.66	0.04	0.07	0.45
			N	30	30	15	30	24	5	5	5	5
			Std. Dev.	53.09	40.25	112.73	11.45	28.63	0.1	0.01	0.05	0.16
		Total	Mean	81.41	10.7	325.18	17.98	48.39	1.54	0.14	0.17	0.48
			N	164	165	78	165	155	46	46	46	46
			Std. Dev.	44.33	19.88	738.16	14.67	27.44	0.76	0.08	0.2	0.19
	2	W	Mean	90.86	7.26	81.54	21.41	37.15	2.22	0.22	0.03	0.58
			N	35	35	18	35	33	12	12	12	12
			Std. Dev.	53.31	7.71	83.59	10.62	30.32	1.13	0.09	0.02	0.32
		G	Mean	27.4	1.59	34.28	30.28	48.58	1.92	0.21	0.1	0.75
			N	35	35	26	35	35	9	9	9	9
			Std. Dev.	14.72	1.21	65.47	15.2	33.05	1.1	0.13	0.22	0.31
		UF	Mean	62.44	5.22	62.43	24.3	48.53	1.7	0.11	0.09	0.47
			N	34	34	18	34	34	10	10	10	10
			Std. Dev.	39.07	4.84	54.99	18	34.13	0.33	0.03	0.12	0.13
		LF	Mean	53.42	6.08	108.38	21.73	45.19	1.49	0.1	0.02	0.49
			N	36	36	27	36	36	14	14	14	14
			Std. Dev.	30.43	9.73	111.15	16.55	31.11	0.33	0.04	0.02	0.12
		S	Mean	66.85	20.73	241.19	8.71	29.85	1.06	0.06	0.18	0.39
			N	33	33	18	33	27	9	9	9	9
			Std. Dev.	32.22	38.24	434.71	12.86	23.83	0.55	0.03	0.09	0.12
		Total	Mean	60.06	8.04	100.47	21.42	42.48	1.69	0.14	0.07	0.53
			N	173	173	107	173	165	54	54	54	54
			Std. Dev.	41.33	18.7	201.78	16.29	31.4	0.83	0.09	0.12	0.24
	3	UF	Mean	77.72	6.32	92.55	23.87	39.69	1.38	0.11	0.34	0.37
			N	29	29	18	29	29	9	9	9	9
			Std. Dev.	35.77	5.86	128.88	10.3	25.11	0.23	0.03	0.24	0.06

	LF	Mean	79.43	9.22	190.81	14.82	41.52	1.27	0.06	0.18	0.31
		N	28	28	22	28	25	9	9	9	9
		Std. Dev.	25.09	5.45	316.87	13.96	31.7	0.57	0.03	0.12	0.08
	S	Mean	69.6	9.55	431.82	8.51	35.1	1.29	0.08	0.11	0.31
		N	35	35	27	35	29	11	11	11	11
		Std. Dev.	36.38	8.69	564.68	13.77	28.34	0.37	0.02	0.06	0.14
	Total	Mean	75.15	8.43	261.53	15.27	38.64	1.31	0.08	0.2	0.33
		N	92	92	67	92	83	29	29	29	29
		Std. Dev.	33.08	7.05	427.97	14.23	28.12	0.4	0.03	0.18	0.1
4	MH	Mean	71.14	12.98	180.35	21.2	54.37	2.57	0.21	0.03	0.8
		N	36	36	18	36	36	14	14	14	14
		Std. Dev.	37.89	13.93	258	16.59	35.25	1.03	0.12	0.02	0.17
	LH	Mean	104.06	35.1	589.38	21.87	44.29	1.96	0.12	0.03	0.63
		N	36	36	18	36	36	18	18	18	18
		Std. Dev.	41.78	31.92	643.36	12.29	28.31	0.44	0.03	0.02	0.3
	Total	Mean	87.6	24.04	384.86	21.53	49.33	2.23	0.16	0.03	0.7
		N	72	72	36	72	72	32	32	32	32
		Std. Dev.	42.93	26.87	525.74	14.5	32.15	0.8	0.09	0.02	0.26
Total	W	Mean	98.01	11.59	522.8	21.83	43.12	2.25	0.19	0.07	0.6
		N	71	71	27	71	69	30	30	30	30
		Std. Dev.	44.27	10.54	1195.45	10.38	29.9	0.79	0.06	0.14	0.24
	G	Mean	32.02	1.73	46.34	27.35	51.81	1.65	0.22	0.18	0.62
		N	65	66	44	66	65	14	14	14	14
		Std. Dev.	16.96	1.36	66.36	15.82	32.06	0.95	0.12	0.23	0.31
	UF	Mean	71.6	6.77	85.93	23.71	45.62	1.49	0.12	0.25	0.41
		N	96	96	54	96	96	28	28	28	28
		Std. Dev.	38.15	8.3	104.16	14.38	28	0.42	0.05	0.22	0.11
	LF	Mean	69.55	7.02	147.59	16.44	44.44	1.28	0.08	0.1	0.41
		N	99	99	67	99	93	32	32	32	32
		Std. Dev.	33.39	7.58	247.13	15.56	29.33	0.46	0.04	0.11	0.13
	S	Mean	80.18	16.83	382.56	8.34	35.77	1.08	0.06	0.12	0.37
		N	98	98	60	98	80	25	25	25	25
		Std. Dev.	44.45	31.99	454.81	12.66	27.19	0.47	0.03	0.08	0.14
	MH	Mean	71.14	12.98	180.35	21.2	54.37	2.57	0.21	0.03	0.8
		N	36	36	18	36	36	14	14	14	14
		Std. Dev.	37.89	13.93	258	16.59	35.25	1.03	0.12	0.02	0.17
	LH	Mean	104.06	35.1	589.38	21.87	44.29	1.96	0.12	0.03	0.63
		N	36	36	18	36	36	18	18	18	18
		Std. Dev.	41.78	31.92	643.36	12.29	28.31	0.44	0.03	0.02	0.3
	Total	Mean	73.78	11.28	234.35	19.18	44.78	1.69	0.13	0.12	0.52
		N	501	502	288	502	475	161	161	161	161
		Std. Dev.	42.44	19.73	498.99	15.29	29.89	0.8	0.08	0.16	0.24

Table 2: The means of the parameters per grass and sedge species.

Species		Length (cm)	Dry weight (g)	% leaves	% green parts	biomass (g/m^2)	% N	% P	% Na	% Ca
Aristida meridionalis	Mean	161,50	78,73	34,44	43,25	379,86	1,32	0,09	0,01	0,32
	N	6	6	6	6	6	3	3	3	3
	Std. Dev.	21,76	36,08	6,38	22,40	310,04	0,08	0,01	0,01	0,01
Aristida stipoides	Mean	93,33	7,45	26,96	38,77	37,23				
	N	6	6	6	6	3				
	Std. Dev.	53,49	5,93	17,67	41,63	0,00				
Bothriochloa bladhii	Mean	76,33	15,42	28,74	62,91	800,86				
	N	3	3	3	3	3				
	Std. Dev.	47,44	16,18	11,32	22,64	0,00				
Cenchrus ciliaris	Mean	95,61	21,14	19,16	40,85	1304,20	1,97	0,18	0,02	0,48
	N	18	18	18	18	6	6	6	6	6
	Std. Dev.	23,73	13,23	7,77	27,67	1959,45	0,38	0,01	0,02	0,06
Chloris virgata	Mean	38,89	1,54	14,19	50,96	11,40				
	N	9	9	9	9	6				
	Std. Dev.	11,85	1,11	7,10	28,81	10,25				
Cynodon dactylon	Mean	26,46	2,82	30,53	36,62	147,25	1,43	0,10	0,04	0,46
	N	37	37	37	37	21	8	8	8	8
	Std. Dev.	10,09	2,96	12,46	29,31	95,55	0,24	0,02	0,04	0,06
Cyperus articulatis	Mean	101,00	8,32	5,48	59,25	39,82	0,59	0,04	0,22	0,36
	N	11	11	11	6	9	6	6	6	6
	Std. Dev.	18,43	5,09	12,37	23,55	108,05	0,14	0,03	0,09	0,11
Cyperus denudatus	Mean	52,73	5,98	1,54	67,39	121,93	0,93	0,07	0,17	0,40
	N	41	41	41	29	30	12	12	12	12
	Std. Dev.	16,64	12,28	6,99	23,32	150,11	0,46	0,06	0,09	0,15
Dactyloctenium aegyptum	Mean	12,67	0,46	65,00	100,00		4,72	0,44	0,06	0,76
	N	3	3	3	3		2	2	2	2
	Std. Dev.	1,15	0,32	4,52	0,00		0,45	0,04	0,04	0,00
Dactyloctenium giganteum	Mean	63,33	5,66	9,19	19,21					
	N	3	3	3	3					
	Std. Dev.	16,26	3,36	1,66	4,70					
Digitaria ciliaris	Mean	76,00	2,06	10,85	64,15	6,68				
	N	3	3	3	3	3				
	Std. Dev.	10,58	0,67	2,42	2,12	0,00				
Digitaria eriantha	Mean	56,00	0,80	20,19	18,98		1,56	0,24	0,05	1,18
	N	2	2	2	2		1	1	1	1
	Std. Dev.	25,46	0,40	6,80	8,51		.	.	.	.
Enteropogon macrostachius	Mean	49,00	11,56	21,57	72,90		2,69	0,21	0,04	0,64
	N	3	3	3	3		3	3	3	3
	Std. Dev.	15,62	4,74	12,57	17,45		0,12	0,04	0,03	0,13
Eragrostis inamoena	Mean	94,17	7,62	19,03	70,88	94,98	1,59	0,07	0,06	0,37
	N	6	6	6	6	6	5	5	5	5

	Std. Dev.	11,18	5,62	5,18	23,55	226,93	0,39	0,02	0,05	0,06
Eragrostis jeffreysii	Mean	117,67	23,48	25,12	53,00	372,70	1,77	0,11	0,05	0,35
	N	3	3	3	3	3	3	3	3	3
	Std. Dev.	20,43	31,10	6,23	17,47	321,20	0,60	0,03	0,06	0,07
Eragrostis lappula	Mean	98,17	11,81	18,27	36,78	6,36	1,17	0,06	0,08	0,27
	N	6	6	6	6	3	1	1	1	1
	Std. Dev.	12,19	9,48	8,84	29,07	3,95	.	.	.	.
Eragrostis lehmanniana	Mean	73,33	4,01	15,25	73,34	0,18	1,76	0,09	0,00	0,58
	N	6	6	6	6	6	5	5	5	5
	Std. Dev.	13,41	2,96	3,94	8,62	0,00	0,23	0,01	0,01	0,05
Eragrostis pallens	Mean	110,33	4,56	21,92	4,93					
	N	3	3	3	3					
	Std. Dev.	23,09	0,99	9,69	3,38					
Eragrostis pilgerana	Mean	31,33	2,14	41,84	36,71	1,29	1,44	0,17	0,03	0,60
	N	3	3	3	3	3	2	2	2	2
	Std. Dev.	6,807	1,057	13,959	15,484	0,000	0,157	0,026	0,017	0,024
Eragrostis porosa	Mean	80,333	5,517	18,349	85,797	0,102				
	N	3	3	3	3	3				
	Std. Dev.	15,89	1,40	16,33	12,96	0,04				
Eragrostis rigidior	Mean	103,33	12,71	12,21	65,45		1,75	0,13	0,01	0,33
	N	3	3	3	3		2	2	2	2
	Std. Dev.	10,07	4,06	2,93	16,74		0,05	0,04	0,00	0,06
Eragrostis rotifer	Mean	133,33	46,80	18,70	48,79	284,09				
	N	3	3	3	3	3				
	Std. Dev.	6,51	29,62	1,29	6,54	0,00				
Eragrostis stapfii	Mean	81,50	4,41	14,45	63,73	50,65				
	N	6	6	6	6	6				
	Std. Dev.	12,24	2,66	1,92	21,48	44,24				
Eragrostis trichophora	Mean	37,57	2,26	22,95	35,64	201,94	1,23	0,15	0,05	0,40
	N	7	7	7	6	3	3	3	3	3
	Std. Dev.	12,55	1,52	18,59	19,15	61,11	0,24	0,05	0,05	0,15
Eragrostis viscosa	Mean	31,17	3,79	11,71	53,38	8,16	1,35	0,38	0,17	0,64
	N	6	6	6	6	3	1	1	1	1
	Std. Dev.	4,62	2,07	3,17	41,86	0,00	.	.	.	.
Fimbristylis complanata	Mean	98,67	8,57	10,72	32,77		0,76	0,06	0,07	0,36
	N	3	3	3	3		1	1	1	1
	Std. Dev.	25,32	4,22	16,36	29,65		.	.	.	.
Fuirema pubescens	Mean	67,00	2,93	12,81	13,92					
	N	6	6	6	6					
	Std. Dev.	36,59	0,97	14,46	6,24					
Miscanthus junceus	Mean	177,67	29,19	6,46	9,62					
	N	3	3	3	3					
	Std. Dev.	29,14	4,32	5,77	3,87					

Panicem porphyrrizos	Mean	116,67	5,16	14,91	57,66	0,15	1,22	0,06	0,03	0,44
	N	3	3	3	3	3	3	3	3	3
	Std. Dev.	19,30	1,00	2,38	19,05	0,00	0,12	0,01	0,01	0,15
Panicem repens	Mean	60,86	8,86	25,00	28,15	358,95	1,52	0,10	0,18	0,32
	N	57	57	57	57	34	13	13	13	13
	Std. Dev.	24,80	7,13	10,32	20,01	389,73	0,36	0,03	0,07	0,06
Pogonarthia squarrosa	Mean	57,89	7,13	11,12	55,06	28,24	1,87	0,09	0,04	0,99
	N	9	9	9	9	6	6	6	6	6
	Std. Dev.	11,30	3,42	4,85	28,23	13,26	0,21	0,03	0,02	0,15
Sacciolepis typhura	Mean	131,67	8,92	25,60	49,42	57,22	1,35	0,07	0,00	0,31
	N	3	3	3	3	3	3	3	3	3
	Std. Dev.	37,11	0,28	5,92	21,59	0,00	0,16	0,02	0,01	0,14
Schidtia pappophoroides	Mean	30,67	4,87	30,94	82,59		2,37	0,16	0,03	0,74
	N	3	3	3	3		3	3	3	3
	Std. Dev.	3,79	2,49	5,01	18,07		0,22	0,01	0,00	0,03
Scoenoplectus corymbosus	Mean	91,98	19,76	0,00	26,20	539,88	0,89	0,06	0,09	0,30
	N	43	43	43	36	24	7	7	7	7
	Std. Dev.	39,25	32,94	0,00	19,38	531,66	0,35	0,02	0,05	0,15
Setaria sphacelata	Mean	99,53	12,00	16,25	34,47	47,55	1,81	0,17	0,41	0,41
	N	15	15	15	15	5	4	4	4	4
	Std. Dev.	27,47	16,09	7,37	29,36	37,88	0,63	0,10	0,31	0,11
Setaria sphacelata var. ericea	Mean	110,78	12,24	16,10	16,83		1,42	0,11	0,26	0,41
	N	9	9	9	9		3	3	3	3
	Std. Dev.	21,80	6,65	8,48	20,65		0,49	0,06	0,05	0,14
Setaria sphacelata var. sphacelata	Mean	115,33	7,58	24,20	64,78	66,67	1,33	0,13	0,48	0,44
	N	6	6	6	6	6	6	6	6	6
	Std. Dev.	25,63	2,99	11,17	20,40	66,45	0,28	0,02	0,19	0,08
Setaria verticillata	Mean	102,25	12,95	22,38	46,01	201,01	2,87	0,19	0,36	0,56
	N	8	8	8	8	3	4	4	4	4
	Std. Dev.	25,94	7,41	8,03	32,17	153,77	0,31	0,03	0,24	0,15
Sporobolus fimbriatus	Mean	104,86	7,66	23,06	40,90	91,86	2,00	0,17	0,15	0,51
	N	21	21	21	21	12	5	5	5	5
	Std. Dev.	45,79	6,76	9,26	33,28	90,55	0,69	0,08	0,29	0,32
Sporobolus iocladus	Mean	47,77	3,21	30,79	38,22	100,29	1,12	0,18	0,37	0,43
	N	13	14	14	14	6	5	5	5	5
	Std. Dev.	32,79	1,48	16,64	22,72	93,39	0,15	0,08	0,14	0,09
Sporobolus macranthelus	Mean	173,89	19,86	17,41	68,46	121,83	1,09	0,15	0,04	0,38
	N	9	9	9	9	6	3	3	3	3
	Std. Dev.	13,27	29,20	8,27	31,29	173,58	0,32	0,09	0,02	0,12
Sporobolus pyramidialis	Mean	81,89	5,57	20,42	40,28	0,09	1,92	0,14	0,02	0,49
	N	9	9	9	7	3	3	3	3	3
	Std. Dev.	44,32	7,04	17,93	28,07	0,00	0,19	0,02	0,01	0,06

Sporobolus spicatus	Mean	32,00	1,51	34,07	62,03	11,69				
	N	3	3	3	3	3				
	Std. Dev.	2,00	0,71	3,75	20,08	0,00				
Stipagrostis uniplumis	Mean	85,76	32,48	17,42	43,72	948,32	2,04	0,15	0,03	0,74
	N	21	21	21	21	6	12	12	12	12
	Std. Dev.	16,18	20,95	12,83	32,46	1035,89	0,39	0,04	0,02	0,24
Tragus berteronianus	Mean	11,80	0,46	24,63	65,55	11,90				
	N	5	5	5	5	5				
	Std. Dev.	5,17	0,44	3,62	27,43	18,91				
Urochloa mosambicensis	Mean	50,75	3,84	31,10	56,00	240,96	2,45	0,22	0,02	0,82
	N	40	40	40	40	34	14	14	14	14
	Std. Dev.	27,48	3,42	16,56	31,88	664,06	1,12	0,13	0,02	0,26
Urochloa Trichopus	Mean	6,67	0,16	56,22	90,00					
	N	3	3	3	3					
	Std. Dev.	1,53	0,11	8,80	17,32					
Total	Mean	73,58	10,70	19,12	44,45	233,23	1,66	0,13	0,12	0,51
	N	492	493	493	466	285	158	158	158	158
	Std. Dev.	41,62	17,64	15,24	29,95	501,12	0,78	0,08	0,16	0,24

Table 3: mean mineral content of grasses by McDowell et al. 1974 and Whitehead 2000 compared to the mean content in grasses of the sampling area in the Okavango Delta.

Mineral	*Content in tropical grass (%)*	*Content in grasses of the Okavango Delta (%)*
Nitrogen	2.80*	1.69
Phosphorus	0.22	0.13
Calcium	0.40	0.52
Sodium	0.26	0.12

* Average of the temperate region

Table 4: Output of the Multiple Comparisons Test of Bonferroni of the parameters per habitat type. W: mixed *Acacia* woodland, G: grassland, UF: upper floodplain, LF: lower floodplain, S: sedge zone, MH: *Mopane* high-density woodland, ML: *Mopane* low-density woodland

Dependent Variable	(I) Habitat type	(J) Habitat type	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
length (cm)	W	G	65,999	6,490	0,000	46,179	85,818
		UF	26,415	5,918	0,000	8,343	44,487
		LF	28,469	5,879	0,000	10,513	46,424
		S	17,830	5,892	0,055	-0,163	35,824
		MH	26,875	7,735	0,012	3,253	50,498
		ML	-6,041	7,735	1,000	-29,664	17,581
	G	W	-65,999	6,490	0,000	-85,818	-46,179
		UF	-39,584	6,073	0,000	-58,129	-21,038
		LF	-37,530	6,035	0,000	-55,962	-19,099
		S	-48,168	6,048	0,000	-66,637	-29,700
		MH	-39,124	7,854	0,000	-63,110	-15,137
		ML	-72,040	7,854	0,000	-96,027	-48,054
	UF	W	-26,415	5,918	0,000	-44,487	-8,343
		G	39,584	6,073	0,000	21,038	58,129
		LF	2,054	5,415	1,000	-14,484	18,591
		S	-8,585	5,429	1,000	-25,164	7,994
		MH	0,460	7,389	1,000	-22,104	23,024
		ML	-32,457	7,389	0,000	-55,020	-9,893
	LF	W	-28,469	5,879	0,000	-46,424	-10,513
		G	37,530	6,035	0,000	19,099	55,962
		UF	-2,054	5,415	1,000	-18,591	14,484
		S	-10,638	5,387	1,000	-27,090	5,814
		MH	-1,593	7,358	1,000	-24,064	20,877
		ML	-34,510	7,358	0,000	-56,980	-12,040
	S	W	-17,830	5,892	0,055	-35,824	0,163
		G	48,168	6,048	0,000	29,700	66,637
		UF	8,585	5,429	1,000	-7,994	25,164
		LF	10,638	5,387	1,000	-5,814	27,090
		MH	9,045	7,368	1,000	-13,456	31,546
		ML	-23,872	7,368	0,027	-46,373	-1,371
	MH	W	-26,875	7,735	0,012	-50,498	-3,253
		G	39,124	7,854	0,000	15,137	63,110
		UF	-0,460	7,389	1,000	-23,024	22,104
		LF	1,593	7,358	1,000	-20,877	24,064
		S	-9,045	7,368	1,000	-31,546	13,456
		ML	-32,917	8,911	0,005	-60,130	-5,704
	ML	W	6,041	7,735	1,000	-17,581	29,664
		G	72,040	7,854	0,000	48,054	96,027
		UF	32,457	7,389	0,000	9,893	55,020
		LF	34,510	7,358	0,000	12,040	56,980
		S	23,872	7,368	0,027	1,371	46,373
		MH	32,917	8,911	0,005	5,704	60,130
dry weight (g)	W	G	9,864	3,091	0,032	0,425	19,304
		UF	4,819	2,830	1,000	-3,822	13,461
		LF	4,569	2,811	1,000	-4,016	13,154
		S	-5,243	2,817	1,000	-13,847	3,361
		MH	-1,388	3,699	1,000	-12,683	9,907

dry weight (g)	W	ML	-23,512	3,699	0,000	-34,807	-12,216
	G	W	-9,864	3,091	0,032	-19,304	-0,425
		UF	-5,045	2,891	1,000	-13,872	3,783
		LF	-5,295	2,873	1,000	-14,068	3,477
		S	-15,107	2,879	0,000	-23,898	-6,317
		MH	-11,252	3,746	0,059	-22,690	0,186
		ML	-33,376	3,746	0,000	-44,814	-21,938
	UF	W	-4,819	2,830	1,000	-13,461	3,822
		G	5,045	2,891	1,000	-3,783	13,872
		LF	-0,250	2,589	1,000	-8,158	7,657
		S	-10,062	2,596	0,003	-17,990	-2,135
		MH	-6,207	3,533	1,000	-16,996	4,582
		ML	-28,331	3,533	0,000	-39,120	-17,542
	LF	W	-4,569	2,811	1,000	-13,154	4,016
		G	5,295	2,873	1,000	-3,477	14,068
		UF	0,250	2,589	1,000	-7,657	8,158
		S	-9,812	2,576	0,003	-17,679	-1,945
		MH	-5,957	3,518	1,000	-16,701	4,788
		ML	-28,081	3,518	0,000	-38,825	-17,336
	S	W	5,243	2,817	1,000	-3,361	13,847
		G	15,107	2,879	0,000	6,317	23,898
		UF	10,062	2,596	0,003	2,135	17,990
		LF	9,812	2,576	0,003	1,945	17,679
		MH	3,855	3,523	1,000	-6,904	14,614
		ML	-18,269	3,523	0,000	-29,028	-7,510
	MH	W	1,388	3,699	1,000	-9,907	12,683
		G	11,252	3,746	0,059	-0,186	22,690
		UF	6,207	3,533	1,000	-4,582	16,996
		LF	5,957	3,518	1,000	-4,788	16,701
		S	-3,855	3,523	1,000	-14,614	6,904
		ML	-22,124	4,261	0,000	-35,136	-9,112
	ML	W	23,512	3,699	0,000	12,216	34,807
		G	33,376	3,746	0,000	21,938	44,814
		UF	28,331	3,533	0,000	17,542	39,120
		LF	28,081	3,518	0,000	17,336	38,825
		S	18,269	3,523	0,000	7,510	29,028
		MH	22,124	4,261	0,000	9,112	35,136
% leaves	W	G	-5,511	2,402	0,466	-12,845	1,824
		UF	-1,879	2,199	1,000	-8,593	4,835
		LF	5,395	2,184	0,291	-1,276	12,066
		S	13,493	2,189	0,000	6,808	20,178
		MH	0,639	2,874	1,000	-8,137	9,416
		ML	-0,035	2,874	1,000	-8,811	8,742
	G	W	5,511	2,402	0,466	-1,824	12,845
		UF	3,632	2,246	1,000	-3,227	10,491
		LF	10,906	2,232	0,000	4,090	17,723
		S	19,004	2,237	0,000	12,174	25,835
		MH	6,150	2,910	0,737	-2,737	15,038
		ML	5,476	2,910	1,000	-3,412	14,364
	UF	W	1,879	2,199	1,000	-4,835	8,593
		G	-3,632	2,246	1,000	-10,491	3,227
		LF	7,274	2,012	0,007	1,130	13,419
		S	15,372	2,017	0,000	9,213	21,532
		MH	2,519	2,745	1,000	-5,865	10,902

% leaves	UF	ML	1,844	2,745	1,000	-6,539	10,227
	LF	W	-5,395	2,184	0,291	-12,066	1,276
		G	-10,906	2,232	0,000	-17,723	-4,090
		UF	-7,274	2,012	0,007	-13,419	-1,130
		S	8,098	2,002	0,001	1,986	14,211
		MH	-4,756	2,734	1,000	-13,104	3,593
		ML	-5,430	2,734	0,999	-13,779	2,918
	S	W	-13,493	2,189	0,000	-20,178	-6,808
		G	-19,004	2,237	0,000	-25,835	-12,174
		UF	-15,372	2,017	0,000	-21,532	-9,213
		LF	-8,098	2,002	0,001	-14,211	-1,986
		MH	-12,854	2,737	0,000	-21,214	-4,494
		ML	-13,528	2,737	0,000	-21,888	-5,168
	MH	W	-0,639	2,874	1,000	-9,416	8,137
		G	-6,150	2,910	0,737	-15,038	2,737
		UF	-2,519	2,745	1,000	-10,902	5,865
		LF	4,756	2,734	1,000	-3,593	13,104
		S	12,854	2,737	0,000	4,494	21,214
		ML	-0,674	3,311	1,000	-10,785	9,436
	ML	W	0,035	2,874	1,000	-8,742	8,811
		G	-5,476	2,910	1,000	-14,364	3,412
		UF	-1,844	2,745	1,000	-10,227	6,539
		LF	5,430	2,734	0,999	-2,918	13,779
		S	13,528	2,737	0,000	5,168	21,888
		MH	0,674	3,311	1,000	-9,436	10,785
% green parts	W	G	-8,684	5,117	1,000	-24,315	6,947
		UF	-2,495	4,672	1,000	-16,768	11,777
		LF	-1,312	4,704	1,000	-15,680	13,057
		S	7,352	4,864	1,000	-7,506	22,209
		MH	-11,248	6,086	1,000	-29,841	7,345
		ML	-1,162	6,086	1,000	-19,754	17,431
	G	W	8,684	5,117	1,000	-6,947	24,315
		UF	6,189	4,755	1,000	-8,337	20,715
		LF	7,372	4,786	1,000	-7,248	21,993
		S	16,036	4,943	0,027	0,935	31,137
		MH	-2,564	6,150	1,000	-21,352	16,224
		ML	7,522	6,150	1,000	-11,265	26,310
	UF	W	2,495	4,672	1,000	-11,777	16,768
		G	-6,189	4,755	1,000	-20,715	8,337
		LF	1,184	4,307	1,000	-11,974	14,341
		S	9,847	4,481	0,598	-3,843	23,537
		MH	-8,753	5,786	1,000	-26,426	8,921
		ML	1,334	5,786	1,000	-16,340	19,007
	LF	W	1,312	4,704	1,000	-13,057	15,680
		G	-7,372	4,786	1,000	-21,993	7,248
		UF	-1,184	4,307	1,000	-14,341	11,974
		S	8,663	4,514	1,000	-5,127	22,453
		MH	-9,936	5,811	1,000	-27,687	7,815
		ML	0,150	5,811	1,000	-17,601	17,901
	S	W	-7,352	4,864	1,000	-22,209	7,506
		G	-16,036	4,943	0,027	-31,137	-0,935
		UF	-9,847	4,481	0,598	-23,537	3,843
		LF	-8,663	4,514	1,000	-22,453	5,127
		MH	-18,599	5,941	0,039	-36,749	-0,450

% green parts	S	ML	-8,513	5,941	1,000	-26,662	9,636
	MH	W	11,248	6,086	1,000	-7,345	29,841
		G	2,564	6,150	1,000	-16,224	21,352
		UF	8,753	5,786	1,000	-8,921	26,426
		LF	9,936	5,811	1,000	-7,815	27,687
		S	18,599	5,941	0,039	0,450	36,749
		ML	10,086	6,978	1,000	-11,229	31,401
	ML	W	1,162	6,086	1,000	-17,431	19,754
		G	-7,522	6,150	1,000	-26,310	11,265
		UF	-1,334	5,786	1,000	-19,007	16,340
		LF	-0,150	5,811	1,000	-17,901	17,601
		S	8,513	5,941	1,000	-9,636	26,662
		MH	-10,086	6,978	1,000	-31,401	11,229
biomass (g/m^2)	W	G	476,463	115,132	0,001	123,472	829,454
		UF	436,869	111,004	0,002	96,534	777,204
		LF	375,212	107,355	0,012	46,067	704,357
		S	140,239	109,139	1,000	-194,375	474,854
		MH	342,451	143,306	0,368	-96,920	781,821
		ML	-66,575	143,306	1,000	-505,945	372,795
	G	W	-476,463	115,132	0,001	-829,454	-123,472
		UF	-39,594	95,646	1,000	-332,840	253,653
		LF	-101,250	91,385	1,000	-381,432	178,932
		S	-336,223	93,474	0,008	-622,811	-49,636
		MH	-134,012	131,768	1,000	-538,007	269,983
		ML	-543,038	131,768	0,001	-947,033	-139,043
	UF	W	-436,869	111,004	0,002	-777,204	-96,534
		G	39,594	95,646	1,000	-253,653	332,840
		LF	-61,656	86,126	1,000	-325,716	202,403
		S	-296,630	88,340	0,019	-567,476	-25,783
		MH	-94,418	128,177	1,000	-487,403	298,567
		ML	-503,444	128,177	0,002	-896,429	-110,459
	LF	W	-375,212	107,355	0,012	-704,357	-46,067
		G	101,250	91,385	1,000	-178,932	381,432
		UF	61,656	86,126	1,000	-202,403	325,716
		S	-234,973	83,708	0,112	-491,617	21,671
		MH	-32,762	125,029	1,000	-416,097	350,573
		ML	-441,787	125,029	0,010	-825,122	-58,452
	S	W	-140,239	109,139	1,000	-474,854	194,375
		G	336,223	93,474	0,008	49,636	622,811
		UF	296,630	88,340	0,019	25,783	567,476
		LF	234,973	83,708	0,112	-21,671	491,617
		MH	202,211	126,565	1,000	-185,830	590,253
		ML	-206,814	126,565	1,000	-594,856	181,227
	MH	W	-342,451	143,306	0,368	-781,821	96,920
		G	134,012	131,768	1,000	-269,983	538,007
		UF	94,418	128,177	1,000	-298,567	487,403
		LF	32,762	125,029	1,000	-350,573	416,097
		S	-202,211	126,565	1,000	-590,253	185,830
		ML	-409,026	156,984	0,203	-890,332	72,281
	ML	W	66,575	143,306	1,000	-372,795	505,945
		G	543,038	131,768	0,001	139,043	947,033
		UF	503,444	128,177	0,002	110,459	896,429
		LF	441,787	125,029	0,010	58,452	825,122
		S	206,814	126,565	1,000	-181,227	594,856

biomass (g/m^2)	ML	MH	409,026	156,984	0,203	-72,281	890,332
% N	W	G	0,609	0,208	0,083	-0,034	1,252
		UF	0,763	0,169	0,000	0,241	1,285
		LF	0,979	0,163	0,000	0,474	1,484
		S	1,171	0,174	0,000	0,633	1,709
		MH	-0,319	0,208	1,000	-0,962	0,324
		ML	0,296	0,192	1,000	-0,296	0,888
	G	W	-0,609	0,208	0,083	-1,252	0,034
		UF	0,154	0,210	1,000	-0,496	0,804
		LF	0,370	0,206	1,000	-0,266	1,007
		S	0,562	0,215	0,204	-0,101	1,225
		MH	-0,928	0,243	0,004	-1,678	-0,177
		ML	-0,313	0,229	1,000	-1,021	0,395
	UF	W	-0,763	0,169	0,000	-1,285	-0,241
		G	-0,154	0,210	1,000	-0,804	0,496
		LF	0,216	0,166	1,000	-0,298	0,730
		S	0,408	0,177	0,472	-0,139	0,954
		MH	-1,082	0,210	0,000	-1,732	-0,432
		ML	-0,467	0,194	0,364	-1,067	0,133
	LF	W	-0,979	0,163	0,000	-1,484	-0,474
		G	-0,370	0,206	1,000	-1,007	0,266
		UF	-0,216	0,166	1,000	-0,730	0,298
		S	0,192	0,172	1,000	-0,338	0,722
		MH	-1,298	0,206	0,000	-1,934	-0,661
		ML	-0,683	0,189	0,009	-1,268	-0,098
	S	W	-1,171	0,174	0,000	-1,709	-0,633
		G	-0,562	0,215	0,204	-1,225	0,101
		UF	-0,408	0,177	0,472	-0,954	0,139
		LF	-0,192	0,172	1,000	-0,722	0,338
		MH	-1,490	0,215	0,000	-2,153	-0,827
		ML	-0,875	0,199	0,000	-1,489	-0,261
	MH	W	0,319	0,208	1,000	-0,324	0,962
		G	0,928	0,243	0,004	0,177	1,678
		UF	1,082	0,210	0,000	0,432	1,732
		LF	1,298	0,206	0,000	0,661	1,934
		S	1,490	0,215	0,000	0,827	2,153
		ML	0,615	0,229	0,170	-0,093	1,322
	ML	W	-0,296	0,192	1,000	-0,888	0,296
		G	0,313	0,229	1,000	-0,395	1,021
		UF	0,467	0,194	0,364	-0,133	1,067
		LF	0,683	0,189	0,009	0,098	1,268
		S	0,875	0,199	0,000	0,261	1,489
		MH	-0,615	0,229	0,170	-1,322	0,093
% P	W	G	-0,027	0,021	1,000	-0,091	0,036
		UF	0,072	0,017	0,001	0,021	0,124
		LF	0,113	0,016	0,000	0,063	0,162
		S	0,131	0,017	0,000	0,078	0,184
		MH	-0,018	0,021	1,000	-0,081	0,046
		ML	0,074	0,019	0,003	0,016	0,133
	G	W	0,027	0,021	1,000	-0,036	0,091
		UF	0,100	0,021	0,000	0,036	0,164
		LF	0,140	0,020	0,000	0,077	0,203
		S	0,159	0,021	0,000	0,093	0,224
		MH	0,010	0,024	1,000	-0,064	0,084

% P	G	ML	0,102	0,023	0,000	0,032	0,172
	UF	W	-0,072	0,017	0,001	-0,124	-0,021
		G	-0,100	0,021	0,000	-0,164	-0,036
		LF	0,040	0,016	0,315	-0,010	0,091
		S	0,059	0,017	0,018	0,005	0,113
		MH	-0,090	0,021	0,001	-0,154	-0,026
		ML	0,002	0,019	1,000	-0,057	0,061
	LF	W	-0,113	0,016	0,000	-0,162	-0,063
		G	-0,140	0,020	0,000	-0,203	-0,077
		UF	-0,040	0,016	0,315	-0,091	0,010
		S	0,019	0,017	1,000	-0,033	0,071
		MH	-0,130	0,020	0,000	-0,193	-0,068
		ML	-0,038	0,019	0,893	-0,096	0,019
	S	W	-0,131	0,017	0,000	-0,184	-0,078
		G	-0,159	0,021	0,000	-0,224	-0,093
		UF	-0,059	0,017	0,018	-0,113	-0,005
		LF	-0,019	0,017	1,000	-0,071	0,033
		MH	-0,149	0,021	0,000	-0,215	-0,084
		ML	-0,057	0,020	0,087	-0,118	0,003
	MH	W	0,018	0,021	1,000	-0,046	0,081
		G	-0,010	0,024	1,000	-0,084	0,064
		UF	0,090	0,021	0,001	0,026	0,154
		LF	0,130	0,020	0,000	0,068	0,193
		S	0,149	0,021	0,000	0,084	0,215
		ML	0,092	0,023	0,002	0,022	0,162
	ML	W	-0,074	0,019	0,003	-0,133	-0,016
		G	-0,102	0,023	0,000	-0,172	-0,032
		UF	-0,002	0,019	1,000	-0,061	0,057
		LF	0,038	0,019	0,893	-0,019	0,096
		S	0,057	0,020	0,087	-0,003	0,118
		MH	-0,092	0,023	0,002	-0,162	-0,022
% Na	W	G	-0,114	0,046	0,323	-0,257	0,030
		UF	-0,180	0,038	0,000	-0,296	-0,063
		LF	-0,028	0,036	1,000	-0,140	0,085
		S	-0,056	0,039	1,000	-0,176	0,064
		MH	0,039	0,046	1,000	-0,104	0,182
		ML	0,039	0,043	1,000	-0,093	0,171
	G	W	0,114	0,046	0,323	-0,030	0,257
		UF	-0,066	0,047	1,000	-0,211	0,079
		LF	0,086	0,046	1,000	-0,056	0,228
		S	0,058	0,048	1,000	-0,090	0,206
		MH	0,153	0,054	0,114	-0,015	0,320
		ML	0,153	0,051	0,067	-0,005	0,311
	UF	W	0,180	0,038	0,000	0,063	0,296
		G	0,066	0,047	1,000	-0,079	0,211
		LF	0,152	0,037	0,001	0,037	0,267
		S	0,124	0,039	0,042	0,002	0,246
		MH	0,219	0,047	0,000	0,074	0,364
		ML	0,219	0,043	0,000	0,085	0,353
	LF	W	0,028	0,036	1,000	-0,085	0,140
		G	-0,086	0,046	1,000	-0,228	0,056
		UF	-0,152	0,037	0,001	-0,267	-0,037
		S	-0,028	0,038	1,000	-0,146	0,090
		MH	0,067	0,046	1,000	-0,075	0,209

% Na	LF	ML	0,067	0,042	1,000	-0,063	0,198
	S	W	0,056	0,039	1,000	-0,064	0,176
		G	-0,058	0,048	1,000	-0,206	0,090
		UF	-0,124	0,039	0,042	-0,246	-0,002
		LF	0,028	0,038	1,000	-0,090	0,146
		MH	0,095	0,048	1,000	-0,053	0,243
		ML	0,095	0,044	0,698	-0,042	0,232
	MH	W	-0,039	0,046	1,000	-0,182	0,104
		G	-0,153	0,054	0,114	-0,320	0,015
		UF	-0,219	0,047	0,000	-0,364	-0,074
		LF	-0,067	0,046	1,000	-0,209	0,075
		S	-0,095	0,048	1,000	-0,243	0,053
		ML	0,000	0,051	1,000	-0,157	0,158
	ML	W	-0,039	0,043	1,000	-0,171	0,093
		G	-0,153	0,051	0,067	-0,311	0,005
		UF	-0,219	0,043	0,000	-0,353	-0,085
		LF	-0,067	0,042	1,000	-0,198	0,063
		S	-0,095	0,044	0,698	-0,232	0,042
		MH	0,000	0,051	1,000	-0,158	0,157
% Ca	W	G	-0,024	0,065	1,000	-0,225	0,177
		UF	0,188	0,053	0,011	0,025	0,351
		LF	0,191	0,051	0,006	0,033	0,349
		S	0,229	0,054	0,001	0,061	0,397
		MH	-0,202	0,065	0,047	-0,403	-0,001
		ML	-0,028	0,060	1,000	-0,213	0,157
	G	W	0,024	0,065	1,000	-0,177	0,225
		UF	0,212	0,066	0,033	0,008	0,415
		LF	0,215	0,064	0,023	0,016	0,414
		S	0,253	0,067	0,005	0,046	0,460
		MH	-0,178	0,076	0,422	-0,413	0,056
		ML	-0,004	0,072	1,000	-0,225	0,217
	UF	W	-0,188	0,053	0,011	-0,351	-0,025
		G	-0,212	0,066	0,033	-0,415	-0,008
		LF	0,003	0,052	1,000	-0,158	0,164
		S	0,041	0,055	1,000	-0,129	0,212
		MH	-0,390	0,066	0,000	-0,593	-0,187
		ML	-0,216	0,061	0,011	-0,403	-0,028
	LF	W	-0,191	0,051	0,006	-0,349	-0,033
		G	-0,215	0,064	0,023	-0,414	-0,016
		UF	-0,003	0,052	1,000	-0,164	0,158
		S	0,038	0,054	1,000	-0,127	0,204
		MH	-0,393	0,064	0,000	-0,592	-0,194
		ML	-0,219	0,059	0,006	-0,402	-0,036
	S	W	-0,229	0,054	0,001	-0,397	-0,061
		G	-0,253	0,067	0,005	-0,460	-0,046
		UF	-0,041	0,055	1,000	-0,212	0,129
		LF	-0,038	0,054	1,000	-0,204	0,127
		MH	-0,431	0,067	0,000	-0,639	-0,224
		ML	-0,257	0,062	0,001	-0,449	-0,065
	MH	W	0,202	0,065	0,047	0,001	0,403
		G	0,178	0,076	0,422	-0,056	0,413
		UF	0,390	0,066	0,000	0,187	0,593
		LF	0,393	0,064	0,000	0,194	0,592
		S	0,431	0,067	0,000	0,224	0,639

% Ca	MH	ML	0,174	0,072	0,337	-0,047	0,396
	ML	W	0,028	0,060	1,000	-0,157	0,213
		G	0,004	0,072	1,000	-0,217	0,225
		UF	0,216	0,061	0,011	0,028	0,403
		LF	0,219	0,059	0,006	0,036	0,402
		S	0,257	0,062	0,001	0,065	0,449
		MH	-0,174	0,072	0,337	-0,396	0,047

Table 5: Output of the Multiple Comparisons test of Bonferroni between the parameters and the sites. CI: Crocks island, LI: Lions island, W: The Weir, M: The Mopane Transect.

Dependent Variable	*(I) site*	*(J) site*	*Mean Difference (I-J)*	*Std. Error*	*Sig.*	*95% Confidence Interval*	
						Lower Bound	Upper Bound
length (cm)	CI	LI	21,348	4,493	0,000	9,447	33,249
		W	6,259	5,370	1,000	-7,964	20,483
		M	-6,186	5,828	1,000	-21,623	9,252
	LI	CI	-21,348	4,493	0,000	-33,249	-9,447
		W	-15,089	5,319	0,028	-29,179	-0,998
		M	-27,534	5,782	0,000	-42,848	-12,219
	W	CI	-6,259	5,370	1,000	-20,483	7,964
		LI	15,089	5,319	0,028	0,998	29,179
		M	-12,445	6,487	0,334	-29,627	4,737
	M	CI	6,186	5,828	1,000	-9,252	21,623
		LI	27,534	5,782	0,000	12,219	42,848
		W	12,445	6,487	0,334	-4,737	29,627
dry weight (g)	CI	LI	2,664	2,073	1,000	-2,827	8,156
		W	2,267	2,479	1,000	-4,299	8,834
		M	-13,340	2,691	0,000	-20,467	-6,212
	LI	CI	-2,664	2,073	1,000	-8,156	2,827
		W	-0,397	2,458	1,000	-6,908	6,115
		M	-16,004	2,672	0,000	-23,081	-8,927
	W	CI	-2,267	2,479	1,000	-8,834	4,299
		LI	0,397	2,458	1,000	-6,115	6,908
		M	-15,607	2,998	0,000	-23,548	-7,667
	M	CI	13,340	2,691	0,000	6,212	20,467
		LI	16,004	2,672	0,000	8,927	23,081
		W	15,607	2,998	0,000	7,667	23,548
% leaves	CI	LI	-3,436	1,649	0,226	-7,803	0,931
		W	2,707	1,971	1,000	-2,514	7,928
		M	-3,553	2,140	0,585	-9,221	2,115
	LI	CI	3,436	1,649	0,226	-0,931	7,803
		W	6,143	1,955	0,011	0,965	11,321
		M	-0,117	2,125	1,000	-5,745	5,511
	W	CI	-2,707	1,971	1,000	-7,928	2,514
		LI	-6,143	1,955	0,011	-11,321	-0,965
		M	-6,260	2,384	0,053	-12,574	0,054
	M	CI	3,553	2,140	0,585	-2,115	9,221
		LI	0,117	2,125	1,000	-5,511	5,745
		W	6,260	2,384	0,053	-0,054	12,574
% green parts	CI	LI	5,917	3,324	0,454	-2,890	14,724
		W	9,758	4,042	0,097	-0,951	20,467
		M	-0,934	4,238	1,000	-12,163	10,295
	LI	CI	-5,917	3,324	0,454	-14,724	2,890
		W	3,841	3,999	1,000	-6,754	14,436
		M	-6,851	4,197	0,620	-17,971	4,269
	W	CI	-9,758	4,042	0,097	-20,467	0,951
		LI	-3,841	3,999	1,000	-14,436	6,754
		M	-10,692	4,786	0,156	-23,372	1,988
	M	CI	0,934	4,238	1,000	-10,295	12,163
		LI	6,851	4,197	0,620	-4,269	17,971
		W	10,692	4,786	0,156	-1,988	23,372
biomass (g/m2)	CI	LI	224,706	72,870	0,013	31,101	418,312

		W	63,644	81,527	1,000	-152,962	280,250
		M	-59,686	98,618	1,000	-321,700	202,328
	LI	CI	-224,706	72,870	0,013	-418,312	-31,101
		W	-161,063	76,251	0,213	-363,652	41,527
		M	-284,392	94,303	0,017	-534,943	-33,841
	W	CI	-63,644	81,527	1,000	-280,250	152,962
		LI	161,063	76,251	0,213	-41,527	363,652
		M	-123,330	101,142	1,000	-392,050	145,391
	M	CI	59,686	98,618	1,000	-202,328	321,700
		LI	284,392	94,303	0,017	33,841	534,943
		W	123,330	101,142	1,000	-145,391	392,050
% N	CI	LI	-0,146	0,149	1,000	-0,545	0,253
		W	0,234	0,176	1,000	-0,238	0,705
		M	-0,683	0,171	0,001	-1,141	-0,226
	LI	CI	0,146	0,149	1,000	-0,253	0,545
		W	0,380	0,171	0,168	-0,078	0,837
		M	-0,537	0,166	0,009	-0,980	-0,094
	W	CI	-0,234	0,176	1,000	-0,705	0,238
		LI	-0,380	0,171	0,168	-0,837	0,078
		M	-0,917	0,191	0,000	-1,426	-0,407
	M	CI	0,683	0,171	0,001	0,226	1,141
		LI	0,537	0,166	0,009	0,094	0,980
		W	0,917	0,191	0,000	0,407	1,426
% P	CI	LI	-0,003	0,016	1,000	-0,047	0,040
		W	0,058	0,019	0,018	0,007	0,109
		M	-0,020	0,019	1,000	-0,070	0,030
	LI	CI	0,003	0,016	1,000	-0,040	0,047
		W	0,061	0,019	0,008	0,011	0,111
		M	-0,017	0,018	1,000	-0,066	0,031
	W	CI	-0,058	0,019	0,018	-0,109	-0,007
		LI	-0,061	0,019	0,008	-0,111	-0,011
		M	-0,078	0,021	0,001	-0,134	-0,023
	M	CI	0,020	0,019	1,000	-0,030	0,070
		LI	0,017	0,018	1,000	-0,031	0,066
		W	0,078	0,021	0,001	0,023	0,134
% Na	CI	LI	0,098	0,029	0,006	0,020	0,177
		W	-0,027	0,035	1,000	-0,120	0,065
		M	0,143	0,034	0,000	0,053	0,233
	LI	CI	-0,098	0,029	0,006	-0,177	-0,020
		W	-0,125	0,034	0,002	-0,215	-0,036
		M	0,045	0,033	1,000	-0,042	0,132
	W	CI	0,027	0,035	1,000	-0,065	0,120
		LI	0,125	0,034	0,002	0,036	0,215
		M	0,171	0,037	0,000	0,070	0,271
	M	CI	-0,143	0,034	0,000	-0,233	-0,053
		LI	-0,045	0,033	1,000	-0,132	0,042
		W	-0,171	0,037	0,000	-0,271	-0,070
% Ca	CI	LI	-0,054	0,042	1,000	-0,167	0,059
		W	0,148	0,050	0,021	0,015	0,282
		M	-0,223	0,049	0,000	-0,353	-0,093
	LI	CI	0,054	0,042	1,000	-0,059	0,167
		W	0,202	0,049	0,000	0,072	0,332
		M	-0,169	0,047	0,003	-0,295	-0,044
	W	CI	-0,148	0,050	0,021	-0,282	-0,015

	LI	-0,202	0,049	0,000	-0,332	-0,072
	M	-0,372	0,054	0,000	-0,516	-0,227
M	CI	0,223	0,049	0,000	0,093	0,353
	LI	0,169	0,047	0,003	0,044	0,295
	W	0,372	0,054	0,000	0,227	0,516

Table 6: Output of the Milytiple Comparisons test of Bonferroni for the parameters per month

Dependent Variable	*(I) Month*	*(J) Month*	*Mean Difference (I-J)*	*Std. Error*	*Sig.*	*95% Confidence Interval*	
						Lower Bound	Upper Bound
length (cm)	February	March	-23,064	5,371	0,000	-37,292	-8,836
		April	-24,255	5,427	0,000	-38,631	-9,879
		May	-14,986	5,399	0,034	-29,286	-0,685
	March	February	23,064	5,371	0,000	8,836	37,292
		April	-1,190	5,134	1,000	-14,789	12,408
		may	8,079	5,104	0,684	-5,440	21,597
	April	February	24,255	5,427	0,000	9,879	38,631
		march	1,190	5,134	1,000	-12,408	14,789
		may	9,269	5,162	0,439	-4,405	22,943
	May	February	14,986	5,399	0,034	0,685	29,286
		March	-8,079	5,104	0,684	-21,597	5,440
		April	-9,269	5,162	0,439	-22,943	4,405
dry weight (g)	February	March	-3,540	2,539	0,984	-10,266	3,187
		April	1,665	2,561	1,000	-5,120	8,449
		May	2,819	2,552	1,000	-3,942	9,580
	March	February	3,540	2,539	0,984	-3,187	10,266
		April	5,205	2,422	0,193	-1,212	11,621
		may	6,359	2,413	0,052	-0,033	12,750
	April	February	-1,665	2,561	1,000	-8,449	5,120
		march	-5,205	2,422	0,193	-11,621	1,212
		may	1,154	2,436	1,000	-5,298	7,606
	May	February	-2,819	2,552	1,000	-9,580	3,942
		March	-6,359	2,413	0,052	-12,750	0,033
		April	-1,154	2,436	1,000	-7,606	5,298
% leaves	February	March	2,194	1,968	1,000	-3,018	7,406
		April	4,816	1,985	0,094	-0,441	10,072
		May	4,798	1,978	0,094	-0,440	10,036
	March	February	-2,194	1,968	1,000	-7,406	3,018
		April	2,622	1,877	0,978	-2,350	7,593
		may	2,604	1,869	0,985	-2,348	7,556
	April	February	-4,816	1,985	0,094	-10,072	0,441
		march	-2,622	1,877	0,978	-7,593	2,350
		may	-0,018	1,887	1,000	-5,017	4,982
	May	February	-4,798	1,978	0,094	-10,036	0,440
		March	-2,604	1,869	0,985	-7,556	2,348
		April	0,018	1,887	1,000	-4,982	5,017
% green parts	February	March	13,417	3,207	0,000	4,920	21,914
		April	23,175	3,231	0,000	14,616	31,734
		May	53,954	3,221	0,000	45,420	62,488
	March	February	-13,417	3,207	0,000	-21,914	-4,920
		April	9,758	2,811	0,003	2,311	17,205
		may	40,537	2,800	0,000	33,119	47,955
	April	February	-23,175	3,231	0,000	-31,734	-14,616
		march	-9,758	2,811	0,003	-17,205	-2,311
		may	30,779	2,827	0,000	23,290	38,268
	May	February	-53,954	3,221	0,000	-62,488	-45,420
		March	-40,537	2,800	0,000	-47,955	-33,119
		April	-30,779	2,827	0,000	-38,268	-23,290

Graphs

Graph 1: Rainfall data in millimetres per month in Maun, year 2000, 2001 and 2002. Values were available till 31 of August 2002

Graph 1