



**An Investigation of seasonal disturbance intensity on wetland grass belts of
Nylsvley Nature Reserve**

By

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Dissertation submitted in fulfillment of the requirements of the
Master of Science Degree in Botany

In the

School of Mathematical and Natural Sciences

University of Venda

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DECLARATION

I, Gelebe Vhuhwavho (Student number 11521083), declare that this research proposal is my original work and has not been submitted for any degree at any other university or institution. The dissertation does not contain another persons' writing unless specifically acknowledged and referenced accordingly.

.....

Gelebe Vhuhwavho

.....

Date

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I would like to thank God who granted me knowledge, wisdom, strength and courage to do my work. I thank my supervisor, Mr MH Ligavha-Mbelengwa for his invaluable advices and support during all the fieldwork. My co-supervisor, Prof MP Tshisikhawe is acknowledged for on time corrections. Prof NH Hahn is thanked for designing kites and identification of grasses. The University of Venda is thanked for providing me with the transport to the study area. The National Research Foundation is acknowledged for funding my project. Team Botany cannot be forgotten for helping me with the fieldwork.

DEDICATION

I would like to dedicate this dissertation to my family particularly my beloved wife Petunia for her endless support and to my son Thendo for keeping my spirit up with all the innocence. Last but not the least, this dissertation is dedicated to my Mom who always belived in my abilities.

Table of Contents

<u>DECLARATION</u>	i
<u>ACKNOWLEDGEMENTS</u>	ii
<u>DEDICATION</u>	iii
<u>TABLE OF CONTENTS</u>	iv
<u>LIST OF TABLES</u>	vi
<u>LIST OF FIGURES</u>	ix
Abstract	XI
CHAPTER 1	1
1.2 Statement of Research Problem	2
1.3 Aim of the study.....	3
1.4 Objective of the study.....	3
1.5 Hypothesis	3
2.2 Construction of quadrats within grass belts	6
Chapter 3.....	10
RESULTS	10
a. <i>Cyperus amabilis</i> Belt (table 2).....	10
i. Habitat description.....	10
ii. Temperature.....	10
iii. Hydric status	11
3.1.1 Quadrat data.	11
Table 2: Representing data collected in the <i>Cyperus amabilis</i> belt in two seasons (June 2016 and December 2016) 1 m x 1 m low.	11
3.2.2 Disturbance classification.....	17
3.2 <i>Sporobolus africanus</i> Belt.....	21
iv. Habitat description	21

v. Quadrat data	22
3.2.1 Temperature	32
3.2.2 Soil type	32
3.2.3 Hydric status	32
c. <i>Themeda triandra</i> Belt	35
3.3.1 Habitat description	35
3.3.2 Quadrat data	35
3.3.3 Temperature	44
3.3.4 Soil type	44
3.3.5 Hydric status	44
3.3.6 Abundance and distribution graphs.....	44
CHAPTER 4	60
Discussion	60
CHAPTER 5	60
Conclusion	58
References	62

List of Tables

Table 1: Classification of plants community according to their hydric status in wetlands, based on U.S. Fish and Wildlife Service Indicator Categories (Reed, 1988), (Page 8).

Table 2: Representing data collected in the *Cyperus amabilis* belt in two seasons (June 2016 and December 2016) 1 m x 1 m low, (Page 11).

Table 3: Representing data collected in the *Cyperus amabilis* belt in two seasons (June 2016 and December 2016) 1 m x 1 m high, (Page 12).

Table 4: Representing data collected in the *Cyperus amabilis* belt in two seasons (June 2016 and December 2016) 2 m x 2 m low, (Page 13).

Table 5: Representing data collected in the *Cyperus amabilis* belt in two seasons (June 2016 and December 2016) 2 m x 2 m high, (Page 13).

Table 6: Representing data collected in the *Cyperus amabilis* belt in two seasons (December 2016 and June 2017) 1 m x 1 m low, (Page 14).

Table 7: Representing data collected in the *Cyperus amabilis* belt in two seasons (December 2016 and June 2017) 1 m x 1 m high, (Page 15).

Table 8: Representing data collected in the *Cyperus amabilis* belt in two seasons (December 2016 and June 2017) 2 m x 2 m low, (Page 16).

Table 9: Representing data collected in the *Cyperus amabilis* belt in two seasons (December 2016 and June 2017) 2 m x 2 m high, (Page 16).

Table 10: Comparison of species at high and low intensities in the clayed soil, (Page 18).

Table 11: Representing data collected in the *Sporobolus africanus* belt in two seasons (June 2016 and December 2016) 1 m x 1 m low, (Page 21).

Table 12: Representing data collected in the *Sporobolus africanus* belt in two seasons (June 2016 and December 2016) 1 m x 1 m high, (Page 22).

Table 13: Representing data collected in the *Sporobolus africanus* belt in two seasons (June 2016 and December 2016) 2 m x 2 m low, (Page 23).

Table 14: Representing data collected in the *Sporobolus africanus* belt in two seasons (June 2016 and December 2016) 2 m x 2 m high, (Page 24).

Table 15: Representing data collected in the *Sporobolus africanus* belt in two seasons (December 2016 and June 2017) 1 m x 1 m low, (Page 25).

Table 16: Representing data collected in the *Sporobolus africanus* belt in two seasons (December 2016 and June 2017) 1 m x 1 m high, (Page 26).

Table 17: Representing data collected in the *Sporobolus africanus* belt in two seasons (December 2016 and June 2017) 2 m x 2 m low, (Page 27).

Table 18: Representing data collected in the *Sporobolus africanus* belt in two seasons (December 2016 and June 2017) 2 m x 2 m high, (Page 29).

Table 19: Comparison of vegetation cover at low and high intensity in semi clay soil, (Page 30).

Table 20: Representing data collected in the *Themeda triandra* belt in two seasons (June 2016 and December 2016) 1 m x 1 m low, (Page 33).

Table 21: Representing data collected in the *Themeda triandra* belt in two seasons (June 2016 and December 2016) 1 m x 1 m high, (Page 34).

Table 22: Representing data collected in the *Themeda triandra* belt in two seasons (June 2016 and December 2016) 2 m x 2 m low, (Page 35).

Table 23: Representing data collected in the *Themeda triandra* belt in two seasons (June 2016 and December 2016) 2 m x. 2 m high, (Page 37).

Table 24: Representing data collected in the *Themeda triandra* belt in two seasons (December 2016 and June 2017) 1 m x 1 m low, (Page 38).

Table 25: Representing data collected in the *Themeda triandra* belt in two seasons (December 2016 and June 2017) 1 m x 1 m high, (Page 39).

Table 26: Representing data collected in the *Themeda triandra* belt in two seasons (December 2016 and June 2017) 2 m x 2 m low, (Page 40).

Table 27: Representing data collected in the *Themeda triandra* belt in two seasons (December 2016 and June 2017) 2 m x 2 m high, (Page 41).

List of Figures

Figure 1: Map of the study area, (Page 5).

Figure 2: Sketch drawing showing each kite with quadrats and naming convention (not to scale), (Page 6).

Figure 3: Grassland community within the Nylsvlei Nature Reserve in which quadrats were conducted, (Page 7).

Figure 4: Average min and max Temperature at Nylsvlei Nature Reserve 2016-2017, (Page 10).

Figure 5: Graph showing abundance data collected in the *Cyperus amabilis* belt over two seasons (June 2016 and December 2016) 1 m x 1 m low, (Page 19).

Figure 6: Graph showing abundance data collected in the *Cyperus amabilis* belt over two seasons (June 2016 and December 2016) 1 m x 1 m high, (Page 19).

Figure 7: Graph showing abundance data collected in the *Cyperus amabilis* belt over two seasons (June 2016 and December 2016) 2 m x 2 m low, (Page 20).

Figure 8: Graph showing abundance data collected in the *Cyperus amabilis* belt over two seasons (June 2016 and December 2016) 2 m x 2 m high, (Page 20).

Figure 9: Graph showing abundance data collected in the *Sporobolus africanus* belt over two seasons (June 2016 and December 2016) 1 m x 1 m low, (Page 31).

Figure 10: Graph showing abundance data collected in the *Sporobolus africanus* belt over two seasons (June 2016 and December 2016) 1 m x 1 m high, (Page 32).

Figure 11: Graph showing abundance data collected in the *Sporobolus pyramidalis* belt over two seasons (June 2016 and December 2016) 2 m x 2 m low, (Page 32).

Figure 12: Graph showing abundance data collected in the *Sporobolus africanus* belt over two seasons (June 2016 and December 2016) 2 m x 2 m high, (Page 32).

Figure 13: Graph representing data collected in the *Themeda triandra* belt in two seasons (June 2016 and December 2016) 1 m x 1 m low, (Page 42).

Figure 14: Graph representing data collected in the *Themeda triandra* belt in two seasons (June 2016 and December 2016) 1 m x 1 m high, (Page 43).

Figure 15: Graph representing data collected in the *Themeda triandra* belt in two seasons (June 2016 and December 2016) 2 m x 2 m low, (Page 43).

Figure 16: Graph representing data collected in the *Themeda triandra* belt in two seasons (June 2016 and December 2016) 2 m x 2 m high, (Page 44).

Figure 17: Graphs representing data collected in the *Cyperus amabilis* belt in two seasons 1x1 low and 2x2 high, (Page 45).

Figure 18: Graphs representing data collected in the *Cyperus amabilis* belt in two seasons 1x1 low and 2x2 high, (Page 46).

Figure 19: Graph representing data collected in the *Sporobolus africanus* belt in two seasons 1x1 low and 2x2 high, (Page 46).

Figure 20: Graph representing data collected in the *Sporobolus africanus* belt in two seasons 1x1 high and 2x2 low, (Page 47).

Figure 21: Graph representing data collected in the *Themeda triandra* belt in two seasons 1x1 low and 2x2 high, (Page 47).

Abstract

The use of disturbance in the management of Savanna is a common rangeland practice in South Africa. A two-season trial was established in June 2016 and December 2016 to evaluate the effects of disturbance of different intensities on wetland belts in the Nylsvley Nature Reserve. The disturbances were in three different belts of different grass types at different intensities. The experimental treatments consisted of two different intensities, namely; high (H) and low (L). The *Cyperus amabilis* belt was regarded as site 1, the *Sporobolus africanus* as site 2, and the *Themeda triandra* as site 3. Seventeen kites were contracted in each belt, two times 1 m × 1 m at high and low intensity, followed by two times 2 m × 2 m one at high intensity. The results showed that disturbance affects the topsoil by removing the soil which is rich in nutrients producing pioneer species for the first few months and then original species were seen inhibiting again.

Key words: Disturbance; Low intensity; High intensity; wetland belt; Waterlogged; clay soil; *Cyperus amabilis*, *Cynodon dactylon*; *Setaria sphacelata*; *Themeda triandra*; *Sporobolus africanus*.

CHAPTER 1

INTRODUCTION

1.1 Background of the research problem

Disturbances are ecosystem processes which affect the composition structure and function within ecosystems. Their effects include changes of parent material, soil, hydrology and destruction of the biota which lead to alteration in species composition, structure and ecosystem function. Disturbance promotes change in the mutualistic and competitive nature between organisms which then influences the rate of vegetation change and therefore succession. Nylsvley Nature Reserve experiences about 1000 years of significant human disturbance and is not unusual in that regard (Schole and Walker 1993). Detailed examination of what were previously believed to be stable, “climax” communities such as tropical and temperate forests, have shown that ongoing disturbances, often relatively small scale, are essential to the maintenance of the apparently stable state (Walker 1985). All the studies of herbaceous layer composition at Nylsvley Nature Reserve have revealed disturbance to be an important local modifier of the overall pattern imposed by water and nutrient availability. The main cause of disturbance in the wetland belts are borrowing activities of small and large mammals, the death of tree, fire and drought. Although fires occur sufficiently recurrently perhaps to be regarded as ‘included disturbance’, it will Promote development of grass and reduce the occurrence of woody taxa (Scholes and Walker 1993).

The size of disturbance has predictable consequences on the rate and pattern of vegetation recovery (Von Maltiz 1990). Three processes of re-establishment are

involved: the vegetative expansion of neighbouring plants, the formation of daughter grass and stolon extension, and establishment from the seed dominance in the soil. The last process will occur at large scale, but critically depend on the dynamics of the soil seed and condition for establishment. Those factors together result in stimulation of forb seedling establishment in the centre of disturbance patches, and depression near the edge, the timing of disturbance in relation to growing season has large influence on the rate and pattern of subsequent regrowth. The longevity of seed of different species in the soil varies greatly, as does their sensitivity to germination triggers dormancy. An early wet season disturbance favours those species with short-lived life cycle (Scholes and Walker 1993). Disturbance in the middle of the growing season favours species with long-lived, germinated and died before disturbance occurs. Since the seed bank of long-lived seed are much smaller than that of short-lived seed, disturbance later in the growing season result in progressively lower densities of seeding (Scholes and Walker 1993).

1.2 Statement of Research Problem

Nyshivley Nature Reserve harbours numerous animal species, which are supported by its savannah biome. The reserve vegetation is made up of trees, shrubs, forbs and grass layers. The reserve also has a wetland which is supported by plant species that are able to survive in waterlogged areas. However, uncontrolled disturbances that occurs on vegetation in the wetland areas may impact negatively on both animals and plants. Eradication of certain plant species may result in the collapse of wetland plants communities. Feeding habits of certain wildlife may also be impacted negatively.

1.3 Aim of the study

The research mainly focused on the effects of intensity and season of clearing on species richness on the wetland grass belts that are found in Nylsvley Nature Reserve of South Africa

Investigate the influence of soil and Moisture on the Mono-specific wetland grass belts in Nylsvley Nature Reserve.

1.4 Objectives of the study

- To establish suitable seasons to disturb grassy wetland patches of Nylsvley Nature Reserve.
- To assess the advantages and disadvantages of the intensity of disturbance on grassy wetland patches in the reserve.
- To formulate suitable disturbance regime strategies.

1.5 Hypothesis

After high intensity clearance, the distribution pattern will change and no longer be uniform.

Species that were not on that specific area will invade but after some time the original grass species will recover.

Chapter 2

STUDY AREA, MATERIALS AND METHODS

2.1 Description of the study area

Nylsvley Nature Reserve form part of a largest floodplain vlei in South Africa (Noble and Hemens 1978). It is situated 12 km south of the town of Mookgopong formerly known as Naboomspruit in Limpopo Province of South Africa. The reserve's floodplain system extends from Middlefontein (West of Modimolle) in the south west of Moorddrift, near Mokopane in the north-east. The reserve is located in the upper reaches of Nyl River Floodplain (Craig and Johan 1997). It lies between S24°39'50.0 E 28°39'54.4 and straddles the floodplain near the towns of Modimolle (Nylstroom) and Mookgophong (Naboomspruit). The reserve is 3975 ha and lies at an altitude of 1080–1155 m above sea-level. Nylsvley Nature Reserve was designated a Ramsar site in July 1998. Ramsar is an international convention that recognizes and urges protection of globally important wetlands (Craig *et al.* 1997). The reserve is one of about 20 sites registered in South Africa and one of 2065+ in the world.

Nylsvley Nature Reserve is situated in the summer rainfall area of South Africa; receiving rains during the hot summer months and experience cool dry winter (Craig and Johan 1997). The rainfall over the entire system is highly variable in time, space and intensity and varies between 740 mm per annum in the west and 600 mm per annum in the east. The 69-year mean annual rainfall at Nylsvley Nature Reserve is 623 mm per annum with an annual coefficient of variation of 24% (Frost 1987).

Summer temperatures are warm to hot with a maximum of 38–39°C whereas, winters are mild to warm with temperatures rarely dropping below 10°C (Noble *et al.* 1978).

Mean annual temperature is 19 °C (Scholes and Walker 1993). Maximum daily temperature at Nyslvley Nature Reserve ranges from a mean of 30°C degree in December/January to 21 °C, 10 °C in June/July. Minimum daily temperature varies between 16.8 °C in December/ January and 4 °C in June/July).

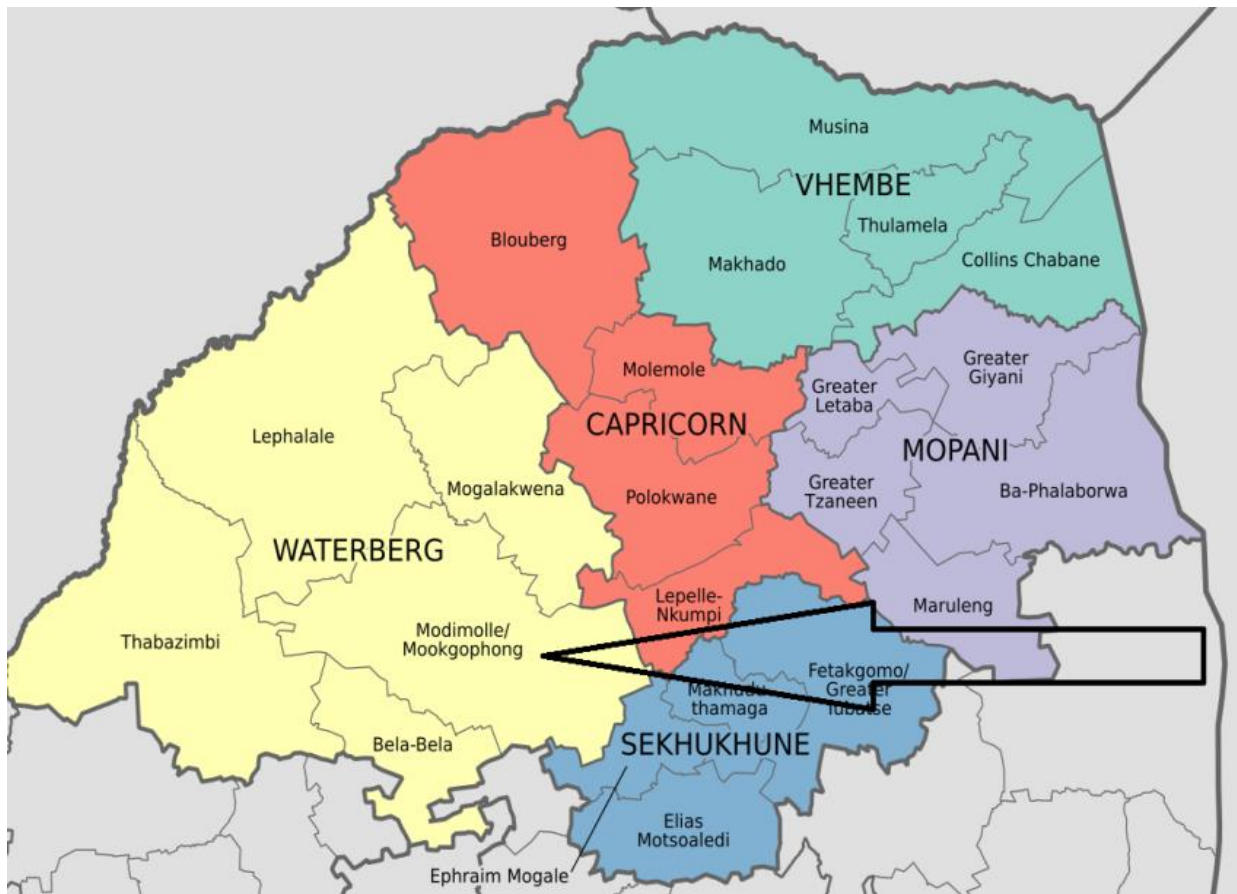


Figure 1: Map of the study area

The vegetation is seasonal grassland and deciduous savanna with four floristically distinct major groups of plant community. Grassland and broad-leaved savannas on non-calcareous sandy soils on elevated sandstone and felsite (Whitecross, 2017).

Its wetland is characterised by three long visible patches of grasses; *C. amabilis*, *S. africanus* and *T. triadra*

2.2 Construction of quadrats within grass belts

The quadrat method has been widely used in plant studies. A quadrat is a four-sided figure which delimits the boundaries of a sample plot (Figure 2). The term quadrat is used more widely to include circular plots and other shapes. Quadrat sampling involves counting all individuals within a known area (a). Since density (D) and population size (N) are related, as $N = D \times a$, we can estimate the density for the sample and from this compute the total population. This assumes that the area the population occupies is finite and known (Gleason, 1920).

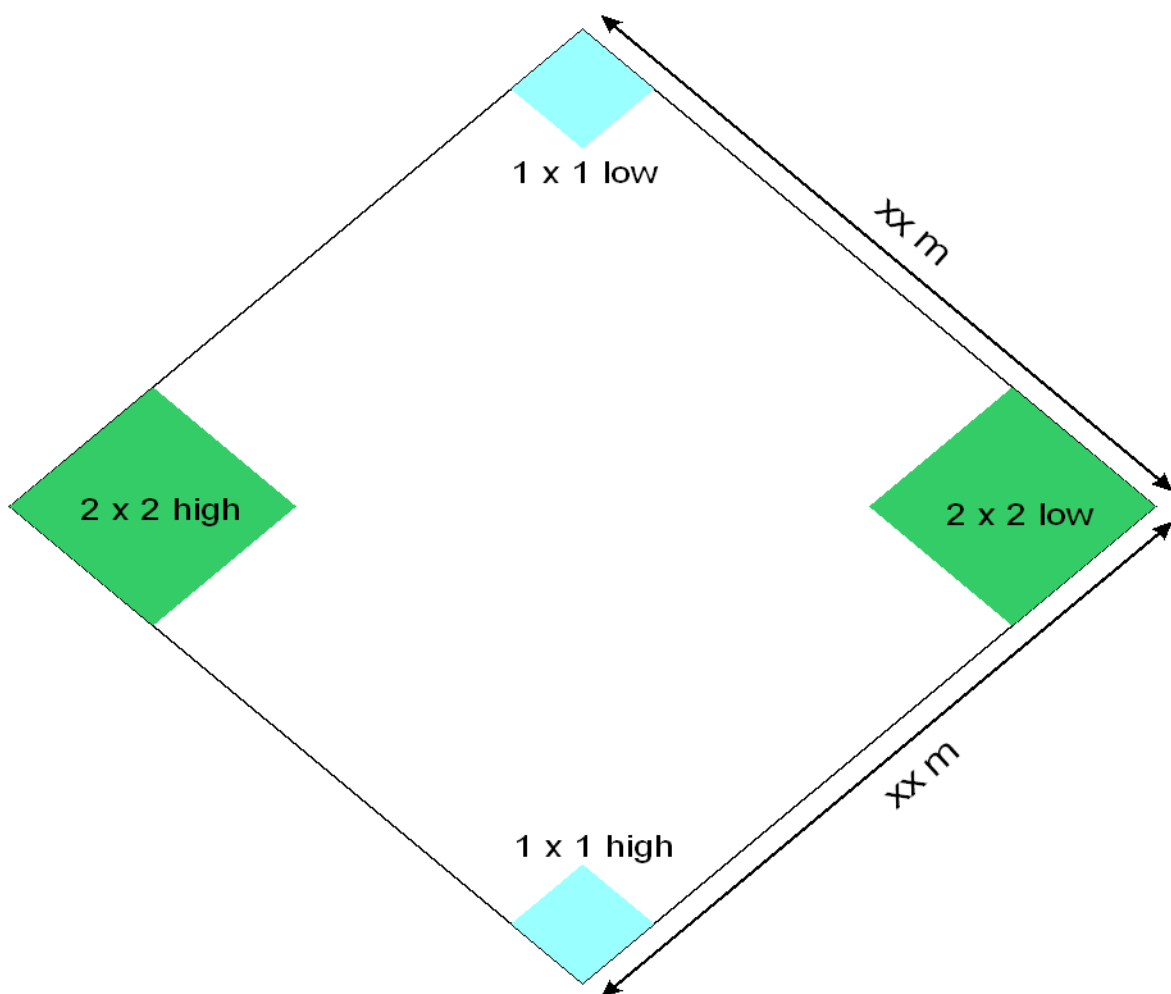


Figure 2: Sketch drawing showing each kite with quadrats and naming convention (not to scale)

Quadrats were constructed within a grassland community (Figure 3) comprised of three grass belts, namely; *Themeda triandra*, *Sporobolus africanum*, and *Cyperus amabilis* belts. The experiments were conducted during the winter and summer seasons of 2016 and 2017.



Figure 3: Grassland community within the Nylsvlei Nature Reserve in which quadrats were conducted.

Two hundred and four quadrats divided into 17 kites of 4 quadrats each were constructed during summer and winter of 2017. The same set of 204 quadrats were constructed during winter and summer seasons of 2018. A total of 816 quadrats were therefore constructed within the grassland community during the two years of experiment.

Two of the four quadrats within a kite were 1 m x 1 m in size and the other pair being 2 m x 2 m in size. Quadrats of the same size were placed opposite to one another within a kite with one of them highly disturbed while the other one was subjected to low disturbance regime. Quadrats were temporarily demarcated with four sticks during

their disturbance experiments. Species within the quadrats were recorded before subjecting them to the two different disturbance regimes (high and low). Recording of new species was done after six months of disturbance.

The hydric status of each vegetation belt was determined using Reed (1988) classification (Table 1).

Table 1: Classification of plants community according to their hydric status in wetlands, based on U.S. Fish and Wildlife Service Indicator Categories (Reed, 1988)

Obligate wetland species	O	Almost always grow in wetlands (>99% of occurrences)
Facultative wetland species	FW	Usually grow in wetlands (66-99% of occurrences) but are occasionally found in non-wetland areas
Facultative species	F	Are equally likely to grow in wetland and non-wetland areas (34-66% of occurrences)
Facultative dryland species	FD	Usually grow in non-wetland areas but sometimes grow in wetlands (1-34% of occurrences)
Dryland species	D	Almost always grow in drylands (>99% of occurrences)

2.3.6.1 Assumptions of Kite Quadrat Sampling

The quadrat method has the following assumptions:

1. The number of individuals in each quadrat is counted.
2. The size of the quadrats is known.
3. Most of environmental variables are covered
4. The quadrat samples are representative of the study area as a whole.

2.3.6.2 Statistical Analysis

The ability of environmental variables to explain the interaction and distribution

structure was tested with a constrained ordination in CANOCO V4.5 (TerBraak & Šmilauer, 2002). The list of environmental variables was first screened for co-linearity by calculating correlation coefficients between the variables and excluding all variables except one, that have coefficients larger than 0.7. The choice between linear or unimodal species response models were made based on the turnover of species in a quadrat. Detrended correspondence analysis (DCA) in CANOCO V4.5 with the choice of detrending by segments, gives an assessment of the length of this gradient, or beta diversity

Chapter 3

RESULTS

a. *Cyperus amabilis* Belt (table 2)

Cyperus amabilis is a widespread weed which can be found in the wild at wet area, rainbanks and waterlogged area. It is well distributed in both hemisphere, mainly in the tropical and subtropical region as well as in temperature region of the pacific (Archer and Craven 2004). In southern Africa, sedges are found in wetland; some are entirely aquatic and along water courses but also occur in moist grasslands.

Their tangled rhizomes contribute to soil erosion control. They also used as a source of food by game animals.

i. Habitat description

Cyperus amabilis occurs in the wide range of habitats, from estuarine to desert. *C. amabilis* has a shallow spreading root surface, which bind the soil, reducing erosion. Their soil binding properties and growth habit means they are excellent at slowing the rate of water flow and trapping sediment within water ways.

ii. Temperature

Cyperus amabilis is seen to be growing fast on temperature $> 28^{\circ}\text{C}$. They sprout very quickly and in number. Wet session favours this type of species.

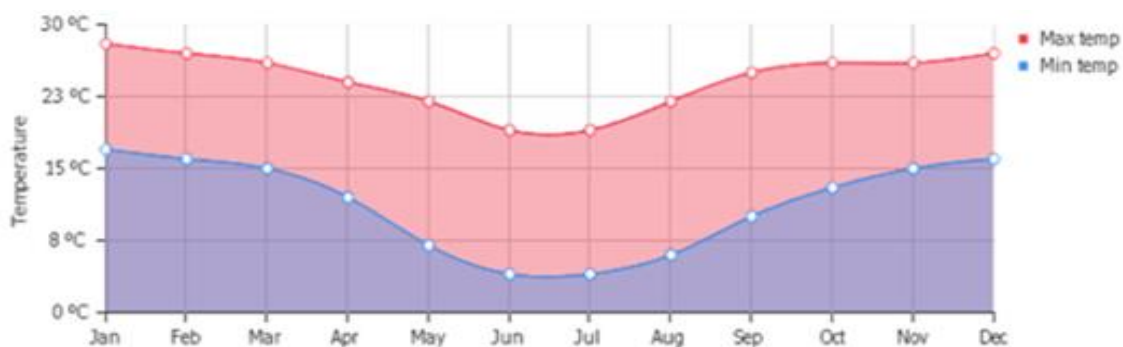


Figure 4: average Min and Max temperature at Nyslvley Nature Reserve 2016-2017

Soil type

The following types of soil has been identified:

Black and red montmorillonitic clays - red clays contain less calcium carbonate, lower phosphorus and have higher percentages of iron and aluminium oxides than black clays. Black clays are confined to the shallow, poorly drained depressions of the floodplain. Lithosols of the scattered sandstone outcrops. Savanna soils of red, yellow and grey ferrisallitic sands (upland situation) and loams of the bottomlands.

C. amabilis grow best in black clay where water table is just above the ground although it was seen also growing where water table is just below the ground.

iii. Hydric status

Cyperus amabilis is an obligate wetland species; Almost always grow in wetlands (>99% of occurrences)

3.1.1 Quadrat data.

Table 2: Representing data collected in the *Cyperus amabilis* belt in two seasons (June 2016 and December 2016) 1 m x 1 m low.

Kite	Cover	Before clearing	Cover	After clearing
1	100	<i>Cyperus amabilis</i> (332)	63	<i>Cyperus amabilis</i> (256), <i>Berkheya cirsiifolia</i> (2)
2	100	<i>Cyperus amabilis</i> (340)	90	<i>Cyperus amabilis</i> (312), <i>Berkheya cirsiifolia</i> (1)
3	100	<i>Cyperus amabilis</i> (325)	65	<i>Cyperus amabilis</i> (290)
4	100	<i>Cyperus amabilis</i> (335)	70	<i>Cyperus amabilis</i> (301)
5	100	<i>Cyperus amabilis</i> (360)	65	<i>Cyperus amabilis</i> (286)
6	100	<i>Cyperus amabilis</i> (344)	55	<i>Cyperus</i> (260), <i>Berkheya cirsiifolia</i> (3)
7	100	<i>Cyperus amabilis</i> (353)	73	<i>Cyperus amabilis</i> (301)
8	100	<i>Cyperus amabilis</i> (320)	70	<i>Cyperus amabilis</i> (305), <i>Corchorus junodii</i> (2), <i>Berkheya cirsiifolia</i> (1)

9	100	<i>Cyperus amabilis</i> (319)	80	<i>Cyperus amabilis</i> (351)
10	100	<i>Cyperus amabilis</i> (340)	63	<i>Cyperus amabilis</i> (299)
11	100	<i>Cyperus amabilis</i> (354)	85	<i>Cyperus amabilis</i> (360)
12	100	<i>Cyperus amabilis</i> (328)	80	<i>Cyperus amabilis</i> (352)
13	100	<i>Cyperus amabilis</i> (312)	60	<i>Cyperus amabilis</i> (324)
14	100	<i>Cyperus amabilis</i> (320)	70	<i>Cyperus amabilis</i> (363)
15	100	<i>Cyperus amabilis</i> (342)	65	<i>Cyperus amabilis</i> (287), <i>Setaria sphacelata</i> (5)
16	100	<i>Cyperus amabilis</i> (333)	60	<i>Cyperus amabilis</i> (250)
17	100	<i>Cyperus amabilis</i> (334)	35	<i>Cyperus amabilis</i> (180)

Table 3: Representing data collected in the *Cyperus amabilis* belt in two seasons (June 2016 and December 2016) 1 m x 1 m high.

Kite	Cover	before clearing	Cover	after clearing
1	100	<i>Cyperus amabilis</i> (340)	15	<i>Phragmites australis</i> (1), <i>Berkheya cirsiifolia</i> (2)
2	100	<i>Cyperus amabilis</i> (320)	9	<i>Cyperus amabilis</i> (2), <i>Corchorus asplenifolius</i> (1)
3	100	<i>Cyperus amabilis</i> (350)	1	<i>Cyperus amabilis</i> (1)
4	100	<i>Cyperus amabilis</i> (344)	20	<i>Cyperus amabilis</i> (25)
5	100	<i>Cyperus amabilis</i> (338)	10	<i>Cyperus amabilis</i> (5), <i>Corchorus asplenifolius</i> (2), <i>Berkheya cirsiifolia</i> (2)
6	100	<i>Cyperus amabilis</i> (358)	2	<i>Cyperus amabilis</i> (1), <i>Berkheya cirsiifolia</i> (1)
7	100	<i>Cyperus amabilis</i> (318)	1	<i>Corchorus junodii</i> (1)
8	100	<i>Cyperus amabilis</i> (339)	4	<i>Cyperus amabilis</i> (2), <i>Berkheya cirsiifolia</i> (1)
9	100	<i>Cyperus amabilis</i> (344)	5	<i>Cyperus amabilis</i> (2)
10	100	<i>Cyperus amabilis</i> (348)	5	<i>Cyperus amabilis</i> (2)
11	100	<i>Cyperus amabilis</i> (330)	1	<i>Cyperus amabilis</i> (1)
12	100	<i>Cyperus amabilis</i> (329)	9	<i>Cyperus amabilis</i> (4)
13	100	<i>Cyperus amabilis</i> (345)	13	<i>Cyperus amabilis</i> (8)
14	100	<i>Cyperus amabilis</i> (320)	1	<i>Cyperus amabilis</i> (1)
15	100	<i>Cyperus amabilis</i> (360)	3	<i>Cyperus amabilis</i> (1)

16	100	<i>Cyperus amabilis</i> (351)	9	<i>Cyperus amabilis</i> (20), <i>Corchorus asplenifolius</i> (10)
17	100	<i>Cyperus amabilis</i> (328)	4	<i>Cyperus amabilis</i> (2) , <i>Alepidea natalensis</i> (1)

Table 4: Representing data collected in the *Cyperus amabilis* belt in two seasons (June 2016 and December 2016) 2 m x 2 m low.

Kite	Cover	Before clearing	cover	After clearing
1	100	<i>Cyperus amabilis</i> (439)	30	<i>Cynodon dactylon</i> (13), <i>Cyperus amabilis</i> (2), <i>Berkheya cirsiifolia</i> (1), <i>Corchorus asplenifolius</i> (1)
2	100	<i>Cyperus amabilis</i> (545)	85	<i>Cyperus amabilis</i> (349), <i>Berkheya cirsiifolia</i> (1), <i>Corchorus junodii</i> (1)
3	100	<i>Cyperus amabilis</i> (429)	67	<i>Cyperus amabilis</i> (303)
4	100	<i>Cyperus amabilis</i> (430)	85	<i>Cyperus amabilis</i> (410)
5	100	<i>Cyperus amabilis</i> (450)	80	<i>Cyperus amabilis</i> (395), <i>Corchorus junodii</i> (1)
6	100	<i>Cyperus amabilis</i> (441)	80	<i>Cyperus amabilis</i> (365), <i>Berkheya cirsiifolia</i> (2)
7	100	<i>Cyperus amabilis</i> (540)	75	<i>Cyperus amabilis</i> (300)
8	100	<i>Cyperus amabilis</i> (555)	90	<i>Cyperus amabilis</i> (399), <i>Berkheya cirsiifolia</i> (1)
9	100	<i>Cyperus amabilis</i> (528)	80	<i>Cyperus amabilis</i> (342)
10	100	<i>Cyperus amabilis</i> (400)	75	<i>Cyperus amabilis</i> (303)
11	100	<i>Cyperus amabilis</i> (462)	90	<i>Cyperus amabilis</i> (396)
12	100	<i>Cyperus amabilis</i> (559)	85	<i>Cyperus amabilis</i> (388)
13	100	<i>Cyperus amabilis</i> (560)	80	<i>Cyperus amabilis</i> (362)
14	100	<i>Cyperus amabilis</i> (475)	70	<i>Cyperus amabilis</i> (341), <i>Corchorus junodii</i> (3)
15	100	<i>Cyperus amabilis</i> (477)	80	<i>Cyperus amabilis</i> (354), <i>Dicerocaryum zanguebaricum</i> (1) <i>Alepidea natalensis</i> (1)
16	100	<i>Cyperus amabilis</i> (420)	55	<i>Cyperus amabilis</i> (220), <i>Corchorus junodii</i> (1)
17	100	<i>Cyperus amabilis</i> (452)	30	<i>Cyperus amabilis</i> (84)

Table 5: Representing data collected in the *Cyperus amabilis* belt in two seasons (June 2016 and December 2016) 2 m x 2 m high.

Kite	Cover	Before clearing	cover	after clearing
1	100	<i>Cyperus amabilis</i> (521)	20	<i>Berkheya cirsiifolia</i> (5), <i>Corchorus asplenifolius</i> (2)
2	100	<i>Cyperus amabilis</i> (528)	2	<i>Cyperus amabilis</i> (1), <i>Berkheya cirsiifolia</i> (1)

3	100	<i>Cyperus amabilis</i> (541)	5	<i>Cyperus amabilis</i> (2), <i>Corchorus asplenifolius</i> (1)
4	100	<i>Cyperus amabilis</i> (508)	6	<i>Cyperus amabilis</i> (2)
5	100	<i>Cyperus amabilis</i> (522)	4	<i>Cyperus amabilis</i> (1), <i>Corchorus asplenifolius</i> (1)
6	100	<i>Cyperus amabilis</i> (500)	60	<i>Setaria sphacelata</i> (14), <i>Berkheya cirsiifolia</i> (2)
7	100	<i>Cyperus amabilis</i> (517)	15	<i>Cyperus amabilis</i> (45)
8	100	<i>Cyperus amabilis</i> (523)	7	<i>Cyperus amabilis</i> (2), <i>Corchorus asplenifolius</i> (1), <i>Berkheya cirsiifolia</i> (1)
9	100	<i>Cyperus amabilis</i> (562)	10	<i>Cyperus amabilis</i> (4)
10	100	<i>Cyperus amabilis</i> (544)	25	<i>Cyperus amabilis</i> (23)
11	100	<i>Cyperus amabilis</i> (498)	15	<i>Cyperus amabilis</i> (5), <i>Corchorus asplenifolius</i> (7)
12	100	<i>Cyperus amabilis</i> (513)	1	<i>Cyperus amabilis</i> (1), <i>Corchorus asplenifolius</i> (1)
13	100	<i>Cyperus amabilis</i> (555)	4	<i>Cyperus amabilis</i> (2)
14	100	<i>Cyperus amabilis</i> (512)	10	<i>Cyperus amabilis</i> (15)
15	100	<i>Cyperus amabilis</i> (500)	15	<i>Cyperus amabilis</i> (20), <i>Corchorus asplenifolius</i> (2)
16	100	<i>Cyperus amabilis</i> (541)	2	<i>Cyperus amabilis</i> (1), <i>Commelina banghalensis</i> (1)
17	100	<i>Cyperus amabilis</i> (559)	5	<i>Cyperus amabilis</i> (2), <i>Commelina benghalensis</i> (1), <i>Corchorus junodii</i> (1)

Table 6: Representing data collected in the *Cyperus amabilis* belt in two seasons (December 2016 and June 2017) 1 m x 1 m low.

Kite	Cover	Before clearing	Cover	After clearing
1	100	<i>Cyperus amabilis</i> (356)	15	<i>Cyperus amabilis</i> (95)
2	100	<i>Cyperus amabilis</i> (357)	60	<i>Cyperus amabilis</i> (198)
3	100	<i>Cyperus amabilis</i> (336)	85	<i>Cyperus amabilis</i> (354), <i>Cynodon dactylon</i> (2)
4	100	<i>Cyperus amabilis</i> (354)	70	<i>Cyperus amabilis</i> (309)
5	100	<i>Cyperus amabilis</i> (323)	80	<i>Cyperus amabilis</i> (334)
6	100	<i>Cyperus amabilis</i> (362)	80	<i>Cyperus amabilis</i> (336), <i>Corchorus tridens</i> (1)
7	100	<i>Cyperus amabilis</i> (387)	85	<i>Cyperus amabilis</i> (350)
8	100	<i>Cyperus amabilis</i> (371)	75	<i>Cyperus amabilis</i> (312)

9	100	<i>Cyperus amabilis</i> (365)	85	<i>Cyperus amabilis</i> (351)
10	95	<i>Cyperus amabilis</i> (326)	80	<i>Cyperus amabilis</i> (340)
11	100	<i>Cyperus amabilis</i> (359)	90	<i>Cyperus amabilis</i> (360)
12	100	<i>Cyperus amabilis</i> (351)	70	<i>Cyperus amabilis</i> (310)
13	100	<i>Cyperus amabilis</i> (400)	90	<i>Cyperus amabilis</i> (358), <i>Cephalaria oblingifolia</i> (1)
14	100	<i>Cyperus amabilis</i> (390)	70	<i>Cyperus amabilis</i> (311)
15	100	<i>Cyperus amabilis</i> (388)	90	<i>Cyperus amabilis</i> (360)
16	100	<i>Cyperus amabilis</i> (374)	70	<i>Cyperus amabilis</i> (320)
17	100	<i>Cyperus amabilis</i> (328)	85	<i>Cyperus amabilis</i> (345)

Table 7: Representing data collected in the *Cyperus amabilis* belt in two seasons (December 2016 and June 2017) 1 m x 1 m high.

Kite	Cover	Before clearing	Cover	After clearing
1	100	<i>Cyperus amabilis</i> (365)	20	<i>Cyperus amabilis</i> (56)
2	100	<i>Cyperus amabilis</i> (342)	10	<i>Cyperus amabilis</i> (16)
3	70	<i>Cyperus amabilis</i> (365)	19	<i>Cyperus amabilis</i> (20)
4	100	<i>Cyperus amabilis</i> (366)	69	<i>Cyperus amabilis</i> (35)
5	92	<i>Cyperus amabilis</i> (391)	10	<i>Cyperus amabilis</i> (17)
6	100	<i>Cyperus amabilis</i> (387)	80	<i>Cyperus amabilis</i> (326), <i>Berkheya cirsiifolia</i> (6)
7	100	<i>Cyperus amabilis</i> (382)	80	<i>Cyperus amabilis</i> (323)
8	100	<i>Cyperus amabilis</i> (330)	30	<i>Cyperus amabilis</i> (23), <i>Cephalaria oblingifolia</i> (7)
9	100	<i>Cyperus amabilis</i> (341)	50	<i>Cyperus amabilis</i> (201), <i>Cynodon dactylon</i> (1), <i>Sonchus nanus</i> (2)
10	100	<i>Cyperus amabilis</i> (410)	19	<i>Cyperus amabilis</i> (20)
11	98	<i>Cyperus amabilis</i> (376)	10	<i>Cyperus amabilis</i> (15)
12	98	<i>Cyperus amabilis</i> (358)	20	<i>Cyperus amabilis</i> (20)
13	95	<i>Cyperus amabilis</i> (342)	15	<i>Cyperus amabilis</i> (18)
14	100	<i>Cyperus amabilis</i> (412)	10	<i>Cyperus amabilis</i> (16)
15	100	<i>Cyperus amabilis</i> (401)	13	<i>Cyperus amabilis</i> (14)
16	100	<i>Cyperus amabilis</i> (387)	10	<i>Cyperus amabilis</i> (19)

17	100	<i>Cyperus amabilis</i> (399)	20	<i>Cyperus amabilis</i> (38)
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Table 8: Representing data collected in the *Cyperus amabilis* belt in two seasons (December 2016 and June 2017) 2 m x 2 m low.

Kite	Cover	Before clearing	Cover	After clearing
1	100	<i>Cyperus amabilis</i> (456)	57	<i>Cyperus amabilis</i> (113), <i>Cynodon dactylon</i> (87)
2	100	<i>Cyperus amabilis</i> (423)	80	<i>Cyperus amabilis</i> (401)
3	100	<i>Cyperus amabilis</i> (596)	70	<i>Cyperus amabilis</i> (310)
4	100	<i>Cyperus amabilis</i> (610)	90	<i>Cyperus amabilis</i> (423)
5	100	<i>Cyperus amabilis</i> (632)	100	<i>Cyperus amabilis</i> (598)
6	100	<i>Cyperus amabilis</i> (512)	80	<i>Cyperus amabilis</i> (410)
7	80	<i>Cyperus amabilis</i> (530)	80	<i>Cyperus amabilis</i> (405)
8	90	<i>Cyperus amabilis</i> (623)	90	<i>Cyperus amabilis</i> (431)
9	90	<i>Cyperus amabilis</i> (641)	90	<i>Cyperus amabilis</i> (420)
10	92	<i>Cyperus amabilis</i> (653)	95	<i>Cyperus amabilis</i> (510), <i>Corchorus tridens</i> (1)
11	95	<i>Cyperus amabilis</i> (687)	85	<i>Cyperus amabilis</i> (417)
12	100	<i>Cyperus amabilis</i> (700)	90	<i>Cyperus amabilis</i> (425)
13	100	<i>Cyperus amabilis</i> (698)	100	<i>Cyperus amabilis</i> (596), <i>Corchorus tridens</i> (1)
14	100	<i>Cyperus amabilis</i> (613)	90	<i>Cyperus amabilis</i> (425)
15	100	<i>Cyperus amabilis</i> (632)	85	<i>Cyperus amabilis</i> (420),, <i>Sonchus nanus</i> (2)
16	95	<i>Cyperus amabilis</i> (589)	89	<i>Cyperus amabili</i> (430), <i>Cephalaria oblingifolia</i> (2)
17	100	<i>Cyperus amabilis</i> (650)	80	<i>Cyperus amabilis</i> (405)

Table 9: Representing data collected in the *Cyperus amabilis* belt in two seasons (December 2016 and June 2017) 2 m x 2 m high.

Kite	Cover	Before clearing	Cover	After clearing
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1	100	<i>Cyperus amabilis</i> (623)	5	<i>Cyperus amabilis</i> (15), <i>Berkheya cirsiifolia</i> (1)
2	100	<i>Cyperus amabilis</i> (563)	65	<i>Cyperus amabilis</i> (232), <i>Corchorus tridens</i> (1)
3	80	<i>Cyperus amabilis</i> (587)	10	<i>Cyperus amabilis</i> (31)
4	90	<i>Cyperus amabilis</i> (541)	8	<i>Cyperus amabilis</i> (18)
5	95	<i>Cyperus amabilis</i> (600)	20	<i>Cyperus amabilis</i> (39)
6	100	<i>Cyperus amabilis</i> (639)	25	<i>Cyperus amabilis</i> (42)
7	95	<i>Cyperus amabilis</i> (580)	30	<i>Cyperus amabilis</i> (46)
8	100	<i>Cyperus amabilis</i> (653)	20	<i>Cyperus amabilis</i> (38), <i>Eragrostis curvula</i> (1)
9	100	<i>Cyperus amabilis</i> (623)	15	<i>Cyperus amabilis</i> (29)
10	98	<i>Cyperus amabilis</i> (667)	15	<i>Cyperus amabilis</i> (28)
11	95	<i>Cyperus amabilis</i> (598)	15	<i>Cyperus amabilis</i> (30), <i>Cynodon dactylon</i> (1), <i>Cephalaria oblingifolia</i> (2)
12	97	<i>Cyperus amabilis</i> (577)	25	<i>Cyperus amabilis</i> (44), <i>Setaria sphacelata</i> (2)
13	100	<i>Cyperus amabilis</i> (585)	20	<i>Cyperus amabilis</i> (37)
14	100	<i>Cyperus amabilis</i> (605)	15	<i>Cyperus amabilis</i> (29)
15	100	<i>Cyperus amabilis</i> (603)	30	<i>Cyperus amabilis</i> (44)
16	100	<i>Cyperus amabilis</i> (630)	25	<i>Cyperus amabilis</i> (40)
17	100	<i>Cyperus amabilis</i> (607)	10	<i>Cyperus amabilis</i> (28)

3.1.2 Disturbance classification

Based on disturbance characteristics, ecologists have devised several dichotomies for classifying disturbance. Disturbance can be natural or human – caused, biotic or abiotic, and originate externally or internally. Natural disturbance is one without anthropogenic roots; include things like land use change, toxic spills, and alteration of flooding regimes. Although *C.amabilis* react differently to anthropogenic disturbance than to natural one, it is not clear that they have fundamentally different effects (either facilitative or inhibitory) on non-native species establishment. *C.amabilis* is seen re-germinating much quicker under different intensity more especially under low intensity clearance than any other grass species.

3.1.3 Statistical Analysis

Table 10: Comparison of species at high and low intensities in the clayed soil

Species	Vegetation on cover	Average number of new species	Minimum number of individuals	Maximum number of individuals	X ²	P
L Low Intensity	0.71	0.54	4.00	0.00	-	ns
L High Intensity	0.15	0.78	0.00	10.00		
M Low Intensity			0.00	50.00	-0.27	
M high Intensity			0.00	6.00		ns
N low Intensity			0.00	25.00	0.234	
N high Intensity			0.00	15.00	-	ns
O low Intensity			15.00	100.00	1.65	
O high Intensity			0.00	20.00		ns

Significance level is at $p < 0.05$

Ns = Not significance

*= significance

**= highly significant

The table shows that there was a highest percentage of vegetation cover for the low intensely disturbed quadrats in the belts when compared to the high intensely disturbed quadrats.

3.1.4 Abundance and distribution graphs

Each and every quadrat is presented by graphs. It is the comparison of seasons before clearing the ground and again after clearing.

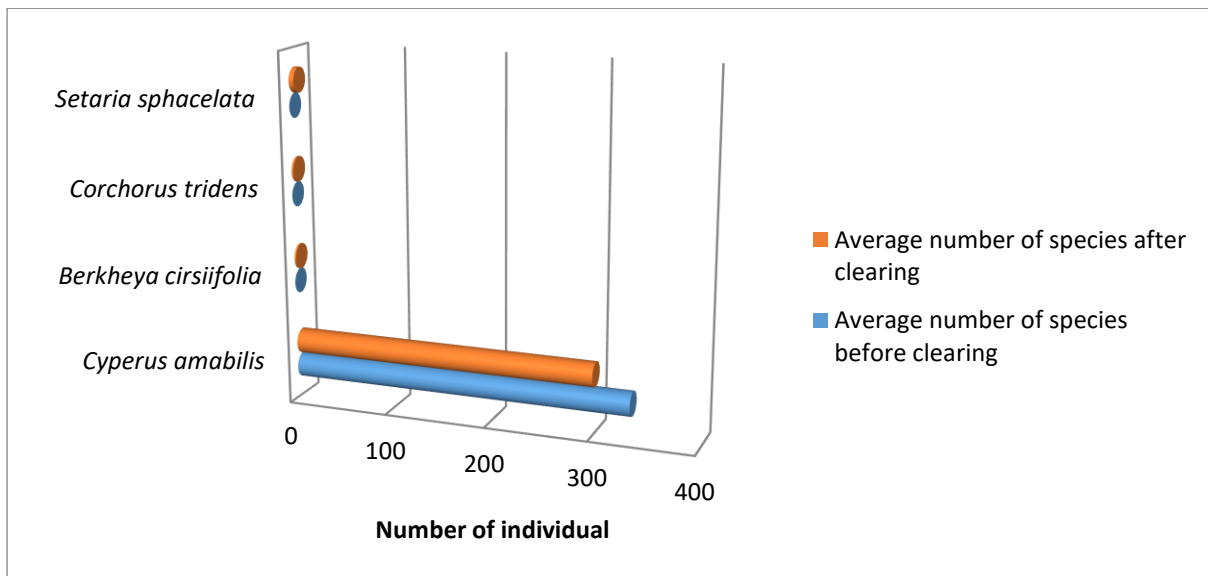


Figure 5: Graph showing abundance data collected in the *Cyperus amabilis* belt over two seasons (June 2016 and December 2016) 1 m x 1 m low.

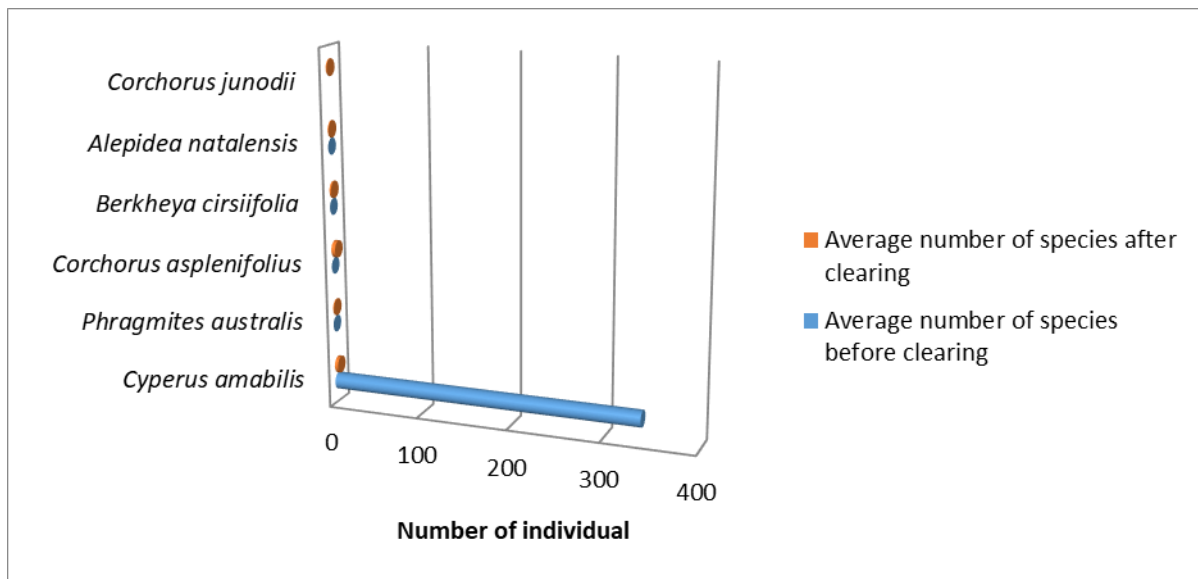


Figure 6: Graph showing abundance data collected in the *Cyperus amabilis* belt over two seasons (June 2016 and December 2016) 1 m x 1 m high.

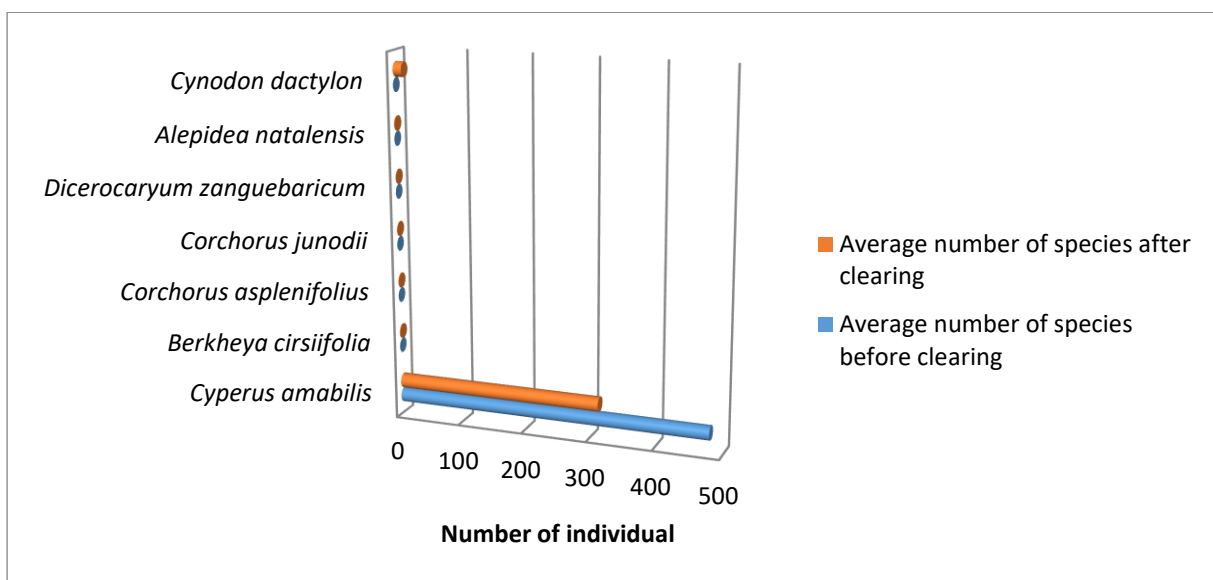


Figure 7: Graph showing abundance data collected in the *Cyperus amabilis* belt over two seasons (June 2016 and December 2016) 2 m x 2 m low.

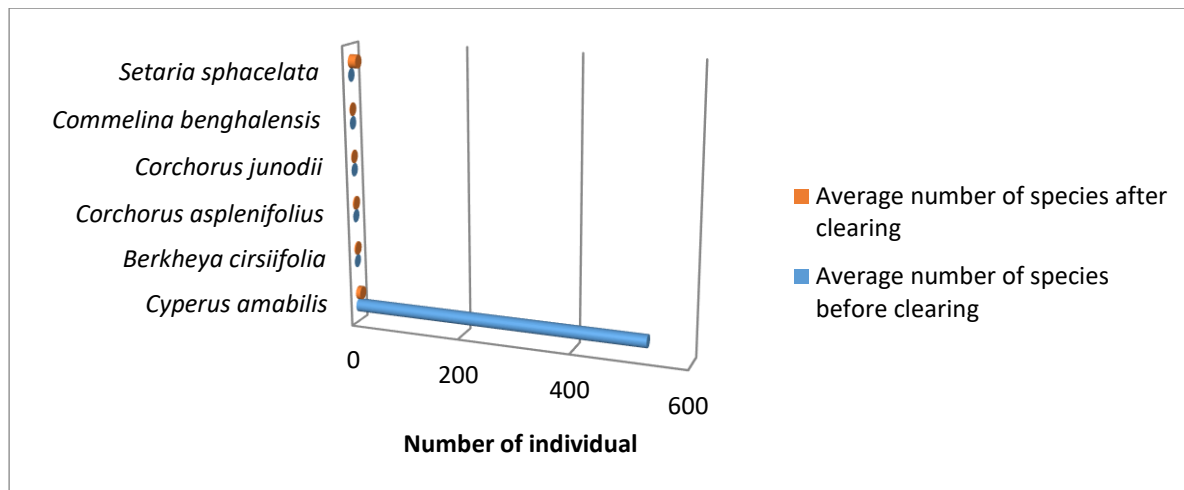


Figure 8: Graph showing abundance data collected in the *Cyperus amabilis* belt over two seasons (June 2016 and December 2016) 2 m x 2 m high.

3.2 *Sporobolus africanus* Belt

S.africanus is an erect, tough, caespitose, perennial tussock grass usually growing to 60 cm in height, but up to 1.1 m. Stems are dark green, upright and slender. Leaves are dark green, glabrous, mostly occurring around the base, and are slender and stiff, to 18 cm long, acuminate and with in-rolled margins. The spike-like inflorescence, which is grey-green in colour, up to 35 cm long and 7 mm diameter and resembles a rat's tail, has many branches tightly packed against the main stem but sometimes interrupted near the base to expose the stem. Individual clusters of spikelets each have one floret which is about 2.5 mm long, with unequal outer bracts (glumes), and are closely arranged along the branches. The seeds are about 1 mm in diameter and brown. The roots are fibrous.

iv. Habitat description

They grow in lower rainfall (600m average annual rainfall). They are adapted to wide range of soils and climatic conditions. *S.africanus* produce large quantities of seed that

disperse readily, the soil seed bank can build up quickly and seeds remain viable for a long time

v. Quadrat data

Table 11: Representing data collected in the *Sporobolus africanus* belt in two seasons (June 2016 and December 2016) 1 m x 1 m low.

Kite	Cover	Before clearing	Kite	Cover	After clearing
1	100	<i>Sporobolus africanus</i> (13)	1	55	<i>Eragrostis curvula</i> (8), <i>Berkheya cirsiifolio</i> (3)
2	90	<i>Sporobolus africanus</i> (11)	2	45	<i>Setaria sphacelata</i> (6), <i>Cyperus amabilis</i> (3), <i>Cynodon dactylon</i> (4)
3	90	<i>Sporobolus africanus</i> (8)	3	55	<i>Cyperus amabilis</i> (9), <i>Cynodon dactylon</i> (5), <i>Berkheya cirsiifolio</i> (4), <i>Setaria sphacelata</i> (9)
4	80	<i>Cynodon dactylon</i> (19)	4	65	<i>Digitaria eriantha</i> (6), <i>Hibiscus trionum</i> (2), <i>Cynodon dactylon</i> (9)
5	90	<i>Sporobolus africanus</i> (11)	5	20	<i>Setaria sphacelata</i> (2), <i>Berkheya cirsiifolio</i> (1), <i>Corchorus junodii</i> (1)
6	50	<i>Sporobolus africanus</i> (8)	6	50	<i>Setaria sphacelata</i> (8), <i>Cyperus amabilis</i> (11)
7	80	<i>Sporobolus africanus</i> (9)	7	50	<i>Cyperus amabilis</i> (5), <i>Setaria sphacelata</i> (8), <i>Berkheya cirsiifolio</i> (3)
8	100	<i>Eragrostis curvula</i> (14)	8	30	<i>Commelina benghalensis</i> (9)
9	90	<i>Sporobolus africanus</i> (10)	9	70	<i>Cyperus amabilis</i> (15), <i>Eragrostis curvula</i> (6), <i>Berkheya cirsiifolio</i> (4)
10	80	<i>Sporobolus africanus</i> (10)	10	15	<i>Berkheya cirsiifolio</i> (1), <i>Eragrostis curvula</i> (1)
11	90	<i>Eragrostis curvula</i> (13)	11	25	<i>Digitaria eriantha</i> (2), <i>Berkheya cirsiifolio</i> (1)
12	100	<i>Sporobolus africanus</i> (16)	12	50	<i>Cyperus amabilis</i> (14), <i>Setaria sphacelata</i> (8)
13	95	<i>Sporobolus africanus</i> (14)	13	5	<i>Cyperus amabilis</i> (1), <i>Setaria sphacelata</i> (1)
14	100	<i>Sporobolus africanus</i> (18)	14	70	<i>Cyperus amabilis</i> (12), <i>Setaria sphacelata</i> (6), <i>Cynodon dactylon</i> (2)
15	10	<i>Sporobolus africanus</i> (3)	15	90	<i>Cyperus amabilis</i> (18) , <i>Sporobolus africanus</i> (12)
16	100	<i>Cynodon dactylon</i> (18), <i>Sporobolus africanus</i> (7)	16	80	<i>Cyperus amabilis</i> (11), <i>Berkheya cirsiifolio</i> (5),

					<i>Cynodon dactylon</i> (4), <i>Hibiscus trionum</i> (3), <i>Themeda triandra</i> (6)
17	90	<i>Eragrostis curvula</i> (13)	17	60	<i>Cynodon dactylon</i> (6), <i>Cyperus amabilis</i> (8), <i>Setaria sphacelata</i> (4), <i>Digitaria eriantha</i> (2)

Table 12: Representing data collected in the *Sporobolus africanus* belt in two seasons (June 2016 and December 2016) 1 m x 1 m high.

Kite	Cover	Before clearing	Cover	After clearing
1	50	<i>Eragrostis curvula</i> (14)	30	<i>Berkheya cirsiifolio</i> (1), <i>Digitaria eriantha</i> (2), <i>Setaria sphacelata</i> (1)
2	100	<i>Eragrostis curvula</i> (18)	20	<i>Sporobolus africanus</i> (2), <i>Setaria sphacelata</i> (1)
3	90	<i>Eragrostis curvula</i> (10)	15	<i>Sporobolus africanus</i> (1), <i>Setaria sphacelata</i> (1)
4	80	<i>Sporobolus africanus</i> (10)	5	<i>Cyperus amabilis</i> (2)
5	100	<i>Sporobolus africanus</i> (7), <i>Setaria sphacelata</i> (2)	5	<i>Setaria sphacelata</i> (2)
6	100	<i>Sporobolus africanus</i> (6), <i>Eragrostis curvula</i> (5)	10	<i>Setaria sphacelata</i> (1), <i>Sporobolus africanus</i> (1), <i>Cyperus amabilis</i> (2)
7	90	<i>Sporobolus africanus</i> (11), <i>Eragrostis curvula</i> (2)	2	<i>Commelina beghalensis</i> (1), <i>Setaria sphacelata</i> (1)
8	100	<i>Sporobolus africanus</i> (13)	5	<i>Setaria sphacelata</i> (1), <i>Berkheya cirsiifolio</i> (1)
9	100	<i>Sporobolus africanus</i> (12), <i>Eragrostis curvula</i> (3)	4	<i>Hibiscus trionum</i> (2)
10	90	<i>Sporobolus africanus</i> (9)	2	<i>Setaria sphacelata</i> (1)
11	80	<i>Sporobolus africanus</i> (6)	10	<i>Cyperus amabilis</i> (3), <i>Berkheya cirsiifolio</i> (1)
12	70	<i>Cynodon dactylon</i> (18), <i>Eragrostis curvula</i> (2)	20	<i>Cyperus amabilis</i> (10), <i>Berkheya cirsiifolio</i> (1)
13	80	<i>Sporobolus africanus</i> (8), <i>Themeda triandra</i> (1)	15	<i>Themeda triandra</i> (1), <i>Cynodon dactylon</i> (1), <i>Berkheya cirsiifolio</i> (1)
14	100	<i>Sporobolus africanus</i> (7)	10	<i>Themeda triandra</i> (1), <i>Sporobolus africanus</i> (1), <i>Cyperus amabilis</i> (1)
15	90	<i>Sporobolus africanus</i> (7)	5	<i>Cyperus amabilis</i> (1), <i>Berkheya cirsiifolio</i> (1)

16	90	<i>Sporobolus africanus</i> (8)	10	<i>Setaria sphacelata</i> (1), <i>Cynodon dactylon</i> (4)
17	90	<i>Sporobolus africanus</i> (6)	7	<i>Cyperus amabilis</i> (1), <i>Setaria Sphacelata</i> (1), <i>Digitaria eriantha</i> (1)

Table 13: Representing data collected in the *Sporobolus africanus* belt in two seasons (June 2016 and December 2016) 2 m x 2 m low.

kite	Cover	Before clearing	Cover	After clearing
1	100	<i>Sporobolus africanus</i> (18), <i>Setaria sphacelata</i> (2), <i>Eragrostis curvula</i> (6)	50	<i>Berkheya cirsiifolia</i> (2), <i>Hibiscus trionum</i> (3), <i>Digitaria eriantha</i> (12)
2	70	<i>Sporobolus africanus</i> (21)	80	<i>Digitaria eriantha</i> (12), <i>Cyperus amabilis</i> (11), <i>Cynodon dactylon</i> (6)
3	60	<i>Sporobolus africanus</i> (16), <i>Setaria sphacelata</i> (5)	75	<i>Cyperus amabilis</i> (10), <i>Hibiscus trionum</i> (3), <i>Cynodon dactylon</i> (4), <i>Setaria sphacelata</i> (5), <i>Digitaria eriantha</i> (6)
4	95	<i>Sporobolus africanus</i> (13), <i>Themeda triandra</i> (3)	50	<i>Cyperus amabilis</i> (13), <i>Alepidea natalensis</i> (1), <i>Setaria sphacelata</i> (8)
5	100	<i>Eragrostis curvula</i> (15)	95	<i>Cyperus amabilis</i> (14), <i>Hibiscus trionum</i> (5), <i>Alepidea natalensis</i> (1), <i>Digitaria eriantha</i> (14)
6	100	<i>Sporobolus africanus</i> (21)	90	<i>Hibiscus trionum</i> (13), <i>Themeda triandra</i> (14), <i>Digitaria eriantha</i> (12)
7	80	<i>Sporobolus africanus</i> (18)	50	<i>Setaria sphacelata</i> (6), <i>Berkheya cirsiifolia</i> (3)
8	90	<i>Sporobolus africanus</i> (24)	48	<i>Setaria sphacelata</i> (2), <i>Berkheya cirsiifolia</i> (1), <i>Commelina beghalensis</i> (3)
9	80	<i>Cynodon dactylon</i> (18), <i>Eragrostis curvula</i> (5)	70	<i>Eragrostis curvula</i> (10), <i>Corchorus asplenifolius</i> (3), <i>Setaria sphacelata</i> (9), <i>Berkheya cirsiifolia</i> (2)
10	70	<i>Eragrostis curvula</i> (16)	50	<i>Berkheya cirsiifolia</i> (5), <i>Corchorus asplenifolius</i> (2), <i>Cynodon dactylon</i> (9)
11	90	<i>Setaria sphecilata</i> (19)	60	<i>Cyperus amabilis</i> (9). <i>Cynodon dactylon</i> (8)
12	80	<i>Setaria sphacelata</i> (8), <i>Themeda triandra</i> (5)	45	<i>Cynodon amabilis</i> (5), <i>Berkheya cirsiifolia</i> (2)

13	70	<i>Sporobolus africanus</i> (12), <i>Themeda triandra</i> (2)	25	<i>Sporobolus africanus</i> (1), <i>Cyperus amabilis</i> (5), <i>Berkheya cirsiifolia</i> (1)
14	100	<i>Cynodon dactylon</i> (13), <i>Sporobolus africanus</i> (8)	75	<i>Cyperus amabilis</i> (11), <i>Sporobolus pyramidalis</i> (8), <i>Berkheya cirsiifolia</i> (1)
15	90	<i>Sporobolus africanus</i> (17)	50	<i>Themeda triandra</i> (7), <i>Berkheya cirsiifolia</i> (1), <i>Setaria sphacelata</i> (6)
16	100	<i>Cynodon dactylon</i> (29)	80	<i>Cynodon dactylon</i> (8), <i>Berkheya cirsiifolia</i> (4), <i>Setaria sphacelata</i> (6)
17	100	<i>Eragrostis curvula</i> (18)	75	<i>Digitaria eriantha</i> (5), <i>Cynodon dactylon</i> (4), <i>Eragrostis curvula</i> (5), <i>Berkheya cirsiifolia</i> (2), <i>Cyperus amabilis</i> (7)

Table 14: Representing data collected in the *Sporobolus africanus* belt in two seasons (June 2016 and December 2016) 2 m x 2 m high.

Kite	Cover	Before clearing	Cover	After clearing
1	95	<i>Sporobolus africanus</i> (20), <i>Eragrostis curvula</i> (6)	45	<i>Berkheya cirsiifolia</i> (5), <i>Digitaria eriantha</i> (4)
2	40	<i>Sporobolus africanus</i> (21)	50	<i>Berkheya cirsiifolia</i> (10), <i>Cyperus amabilis</i> (11), <i>Digitaria eriantha</i> (3), <i>Setaria sphacelata</i> (5)
3	50	<i>Sporobolus africanus</i> (19)	60	<i>Cyperus amabilis</i> (12), <i>Hibiscus trionum</i> (2), <i>Sporobolus africanus</i> (6)
4	90	<i>Sporobolus africanus</i> (24)	15	<i>Cyperus amabilis</i> (2), <i>Cynodon dactylon</i> (5), <i>commelina benghalensis</i> (2)
5	90	<i>Sporobolus africanus</i> (18), <i>Setaria sphacelata</i> (5)	20	<i>Sporobolus africanus</i> (1), <i>Cyperus amabilis</i> (5), <i>Setaria sphacelata</i> (1)
6	80	<i>Sporobolus africanus</i> (22)	70	<i>Sporobolus africanus</i> (15), <i>Setaria sphacelata</i> (13)
7	95	<i>Sporobolus africanus</i> (28)	20	<i>Sporobolus africanus</i> (4), <i>Setaria sphacelata</i> (2), <i>Cyperus amabilis</i> (9)
8	100	<i>Sporobolus africanus</i> (25)	35	<i>Cyperus amabilis</i> (8), <i>Sporobolus africanus</i> (7), <i>Setaria sphacelata</i> (5)

9	100	<i>Sporobolus africanus</i> (24)	15	<i>Commelina benghalensis</i> (2), <i>Setaria sphacelata</i> (2), <i>Cyperus amabilis</i> (3), <i>Cynodon dactylon</i> (5)
10	95	<i>Sporobolus africanus</i> (22)	35	<i>Commelina benghalensis</i> (6), <i>Setaria sphacelata</i> (5), <i>Corchorus asplenifolius</i> (5), <i>Cyperus amabilis</i> (3)
11	100	<i>Sporobolus africanus</i> (26)	45	<i>Cynodon dactylon</i> (16), <i>Berkheya cirsiifolia</i> (2)
12	90	<i>Sporobolus africanus</i> (17)	20	<i>Berkheya cirsiifolia</i> (3), <i>Cyperus amabilis</i> (9), <i>Setaria sphacelata</i> (2)
13	90	<i>Sporobolus pyramidalis</i> (18), <i>Themeda triandra</i> (3)	45	<i>Commelina benghalensis</i> (10), <i>Berkheya cirsiifolia</i> (9)
14	95	<i>Themeda triandra</i> (9)	5	<i>Berkheya cirsiifolia</i> (1)
15	95	<i>Sporobolus africanus</i> (20)	15	<i>Setaria sphacelata</i> (1), <i>Hibiscus trionum</i> (1), <i>Berkheya cirsiifolia</i> (1), <i>Cyperus amabilis</i> (2)
16	100	<i>Sporobolus africanus</i> (22)	15	<i>Setaria sphacelata</i> (1), <i>Berkheya cirsiifolia</i> (1), <i>Cynodon dactylon</i> (3), <i>Cyperus amabilis</i> (2)
17	80	<i>Eragrostis curvula</i> (17)	10	<i>Berkheya cirsiifolia</i> (2), <i>Setaria sphacelata</i> (1)

Table 15: Representing data collected in the *Sporobolus africanus* belt in two seasons (December 2016 and June 2017) 1 m x 1 m low.

Kite	Cover	Before clearing	Cover	After clearing
1	70	<i>Sporobolus africanus</i> (12), <i>Cyperus amabilis</i> Vahl (2), <i>Setaria sphacelata</i> (4)	40	<i>Themeda triandra</i> (1), <i>Corchorus tridens</i> (6)
2	85	<i>Sporobolus africanus</i> (15), <i>Setaria sphacelata</i> (9)	5	<i>Themeda triandra</i> (10)
3	75	<i>Sporobolus africanus</i> (14), <i>Setaria sphacelata</i> (5)	13	<i>Themeda triandra</i> (15) <i>Setaria sphacelata</i> (20)
4	70	<i>Sporobolus africanus</i> (14), <i>Setaria sphacelata</i> (3)	17	<i>Themeda triandra</i> (6)
5	90	<i>Sporobolus africanus</i> (16), <i>Setaria sphacelata</i> (10)	6	<i>Setaria sphacelata</i> (5), <i>Corchorus tridens</i> (4), <i>Berkheya cirsiifolia</i> (3)

6	70	<i>Sporobolus africanus</i> (13), <i>Setaria sphacelata</i> (7), <i>Berkheya cirsiifolia</i> (1)	7	<i>Setaria sphacelata</i> (4)
7	68	<i>Sporobolus africanus</i> (9)	12	
8	70	<i>Sporobolus africanus</i> (11), <i>Themeda triandra</i> (5), <i>Setaria sphacelata</i> (1), <i>cyperus amabilis</i> (91)	14	<i>Themeda triandra</i> (10), <i>Setaria sphacelata</i> (11)
9	80	<i>Sporobolus africanus</i> (12), <i>Themeda triandra</i> (3), <i>Setaria sphacelata</i> (2)	70	<i>Themeda triandra</i> (10), <i>Berkheya cirsiifolia</i> (7), <i>Setaria sphacelata</i> (7)
10	95	<i>Sporobolus africanus</i> (15), <i>Eragrostis curvula</i> (5), <i>setaria sphacelata</i> (1), <i>Berkheya cirsiifolia</i> (1)	0	Empty
11	90	<i>Sporobolus africanus</i> (16), <i>Setaria sphacelata</i> (6), <i>Eragrostis curvula</i> (6)	3	<i>Themeda triandra</i> (5), <i>Setaria sphacelata</i> (10), <i>Cephalaria oblingifolia</i> (4)
12	100	<i>Sporobolus africanus</i> (18), <i>Themeda triandra</i> (5), <i>Setaria sphacelata</i> (3)	80	<i>Cynodo dactylon</i> (10)
13	89	<i>Sporobolus africanus</i> (15), <i>Themeda triandra</i> (5), <i>Setaria sphacelata</i> (6), <i>Digitaria eriantha</i> (2)	12	<i>Sonchus nanus</i> (3), <i>Corchorus junodii</i> (10)
14	95	<i>Sporobolus africanus</i> (12), <i>Themeda triandra</i> (8), <i>Setaria sphacelata</i> (7)	8	<i>Setaria sphacelata</i> (10), <i>Corchorus tridens</i> (5)
15	92	<i>Sporobolus africanus</i> (14), <i>Themeda triandra</i> (5), <i>Setaria sphacelata</i> (3)	17	<i>Themeda triandra</i> (10), <i>Setaria sphacelata</i> (7)
16	95	<i>Sporobolus africanus</i> (16), <i>Themeda triandra</i> (4), <i>Setaria sphacelata</i> (3)	20	<i>Berkheya cirsiifolia</i> (1), <i>Setaria sphacelata</i> (11), <i>Themeda triandra</i> (5)
17	100	<i>Sporobolus africanus</i> (18), <i>Eragrostis curvula</i> (8), <i>Berkheya cirsiifolia</i> (1)	30	<i>Themeda triandra</i> (4), <i>Setaria sphacelata</i> (5)

Table 16: Representing data collected in the *Sporobolus africanus* belt in two seasons (December 2016 and June 2017) 1 m x 1 m high

Kit e	Cove r	Before clearing	Cove r	After clearing
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1	80	<i>Sporobolus africanus</i> (11), <i>Setaria sphacelata</i> (3), <i>Themeda triandra</i> (6)	60	<i>Berkheya cirsiifolia</i> (10) <i>Setaria sphacelata</i> (15)
2	80	<i>Sporobolus africanus</i> (8) , <i>Setaria sphacelata</i> (6), <i>Cyperus amabilis</i> (10)	8	<i>Corchorus tridens</i> (3)
3	95	<i>Cynodon dactylon</i> (6), <i>Setaria sphacelata</i> (3), <i>Eragrostis curvula</i> (4)	10	<i>Corchorus tridens</i> (1), <i>Berkheya cirsiifolia</i> (1)
4	75	<i>Sporobolus africanus</i> (8), <i>Cyperus amabilis</i> (8), <i>Setaria sphacelata</i> (4)	10	<i>Themeda triandra</i> (4)
5	100	<i>Sporobolus africanus</i> (15), <i>Setaria sphacelata</i> (6)	2	<i>Themeda triandra</i> (3)
6	90	<i>Sporobolus africanus</i> (13), <i>Eragrostis curvula</i> (9)	2	<i>Berkheya cirsiifolia</i> (3)
7	90	<i>Sporobolus africanus</i> (12), <i>Eragrostis curvula</i> (7), <i>Setaria sphacelata</i> (5)	8	<i>Setaria sphacelata</i> (10)
8	87	<i>Sporobolus africanus</i> (10), <i>Setaria sphacelata</i> (3), <i>Themeda triandra</i> (4)	10	<i>Themeda triandra</i> (1)
9	85	<i>Sporobolus africanus</i> (14), <i>Setaria sphacelata</i> (9), <i>Eragrostis curvula</i> (1)	1	<i>Berkheya cirsiifolia</i> (3)
10	75	<i>Sporobolus africanus</i> (10), <i>Digitaria eriantha</i> (2), <i>Setaria sphacelata</i> (3)	1	<i>Cynodon dactylon</i> (4)
11	90	<i>Sporobolus africanus</i> (15), <i>Setaria sphacelata</i> (6), <i>Eragrostis curvula</i> (1)	2	<i>Corchorus tridens</i> (2)
12	100	<i>Sporobolus africanus</i> (16), <i>Setaria sphacelata</i> (4), <i>Themeda triandra</i> (6)	9	<i>Themeda triandra</i> (1)
13	80	<i>Sporobolus africanus</i> (13), <i>Themeda triandra</i> (2), <i>Eragrostis curvula</i> (3)	2	<i>Setaria sphacelata</i> (1)
14	100	<i>Sporobolus africanus</i> (16), <i>Setaria sphacelata</i> (3), <i>Themeda triandra</i> (6)	8	<i>Berkeya cirsiifolia</i> (7)
15	95	<i>Sporobolus africanus</i> (14), <i>Setaria sphacelata</i> (6), <i>Themeda triandra</i> (5)	1	<i>Berkheya cirsiifolia</i> (1)
16	100	<i>Sporobolus africanus</i> (17), <i>Themeda triandra</i> (1), <i>Eragrostis curvula</i> (2)	2	<i>Themeda triandra</i> (3)
17	100	<i>Sporobolus africanus</i> (16), <i>Themeda triandra</i> (1), <i>Eragrostis curvula</i> (1)	2	<i>Alepidea natalensis</i> (1)

Table 17: Representing data collected in the *Sporobolus africanus* belt in two seasons (December 2016 and June 2017) 2 m x 2 m low.

Kite	Cover	Before clearing	Cover	After clearing
1	40	<i>Setaria sphacelata</i> (4), <i>Themeda triandra</i> (2)	30	<i>Berkheya cirsiifolia</i> (2), <i>Sonchus nanus</i> (14)
2	65	<i>Cyperus amabilis</i> Vahl (8) , <i>Setaria sphacelata</i> (6), <i>Sporobolus africanus</i> (6)	5	<i>Cyperus amabilis</i> (4)
3	75	<i>Setaria sphacelata</i> (12), <i>Sporobolus africanus</i> (3), <i>Eragrostis curvula</i> (4)	5	<i>Cyperus amabilis</i> (1), <i>Sonchus nanus</i> (1)
4	65	<i>Themeda triandra</i> (8), <i>Eragrostis curvula</i> (7)	10	<i>Berkheya cirsiifolia</i> (1), <i>Alepidea natalensis</i> (6), <i>Cyperus amabilis</i> (3)
5	80	<i>Sporobolus africanus</i> (14), <i>Setaria sphacelata</i> (10)	2	<i>Cyperus amabilis</i> (2)
6	60	<i>Themeda triandra</i> (4), <i>Setaria sphacelata</i> (6), <i>Eragrostis curvula</i> (5)	0	Empty
7	100	<i>Themeda triandra</i> (9), <i>Setaria sphacelata</i> (8), <i>Eragrostis curvula</i> (6)	1	<i>Sonchus nanus</i> (1), <i>Sporobolus africanus</i> (10)
8	100	<i>Themeda triandra</i> (10), <i>Setaria sphacelata</i> (9), <i>Sporobolus africanus</i> (1)	1	<i>Sporobolus pyramidalis</i> (1)
9	100	<i>Sporobolus africanus</i> (13), <i>Setaria sphacelata</i> (7)	1	<i>Sonchus nanus</i> (4)
10	98	<i>Sporobolus africanus</i> (11), <i>Setaria sphacelata</i> (5), <i>Digitaria eriantha</i> (2)	9	<i>Alepidea natalensis</i> (4), <i>Andropogon eucomus</i> (1), <i>Sonchus nanus</i> (7)
11	92	<i>Setaria sphacelata</i> (12), <i>Sporobolus africanus</i> (4), <i>Eragrostis curvula</i> (1), <i>Berkheya cirsiifolia</i> (1)	2	<i>Corchorus junodii</i> (1), <i>Sonchus nanus</i> (3)
12	100	<i>Setaria sphacelata</i> (8), <i>Sporobolus africanus</i> (10), <i>Eragrostis curvula</i> (7)	4	<i>Sonchus nanus</i> (10)
13	100	<i>Sporobolus africanus</i> (16), <i>Themeda triandra</i> (5), <i>Setaria sphacelata</i> (2)	8	<i>Sonchus nanus</i> (31)
14	100	<i>Sporobolus africanus</i> (20), <i>Themeda triandra</i> (6), <i>Setaria sphacelata</i> (2)	4	<i>sonchus nanus</i> (10), <i>Cynodon dactylon</i> (4)
15	98	<i>Sporobolus africanus</i> (19), <i>Themeda triandra</i> (5), <i>Setaria sphacelata</i> (4)	3	<i>Sonchus nanus</i> (3), <i>Sporobolus africanus</i> (1)

16	100	<i>Sporobolus africanus</i> (20), <i>Themeda triandra</i> (2), <i>Eragrostis curvula</i> (3)	4	<i>Sonchus nanus</i> (1), <i>Cynodon dactylon</i> (3)
17	95	<i>Sporobolus africanus</i> (18), <i>Themeda triandra</i> (1), <i>Eragrostis curvula</i> (1)	1	<i>Corchorus junodii</i> (1)

Table 18: Representing data collected in the *Sporobolus africanus* belt in two seasons (December 2016 and June 2017) 2 m x 2 m high.

Kite	Cover	Before clearing	Cover	After clearing
1	85	<i>Sporobolus africanus</i> (19), <i>Setaria sphacelata</i> (9)	10	<i>Corchorus tridens</i> (3)
2	90	<i>Sporobolus africanus</i> (18), <i>Eragrostis curvula</i> (12)	14	<i>Setaria sphacelata</i> (25)
3	85	<i>Sporobolus africanus</i> (16), <i>Setaria sphacelata</i> (5), <i>Eragrostis curvula</i> (4)	5	<i>Setaria sphacelata</i> (10), <i>Berkheya cirsiifolia</i> (7)
4	80	<i>Sporobolus africanus</i> (16), <i>Setaria sphacelata</i> (7)	13	<i>Sporobolus africanus</i> (11), <i>Cephalaria oblingifolia</i> (3)
5	85	<i>Sporobolus africanus</i> (16), <i>Setaria sphacelata</i> (9)	7	<i>Sporobolus africanus</i> (10), <i>Setaria sphacelata</i> (17)
6	80	<i>Sporobolus africanus</i> (14), <i>Eragrostis curvula</i> (5)	17	<i>Berkheya cirsiifolia</i> (25), <i>Setaria sphacelata</i> (1), <i>Themeda triandra</i> (7)
7	80	<i>Sporobolus africanus</i> (12), <i>Setaria sphacelata</i> (7)	14	<i>Digitaria eriantha</i> (2), <i>Berkheya cirsiifolia</i> (10)
8	85	<i>Sporobolus africanus</i> (15), <i>Themeda triandra</i> (1), <i>Setaria sphacelata</i> (3)	28	<i>Themeda triandra</i> (5), <i>Alepidea natalensis</i> (5), <i>Cephalaria oblingifolia</i> (2)
9	85	<i>Sporobolus africanus</i> (16), <i>Themeda triandra</i> (3)	40	<i>Setaria sphacelata</i> (17), <i>Digitaria eriantha</i> (9)
10	60	<i>Sporobolus africanus</i> (9), <i>Setaria sphacelata</i> (2)	15	<i>Berkheya cirsiifolia</i> (4), <i>Cephalaria oblingifolia</i> (2)
11	70	<i>Sporobolus africanus</i> (4), <i>Setaria sphacelata</i> (6), <i>Eragrostis curvula</i> (3), <i>Berkheya cirsiifolia</i> (1)	12	<i>Corchorus tridens</i> (10), <i>Setaria sphacelata</i> (5), <i>Cephalaria oblingifolia</i> (2) <i>Berkheya cirsiifolia</i> (1)
12	100	<i>Sporobolus africanus</i> (16), <i>Setaria sphacelata</i> (4), <i>Digitaria eriantha</i> (1), <i>Cynodon dactylon</i> (2), <i>Berkheya cirsiifolia</i> (1)	45	<i>Setaria sphacelata</i> (20), <i>Cephalaria oblingifolia</i> (3)
13	92	<i>Sporobolus africanus</i> (15), <i>Setaria sphacelata</i> (6), <i>Digitaria eriantha</i> (1) <i>Themeda triandra</i> (2)	23	<i>Berkheya cirsiifolia</i> (4), <i>Alepidea natalensis</i> (2), <i>Cephalaria oblingifolia</i> (5)
14	95	<i>Sporobolus africanus</i> (14), <i>Themeda triandra</i> (7), <i>Setaria sphacelata</i> (2)	25	<i>Sporobolus africanus</i> (2)
15	97	<i>Sporobolus africanus</i> (19), <i>Themeda triandra</i> (2)	35	<i>Setaria sphacelata</i> (6), <i>Berkheya cirsiifolia</i> (3), <i>Helichrysum aureonitens</i> (1)
16	95	<i>Sporobolus africanus</i> (18), <i>Eragrostis curvula</i> (1), <i>Themeda triandra</i> (2)	12	<i>Cephalaria oblingifolia</i> (6), <i>Berkheya cirsiifolia</i> (2), <i>Corchorus tridens</i> (2)
17	80	<i>Sporobolus africanus</i> (15), <i>Themeda triandra</i> (5), <i>Setaria sphacelata</i> (5)	18	<i>Sporobolus africanus</i> (17), <i>Setaria sphacelata</i> (5)

3.2.1 Statistical Analysis

Table 19: Comparison of vegetation cover at low and high intensity in semi clay soil

Species	Vegetation on cover	Average number of new species	Minimum number of individuals	Maximum number of individuals	X ²	P
S Low Intensity	0.73	1.00	4.00	79.00	-0.125	ns
S High intensity	0.13	0.90	0.00	30.00		
P Low intensity			2.00	39.00		
P high intensity			0.00	4.00	-1.99**	ns
Q low intensity			0.00	0.00		
Q high intensity			0.00	7.00	-	ns
O low intensity			0.00	31.00		
O high intensity			0.00	33.00	0.023	ns

The table show that there was a highest percentage of vegetation cover for the low intensely disturbed quadrats in the belts when compared to the high intensely disturbed quadrats.

3.2.2 Temperature

S.africanus seed germinates between 15⁰ C and 35⁰ C

3.2.3 Soil type

Mix of sand and black clay

Different species invaded the area which was originally occupied by *Sporobolus africanus*. This is probably because black clay soil is rich in nutrient and can also hold more for a longer period of time. Clay soil is very fertile and contains plenty of nutrients and the only problem with the clay soil is that they crust and crack when they are to dry.

3.2.4 Hydric status

Facultative species ; Are equally likely to grow in wetland and non-wetland areas (34-66% of occurrences)

3.2.5 Abundance and distribution graphs

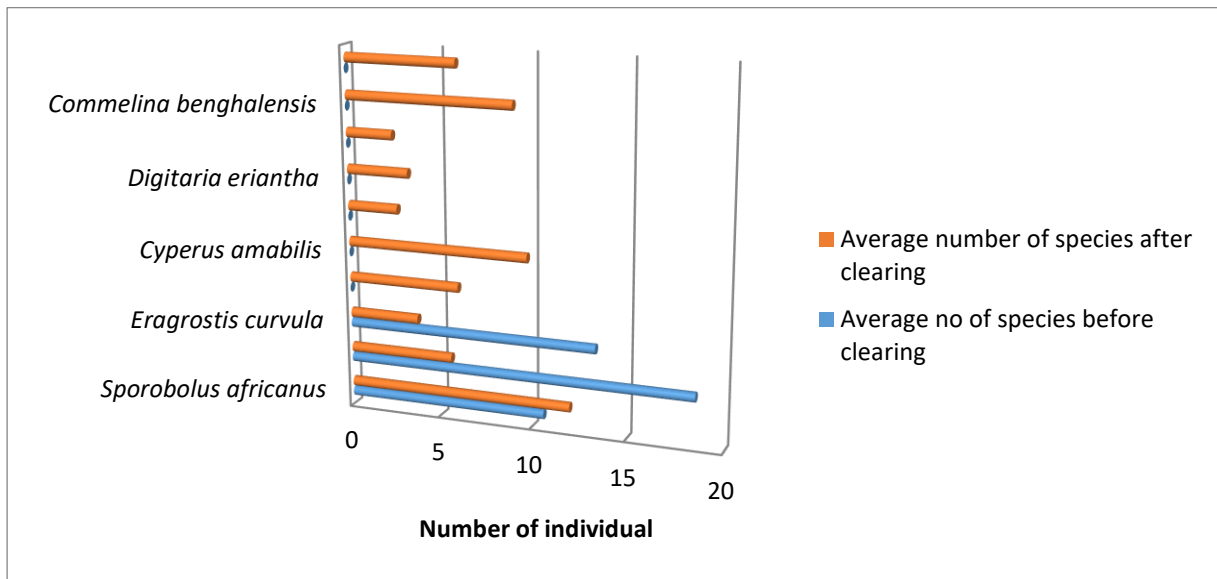


Figure 9: Graph showing abundance data collected in the *Sporobolus africanus* belt over two seasons (June 2016 and December 2016) 1 m x 1 m low.

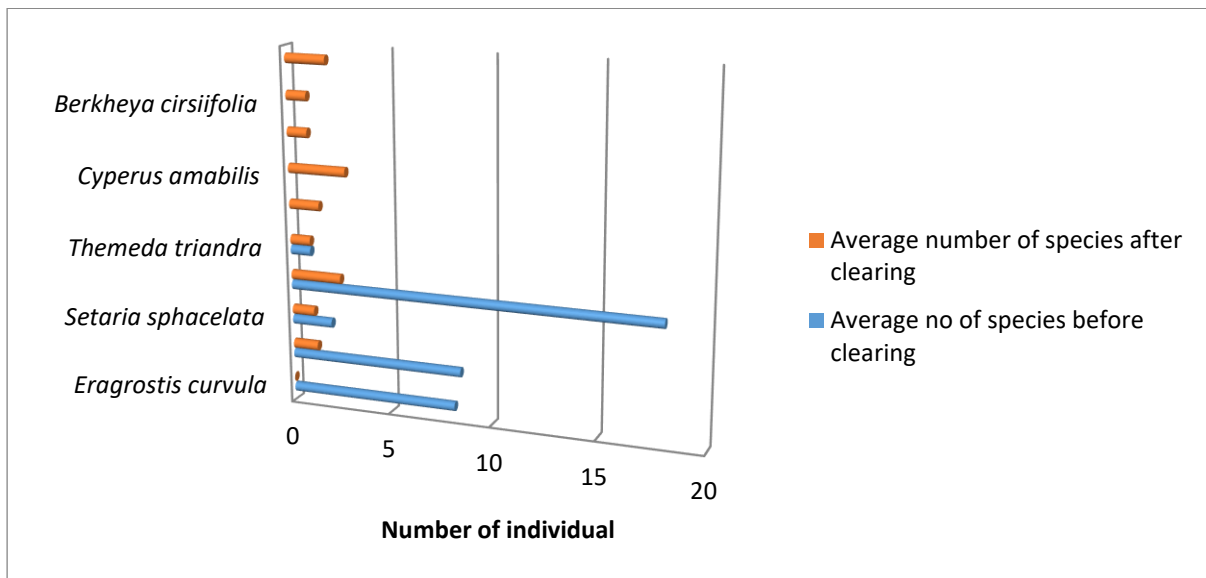


Figure 10: Graph showing abundance data collected in the *Sporobolus africanus* belt over two seasons (June 2016 and December 2016) 1 m x 1 m high.

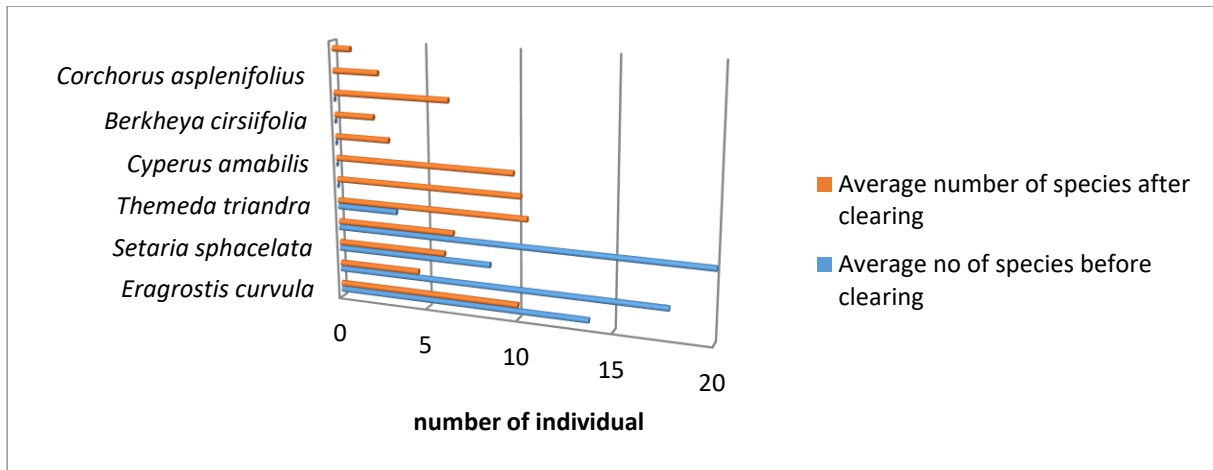


Figure 11: Graph showing abundance data collected in the *Sporobolus africanus* belt over two seasons (June 2016 and December 2016) 2 m x 2 m low.

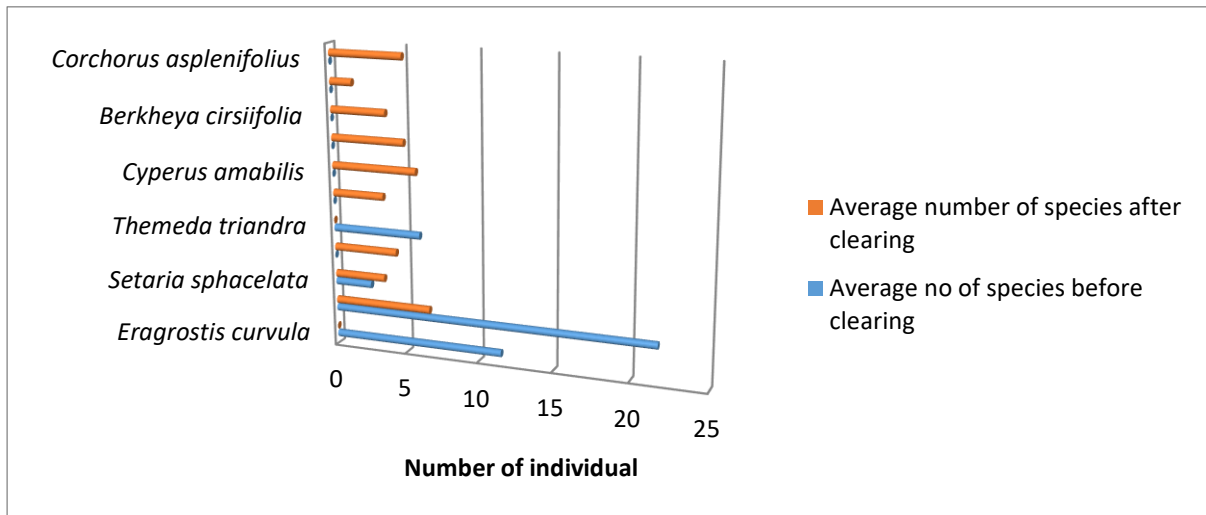
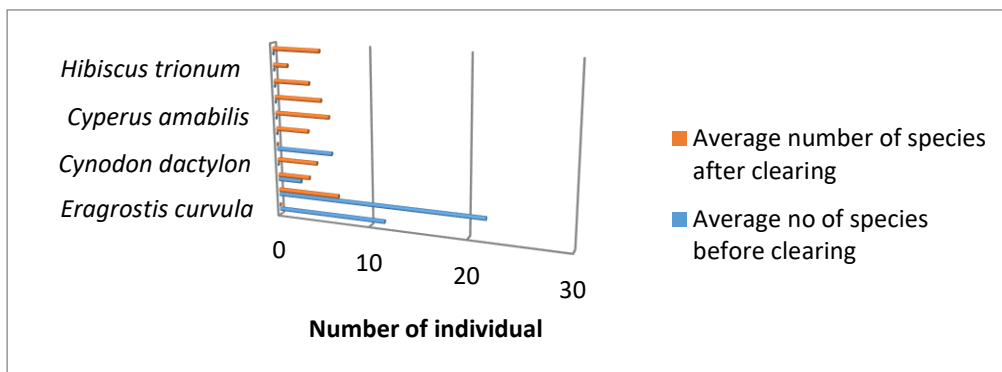


Figure 12: Graph showing abundance data collected in the *Sporobolus africanus* belt over two seasons (June 2016 and December 2016) 2 m x 2 m high.



c. *Themeda triandra* Belt

Themeda triandra is well known as a red grass. Summer-growing tussocky perennial 30–150 cm tall; attractive green or blue-green foliage, maturing to purple, then reddish-brown; inflorescence also colourful; tolerates low fertility soils, drought and fire. Plants from higher altitude tend to be shorter and dark purple color. The basal part of the tuft are usually compressed the wedge-shaped, often pendant cluster of spikelets are often flushed with mauve, purple or red color. The spikelets are also waned, that have long stiff bristle-like projections. Flowering time is from October to July.

3.3.1 Habitat description

This grass is widespread in South Africa, growing in undisturbed grassland to savanna, in area of average to high rainfall. Although the grass grows in any type of soil, it prefers clay and soil with high organic content.

Red grass is an indicator of veld being in a good condition. IT is also known to be resistant to fire; the resistance increasing when burnt regularly, but only if rested after fire overgrazing does not occur. The long awns of the spikelet twirl when wet and drive the seed into ground.

3.3.2 Quadrat data

Table 20: Representing data collected in the *Themeda triandra* belt in two seasons (June 2016 and December 2016) 1 m x 1 m low.

Cover	Before clearing	Cover	After clearing
88	<i>Themeda triandra</i> (8), <i>Setaria sphacelata</i> (2), <i>Sporobolus pyramidalis</i> (3)	72	<i>Themeda triandra</i> (8), <i>Commelina benghalensis</i> (7)
92	<i>Themeda triandra</i> (11), <i>Setaria sphacelata</i> (1), <i>Eragrostis curvula</i> (5)	60	<i>Berkheya cirsiifolia</i> (3), <i>Themeda triandra</i> (6)

100	<i>Themeda triandra</i> (9), <i>Setaria sphacelata</i> (8)	35	<i>commelina benghalensis</i> (1), <i>Hibiscus trionum</i> (2), <i>Themeda triandra</i> (4)
76	<i>Themeda triandra</i> (7), <i>Setaria sphacelata</i> (5)	45	<i>Themeda triandra</i> (6), <i>Berkheya cirsiifolia</i> (1)
74	<i>Themeda triandra</i> (8), <i>Setaria sphacelata</i> (8)	50	<i>Themeda triandra</i> (8), <i>Cyperus amabilis</i> (10)
70	<i>Themeda triandra</i> (7), <i>Setaria sphacelata</i> (3), <i>Eragrostis curvula</i> (7)	70	<i>Themeda triandra</i> (12), <i>Cyperus amabilis</i> (11)
89	<i>Themeda triandra</i> (10), <i>Setaria curvula</i> (9)	65	<i>Themeda triandra</i> (6), <i>Cyperus amabilis</i> (5)
95	<i>Themeda triandra</i> (11), <i>Setaria sphacelata</i> (12)	50	<i>Themeda triandra</i> (5), <i>Cyperus amabilis</i> (8)
88	<i>Themeda triandra</i> (9), <i>Setaria sphacelata</i> (9), <i>Eragrostis curvula</i> (7)	70	<i>Digitaria eriantha</i> (5), <i>Agaricus bisporus</i> (1), <i>Berkheya cirsiifolia</i> (1)
70	<i>Themeda triandra</i> (13), <i>Setaria sphacelata</i> (8)	80	<i>Themeda triandra</i> (14)
95	<i>Themeda triandra</i> (9), <i>Setaria sphacelata</i> (10)	45	<i>Themeda Triandra</i> (6)
97	<i>Themeda triandra</i> (12), <i>Setaria sphacelata</i> (11)	20	<i>Themeda Triandra</i> (6)
81	<i>Themeda triandra</i> (4), <i>Setaria sphacelata</i> (9), <i>Eragrostis curvula</i> (8)	65	<i>Themeda triandra</i> (8), <i>Commelina benghalensis</i> (7)
80	<i>Themeda triandra</i> (11)	55	<i>Themeda triandra</i> (6), <i>Corchorus asplenifolius</i> (1), <i>Commelina benghalensis</i> (2)
60	<i>Themeda triandra</i> (6)	45	<i>Themeda triandra</i> (4), <i>Commelina benghalensis</i> (4)
62	<i>Themeda triandra</i> (5), <i>Setaria sphacelata</i> (5)	75	<i>Themeda triandra</i> (14)
89	<i>Setaria sphacelata</i> (11)	50	<i>Themeda triandra</i> (9)

Table 21: Representing data collected in the *Themeda triandra* belt in two seasons (June 2016 and December 2016) 1 m x 1 m high.

Kite	Cover	Before clearing	Cover	After clearing
1	97	<i>Themeda triandra</i> (8), <i>Setaria sphacelata</i> (11)	45	<i>Berkheya cirsiifolia</i> (2), <i>Themeda triandra</i> (4)
2	86	<i>Themeda triandra</i> (8), <i>Setaria sphacelata</i> (9)	30	<i>Berkheya cirsiifolia</i> (1), <i>Themeda triandra</i> (2)
3	90	<i>Themeda triandra</i> (10), <i>Setaria sphacelata</i> (7)	25	<i>Berkheya cirsiifolia</i> (1), <i>Themeda triandra</i> (2)
4	95	<i>Setaria sphacelata</i> (11), <i>Eragrostis curvula</i> (8)	45	<i>Cyperus amabilis</i> (4), <i>Setaria</i>

				<i>sphacelata</i> (2), <i>Themeda triandra</i> (1)
5	78	<i>Setaria sphacelata</i> (8), <i>Cephalaria oblongifolia</i> (1)	25	<i>Berkheya cirsiifolia</i> (2), <i>Themeda triandra</i> (2)
6	75	<i>Themeda triandra</i> (9), <i>Eragrostis curvula</i> (8)	15	<i>Commelina benghalensis</i> (1) , <i>Cyperus amabilis</i> (1)
7	95	<i>Themeda triandra</i> (7), <i>Setaria sphacelata</i> (8), <i>Eragrostis curvula</i> (6)	35	<i>Berkheya cirsiifolia</i> (6)
8	60	<i>Themeda triandra</i> (6), <i>Setaria sphacelata</i> (6)	30	<i>Themeda triandra</i> (4)
9	60	<i>Themeda triandra</i> (5), <i>Setaria sphacelata</i> (2), <i>Eragrostis curvula</i> (1)	10	<i>Hibiscus trionum</i> (1) <i>Berkheya cirsiifolia</i> (1)
10	80	<i>Themeda triandra</i> (10), <i>Setaria sphacelata</i> (6)	20	<i>Themeda triandra</i> (2)
11	73	<i>Themeda triandra</i> (8), <i>Setaria sphacelata</i> (5), <i>Eragrostis curvula</i> (2)	15	<i>Hibiscus trionum</i> (1), <i>Themeda triandra</i> (1)
12	79	<i>Themeda triandra</i> (6), <i>Setaria sphacelata</i> (4), <i>Eragrostis curvula</i> (2)	60	<i>Themeda triandra</i> (6), <i>Digitaria eriantha</i> (1), <i>Setaria sphacelata</i> (1)
13	65	<i>Themeda triandra</i> (5), <i>Setaria sphacelata</i> (2), <i>Eragrostis curvula</i> (1)	20	<i>Themeda triandra</i> (3)
14	76	<i>Themeda triandra</i> (9), <i>Setaria sphacelata</i> (5), <i>Eragrostis curvula</i> (4)	10	<i>Themeda triandra</i> (2)
15	60	<i>Themeda triandra</i> (4), <i>Setaria sphacelata</i> (3)	30	<i>commelina benghalensis</i> (1), <i>Themeda triandra</i> (1), <i>Cynodon dactylon</i> (4)
16	60	<i>Themeda triandra</i> (6)	40	<i>Setaria sphacelata</i> (2), <i>Cyperus amabilis</i> (3), <i>Themeda triandra</i> (2), <i>Berkheya cirsiifolia</i> (1)
17	62	<i>Themeda triandra</i> (3), <i>Eragrostis curvula</i> (4)	2	<i>Themeda triandra</i> (1)

Table 22: Representing data collected in the *Themeda triandra* belt in two seasons (June 2016 and December 2016) 2 m x 2 m low.

Kite	Cover	Before clearing	Cover	After clearing
1	97	<i>Themeda triandra</i> (15), <i>Setaria sphacelata</i> (9), <i>Sporobolus pyramidalis</i> (8)	70	<i>Digitaria eriantha</i> (12), <i>Setaria sphacelata</i> (3), <i>Themeda triandra</i> (12)

2	98	<i>Themeda triandra</i> (13), <i>Setaria sphacelata</i> (10), <i>Eragrostis curvula</i> (5), <i>Sporobolus pyramidalis</i> (6)	75	<i>Commelina benghalensis</i> (3), <i>Digitaria eriantha</i> (6), <i>Themeda triandra</i> (17)
3	100	<i>Themeda triandra</i> (15), <i>Setaria sphacelata</i> (11)	55	<i>Berkheya cirsiifolia</i> (2), <i>Digitaria eriantha</i> (5)
4	78	<i>Themeda triandra</i> (9), <i>Setaria sphacelata</i> (9), <i>Eragrostis curvula</i> (4)	9	<i>Commelina benghalensis</i> (1), <i>Themeda triandra</i> (1), <i>Cyperus amabilis</i> (1)
5	90	<i>Themeda triandra</i> (14), <i>Setaria sphacelata</i> (8), <i>Eragrostis curvula</i> (8)	75	<i>Berkheya benghalensis</i> (1), <i>Themeda triandra</i> (12), <i>Cyperus amabilis</i> (5), <i>Digitaria eriantha</i> (3)
6	60	<i>Themeda triandra</i> (6), <i>Setaria sphacelata</i> (5)	90	<i>Cyperus amabilis</i> (5), <i>Themeda triandra</i> (16)
7	74	<i>Themeda triandra</i> (9), <i>Setaria curvula</i> (7)	70	<i>Setaria sphacelata</i> (12), <i>Commelina benghalensis</i> (5) <i>Themeda triandra</i> (9)
8	88	<i>Themeda triandra</i> (12), <i>Setaria sphacelata</i> (10)	75	<i>Cyperus amabilis</i> (6), <i>Setaria sphacelata</i> (13), <i>Digitaria eriantha</i> (3)
9	60	<i>Themeda triandra</i> (10), <i>Setaria sphacelata</i> (2), <i>Eragrostis curvula</i> (1)	70	<i>Digitaria eriantha</i> (6), <i>Setaria sphacelata</i> (7), <i>Themeda triandra</i> (6)
10	100	<i>Themeda triandra</i> (16), <i>Setaria sphacelata</i> (8), <i>Eragrostis curvula</i> (6)	70	<i>Digitaria eriantha</i> (7), <i>Themeda triandra</i> (6), <i>Setaria sphacelata</i> (6), <i>Eragrostis curvula</i> (1)
11	82	<i>Themeda triandra</i> (12), <i>Setaria sphacelata</i> (7), <i>Eragrostis curvula</i> (7)	78	<i>Themeda triandra</i> (14)
12	86	<i>Themeda triandra</i> (12), <i>Setaria sphacelata</i> (5), <i>Eragrostis curvula</i> (8), <i>Sporobolus pyramidalis</i> (1)	88	<i>Themeda triandra</i> (16), <i>Cyperus amabilis</i> (20)
13	96	<i>Themeda triandra</i> (16), <i>Setaria sphacelata</i> (9), <i>Eragrostis curvula</i> (2)	60	<i>Berkheya cirsiifolia</i> (11), <i>Cynodon dactylon</i> (13), <i>Commelina benghalensis</i> (1)
14	70	<i>Themeda triandra</i> (11), <i>Eragrostis curvula</i> (7)	75	<i>Commelina benghalensis</i> (3), <i>Setaria sphacelata</i> (6), <i>Themeda triandra</i> (6), <i>Digitaria eriantha</i> (5)
15	97	<i>Themeda triandra</i> (18)	75	<i>Commelina benghalensis</i> (3), <i>Setaria sphacelata</i> (9), <i>Digitaria eriantha</i> (2), <i>Corchorus asplenifolios</i> (3)
16	65	<i>Themeda triandra</i> (11)	85	<i>Setaria sphacelata</i> (12), <i>Themeda triandra</i> (13)

17	90	<i>Themeda triandra</i> (16), <i>Setaria sphacelata</i> (13)	60	<i>Corchorus asplenifolius</i> (3), <i>Setaria sphacelata</i> (6), <i>Themeda triandra</i> (11)
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Table 23: Representing data collected in the *Themeda triandra* belt in two seasons (June 2016 and December 2016) 2 m x. 2 m high

Kite	Cover	Before clearing	Cover	After clearing
1	90	<i>Themeda triandra</i> (13), <i>Setaria sphacelata</i> (5), <i>Eragrostis curvula</i> (4)	30	<i>Themeda triandra</i> (9), <i>Setaria sphacelata</i> (5), <i>Eragrostis curvula</i> (4)
2	95	<i>Themeda triandra</i> (10), <i>Setaria sphacelata</i> (4), <i>Sporobolus pyramidalis</i> (6)	60	<i>Themeda triandra</i> (10), <i>Setaria sphacelata</i> (4), <i>Sporobolus pyramidalis</i> (1)
3	97	<i>Themeda triandra</i> (11), <i>Setaria sphacelata</i> (10), <i>Eragrostis curvula</i> (9)	45	<i>Themeda triandra</i> (5), <i>Setaria sphacelata</i> (1), <i>Eragrostis curvula</i> (9)
4	80	<i>Themeda triandra</i> (10), <i>Setaria sphacelata</i> (9)	20	<i>Themeda triandra</i> (11), <i>Setaria sphacelata</i> (9)
5	65	<i>Themeda triandra</i> (7), <i>Setaria sphacelata</i> (4)	70	<i>Themeda triandra</i> (7), <i>Setaria sphacelata</i> (4)
6	60	<i>Themeda triandra</i> (7), <i>Setaria sphacelata</i> (1), <i>Eragrostis curvula</i> (7)	25	<i>Themeda triandra</i> (7), <i>Setaria sphacelata</i> (1), <i>Eragrostis curvula</i> (4)
7	80	<i>Themeda triandra</i> (12), <i>Setaria sphacelata</i> (9), <i>Eragrostis curvula</i> (6)	30	<i>Themeda triandra</i> (12), <i>Setaria sphacelata</i> (9), <i>Eragrostis curvula</i> (6)
8	82	<i>Themeda triandra</i> (13), <i>Setaria sphacelata</i> (14)	45	<i>Themeda triandra</i> (13), <i>Setaria sphacelata</i> (6)
9	71	<i>Themeda triandra</i> (12), <i>Setaria sphacelata</i> (8)	30	<i>Themeda triandra</i> (2), <i>Setaria sphacelata</i> (3)
10	74	<i>Themeda triandra</i> (12), <i>Setaria sphacelata</i> (9), <i>Eragrostis curvula</i> (6)	15	<i>Themeda triandra</i> (12), <i>Setaria sphacelata</i> (4), <i>Eragrostis curvula</i> (6)
11	85	<i>Themeda triandra</i> (10), <i>Setaria sphacelata</i> (11), <i>Eragrostis curvula</i> (9)	35	<i>Themeda triandra</i> (8), <i>Setaria sphacelata</i> (5), <i>Eragrostis curvula</i> (3)
12	94	<i>Themeda triandra</i> (12), <i>Setaria sphacelata</i> (12), <i>Eragrostis curvula</i> (4)	15	<i>Themeda triandra</i> (6), <i>Setaria sphacelata</i> (2), <i>Eragrostis curvula</i> (4)
13	70	<i>Themeda triandra</i> (5), <i>Setaria sphacelata</i> (6), <i>Eragrostis curvula</i> (6)	20	<i>Themeda triandra</i> (5), <i>Setaria sphacelata</i> (6), <i>Eragrostis curvula</i> (1)
14	82	<i>Themeda triandra</i> (11), <i>Setaria sphacelata</i> (14)	15	<i>Themeda triandra</i> (11), <i>Setaria sphacelata</i> (4)

15	79	<i>Themeda triandra</i> (15)	60	<i>Themeda triandra</i> (9)
16	70	<i>Themeda triandra</i> (12), <i>Eragrostis curvula</i> (4)	60	<i>Themeda triandra</i> (12), <i>Eragrostis curvula</i> (1)
17	70	<i>Themeda triandra</i> (14)	30	<i>Themeda triandra</i> (10)

Table 24: Representing data collected in the *Themeda triandra* belt in two seasons (December 2016 and June 2017) 1 m x 1 m low.

Kite	Cover	Before clearing	Cover	After clearing
1	65	<i>Setaria sphacelata</i> (21)	5	<i>Themeda triandra</i> (1), <i>Corchorus tridens</i> (6)
2	55	<i>Setaria sphacelata</i> (12), <i>Themeda triandra</i> (6), <i>Eragrostis curvula</i> (3)	20	<i>Themeda triandra</i> (10)
3	90	<i>Digitaria eriantha</i> (3), <i>Setaria sphacelata</i> (15)	50	<i>Themeda triandra</i> (15) <i>Setaria sphacelata</i> (20)
4	70	<i>Setaria sphacelata</i> (8), <i>Berkheya cirsiifolia</i> (1)	15	<i>Themeda triandra</i> (6)
5	100	<i>Setaria sphacelata</i> (14), <i>Berkheya cirsiifolia</i> (2)	15	<i>Setaria sphacelata</i> (5), <i>Corchorus tridens</i> (4), <i>Berkheya cirsiifolia</i> (3)
6	75	<i>Setaria sphacelata</i> (12), <i>Digitaria eriantha</i> (8)	17	<i>Setaria sphacelata</i> (4)
7	50	<i>Setaria sphacelata</i> (9), <i>Alepidea natalensis</i> (1)	0	Empty
8	80	<i>Themeda triandra</i> (2), <i>Setaria sphacelata</i> (7), <i>Corchorus tridens</i> (1)	40	<i>Themeda triandra</i> (10), <i>Setaria sphacelata</i> (11)
9	95	<i>Digitaria eriantha</i> (2), <i>Setaria sphacelata</i> (8), <i>Corchorus tridens</i> (7)	60	<i>Themeda triandra</i> (10), <i>Berkheya cirsiifolia</i> (7), <i>Setaria sphacelata</i> (7)
10	80	<i>Setaria sphacelata</i> (8), <i>Themeda triandra</i> (5)	0	Empty
11	95	<i>Setaria sphacelata</i> (10), <i>Digitaria eriantha</i> (2)	50	<i>Themeda triandra</i> (5), <i>Setaria sphacelata</i> (10), <i>Cephalaria oblingifolia</i> (4)
12	60	<i>Setaria sphacelata</i> (7), <i>Corchorus tridens</i> (2)	0	Empty
13	70	<i>Setaria sphacelata</i> (13)	0	Empty
14	80	<i>Setaria sphacelata</i> (11), <i>Eragrostis curvula</i> (3)	40	<i>Setaria sphacelata</i> (10), <i>Corchorus tridens</i> (5)

15	100	<i>Setaria sphacelata</i> (15)	30	<i>Themeda triandra</i> (10), <i>Setaria sphacelata</i> (7)
16	80	<i>Setaria sphacelata</i> (12), <i>Eragrostis curvula</i> (2)	25	<i>Berkheya cirsiifolia</i> (1), <i>Setaria sphacelata</i> (11), <i>Themeda triandra</i> (5)
17	100	<i>Themeda triandra</i> (6), <i>commelina benghalensis</i> (1)	8	<i>Themeda triandra</i> (4), <i>Setaria sphacelata</i> (5)

Table 25: Representing data collected in the *Themeda triandra* belt in two seasons (December 2016 and June 2017) 1 m x 1 m high.

Kite	Cover	Before clearing	Cover	After clearing
1	45	<i>Setaria sphacelata</i> (18)	55	<i>Berkheya cirsiifolia</i> (10), <i>Setaria sphacelata</i> (15)
2	60	<i>Setaria sphacelata</i> (15), <i>Digitaria eriantha</i> (3) <i>Themeda trindra</i> (2)	5	<i>Corchorus tridens</i> (3)
3	58	<i>Setaria sphacelata</i> (17), <i>Eragrostis curvula</i> (2), <i>Digitaria eriantha</i> (1)	1	<i>Corchorus tridens</i> (1), <i>Berkheya cirsiifolia</i> (1)
4	70	<i>Setaria sphacelata</i> (20), <i>Eragrostis curvula</i> (3), <i>Themeda triandra</i> (4)	3	<i>Themeda triandra</i> (4)
5	60	<i>Setaria sphacelata</i> (15), <i>Themeda triandra</i> (5)	3	<i>Themeda triandra</i> (3)
6	85	<i>Digitaria eriantha</i> (5), <i>Setaria sphacelata</i> (18)	2	<i>Berkheya cirsiifolia</i> (3)
7	75	<i>Digitaria eriantha</i> (4), <i>Setaria sphacelata</i> (9)	45	<i>Setaria sphacelata</i> (10)
8	100	<i>Digitaria eriantha</i> (8), <i>Setaria sphacelata</i> (20)	1	<i>Themeda triandra</i> (1)
9	100	<i>Digitaria eriantha</i> (10), <i>Setaria sphacelata</i> (14)	2	<i>Berkheya cirsiifolia</i> (3)
10	80	<i>Themeda triandra</i> (5), <i>Eragrostis curvula</i> (6) <i>Setaria sphecelata</i> (4)	2	<i>Cynodon dactylon</i> (4)
11	70	<i>Setaria sphacelata</i> (7), <i>Themeda triandra</i> (7)	5	<i>Corchorus tridens</i> (2)
12	80	<i>Setaria sphacelata</i> (9), <i>Themeda triandra</i> (5)	1	<i>Themeda triandra</i> (1)
13	95	<i>Setaria sphacelata</i> (16), <i>Themeda triandra</i> (9)	1	<i>Setaria sphacelata</i> (1)
14	65	<i>Setaria sphacelata</i> (9), <i>Digitaria eriantha</i> (4)	12	<i>Berkeya cirsiifolia</i> (7)
15	74	<i>Setaria sphacelata</i> (8), <i>Digitaria eriantha</i> (6)	1	<i>Berkheya cirsiifolia</i> (1)

16	70	<i>Setaria sphacelata</i> (7), <i>Digitaria eriantha</i> (6)	4	<i>Themeda triandra</i> (3)
17	90	<i>Setaria sphacelata</i> (19)	1	<i>Alepidea natalensis</i> (1)

Table 26: Representing data collected in the *Themeda triandra* belt in two seasons (December 2016 and June 2017) 2 m x 2 m low.

Kite	Cover	Before clearing	Cover	After clearing
1	70	<i>Setaria sphacelata</i> (16), <i>Themeda triandra</i> (5), <i>Eragrostis curvula</i> (4)	5	<i>Corchorus tridens</i> (3)
2	65	<i>Setaria sphacelata</i> (13), <i>Themeda triandra</i> (6)	60	<i>Setaria sphacelata</i> (25)
3	50	<i>Setaria sphacelata</i> (14), <i>Themeda triandra</i> (2)	30	<i>Setaria sphacelata</i> (10), <i>Berkheya cirsiifolia</i> (7)
4	80	<i>Setaria sphacelata</i> (19), <i>Themeda triandra</i> (5), <i>Digitaria eriantha</i> (2), <i>Eragrostis curvula</i> (2)	45	<i>Themeda triandra</i> (17), <i>Cephalaria oblingifolia</i> (3)
5	100	<i>Setaria sphacelata</i> (21), <i>Digitaria eriantha</i> (3)	60	<i>Themeda triandra</i> (10), <i>Setaria sphacelata</i> (17)
6	65	<i>Setaria sphacelata</i> (11), <i>Digitaria eriantha</i> (7)	70	<i>Berkheya cirsiifolia</i> (25), <i>Setaria sphacelata</i> (11), <i>Themeda triandra</i> (7)
7	70	<i>Setaria sphacelata</i> (18), <i>Themeda triandra</i> (5), <i>Digitaria eriantha</i> (5)	30	<i>Digitaria eriantha</i> (2), <i>Berkheya cirsiifolia</i> (10)
8	95	<i>Setaria sphacelata</i> (19), <i>Themeda triandra</i> (8), <i>Digitaria eriantha</i> (6)	17	<i>Themeda triandra</i> (5), <i>Alepidea natalensis</i> (5), <i>Cephalaria oblingifolia</i> (2)
9	90	<i>Setaria sphacelata</i> (20), <i>Themeda triandra</i> (6), <i>Digitaria eriantha</i> (7)	70	<i>Setaria sphacelata</i> (17), <i>Digitaria eriantha</i> (9)
10	95	<i>Setaria sphacelata</i> (20), <i>Themeda triandra</i> (8), <i>Eragrostis curvula</i> (7)	10	<i>Berkheya cirsiifolia</i> (4), <i>Cephalaria oblingifolia</i> (2)
11	75	<i>Setaria sphacelata</i> (16), <i>Themeda triandra</i> (9), <i>Eragrostis curvula</i> (7)	40	<i>Corchorus tridens</i> (10), <i>Setaria sphacelata</i> (15), <i>Cephalaria oblingifolia</i> (2), <i>Berkheya cirsiifolia</i> (1)
12	87	<i>Setaria sphacelata</i> (15), <i>Themeda triandra</i> (8), <i>Eragrostis curvula</i> (6)	80	<i>Setaria sphacelata</i> (20), <i>Cephalaria oblingifolia</i> (3)

13	97	<i>Setaria sphacelata</i> (17), <i>Themeda triandra</i> (6)	16	<i>Berkheya cirsiifolia</i> (4), <i>Alepidea natalensis</i> (2), <i>Cephalaria oblingifolia</i> (5)
14	60	<i>Setaria sphacelata</i> (11),	10	<i>Themeda triandra</i> (2)
15	75	<i>Setaria sphacelata</i> (19), <i>Themeda triandra</i> (8)	40	<i>Setaria sphacelata</i> (16), <i>Berkheya cirsiifolia</i> (3), <i>Helichrysum aureonitens</i> (1)
16	72	<i>Setaria sphacelata</i> (16), <i>Themeda triandra</i> (6), <i>Digitaria eriantha</i> (5)	15	<i>Cephalaria oblingifolia</i> (6), <i>Berkheya cirsiifolia</i> (2), <i>Corchorus tridens</i> (2)
17	85	<i>Setaria sphacelata</i> (18), <i>Digitaria eriantha</i> (5), <i>Eragrostis curvula</i> (9)	35	<i>Themeda triandra</i> (17), <i>Setaria sphacelata</i> (5)

Table 27: Representing data collected in the *Themeda triandra* belt in two seasons (December 2016 and June 2017) 2 m x 2 m high.

Kite	Cover	Before clearing	Cover	After clearing
1	60	<i>Setaria sphacelata</i> (13), <i>Themeda triandra</i> (3)	10	<i>Berkheya cirsiifolia</i> (2)
2	65	<i>Setaria sphacelata</i> (11), <i>Themeda triandra</i> (6)	40	<i>Alipedia natalensis</i> (2), <i>Berkheya cirsiifolia</i> (2)
3	44	<i>Setaria sphacelata</i> (8), <i>Eragrostis curvula</i> (1)	35	<i>Alipedia natalensis</i> (2), <i>Berkheya cirsiifolia</i> (15)
4	80	<i>Setaria sphacelata</i> (18), <i>Themeda triandra</i> (9)	0	Empty
5	80	<i>Setaria sphacelata</i> (16), <i>Themeda triandra</i> (6), <i>Eragrostis curvula</i> (5)	40	<i>Berkheya cirsiifolia</i> (19)
6	85	<i>Setaria sphacelata</i> (12), <i>Digitaria eriantha</i> (8), <i>Berkheya cirsiifolia</i> (1)	15	<i>Berkheya cirsiifolia</i> (10)
7	80	<i>Setaria sphacelata</i> (14), <i>Digitaria eriantha</i> (6)	20	<i>Setaria sphacelata</i> (10), <i>Corchorus tridens</i> (5)
8	90	<i>Setaria sphacelata</i> (20), <i>Digitaria eriantha</i> (7)	10	<i>Berkheya cirsiifolia</i> (6), <i>Cephalaria oblingifolia</i> (3)
9	100	<i>Setaria sphacelata</i> (22), <i>Digitaria eriatha</i> (8)	0	Empty
10	95	<i>Setaria sphacelata</i> (20), <i>Digitaria eriantha</i> (6), <i>Berkheya cirsiifolia</i> (1)	45	<i>Setaria sphacelata</i> (10), <i>Berkheya cirsiifolia</i> (6)

11	95	<i>Setaria sphacelata</i> (23), <i>Themeda triandra</i> (10)	3	<i>Themeda triandra</i> (5)
12	65	<i>Setaria sphacelata</i> (13), <i>Themeda triandra</i> (3)	7	<i>Setaria sphacelata</i> (1), <i>Alepidea natalensis</i> (7), <i>Cephalaria oblingifolia</i> (5)
13	100	<i>Setaria sphacelata</i> (23), <i>Digitaria eriantha</i> (6)	0	Empty
14	100	<i>Setaria sphacelata</i> (24), <i>Digitaria eriantha</i> (7)	30	<i>Cephalaria oblingifolia</i> (15)
15	80	<i>Setaria sphacelata</i> (18), <i>Themeda triandra</i> (8)	1	<i>Helichrysum aureonitens</i> (4), <i>Berkheya cirsiifolia</i> (1)
16	70	<i>Setaria sphacelata</i> (15), <i>Themeda triandra</i> (6)	2	<i>Corchorus tridens</i> (3)
17	100	<i>Setaria sphacelata</i> (21), <i>Themeda triandra</i> (8)	2	<i>Themeda triandra</i> (4) <i>Corchorus tridens</i> (1)

3.3.3 Temperature

Seed collected late spring to summer should readily germinate if sown immediately or a year later; optimal temperatures 25-35°C

3.3.4 Soil type

Themeda triandra is found in a sandy soil area, particles in this type of soil are far apart from each other. Water holding capacity of this soil is very poor.

3.3.5 Hydric status

Facultative dryland species; usually grow in non-wetland areas but sometimes grow in wetlands (1-34% of occurrences)

3.3.6 Abundance and distribution graphs

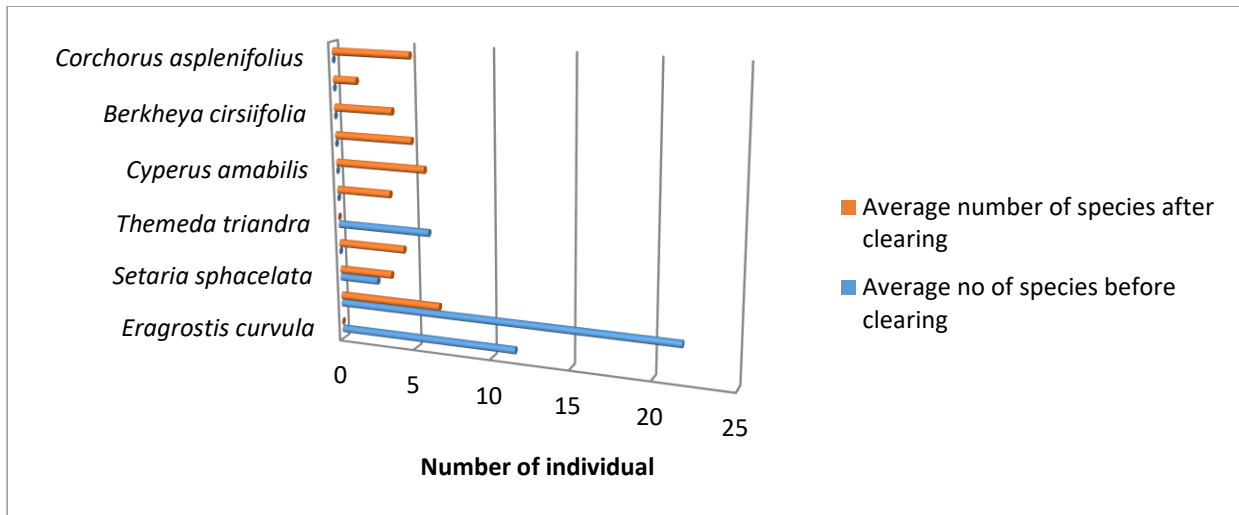


Figure 13: Graph representing data collected in the *Themeda triandra* belt in two seasons (June 2016 and December 2016) 1 m x 1 m low.

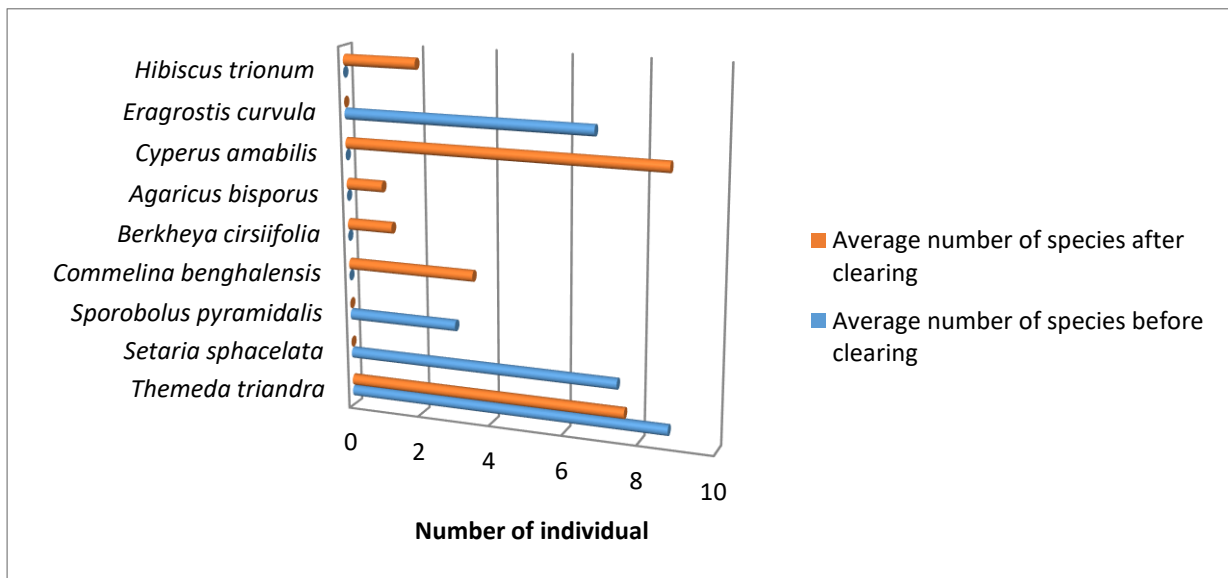


Figure 14: Graph representing data collected in the *Themeda triandra* belt in two seasons (June 2016 and December 2016) 1 m x 1 m high.

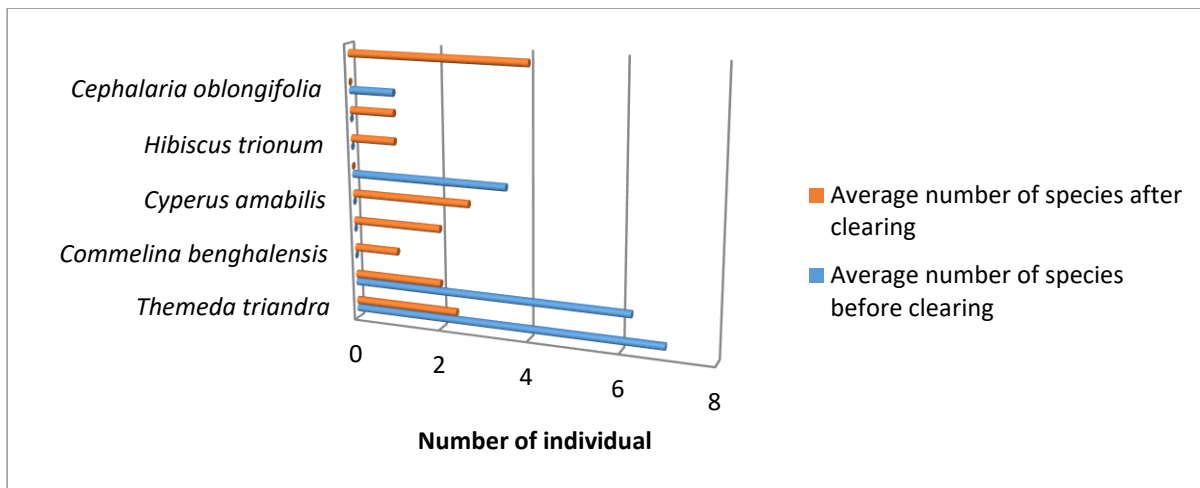


Figure 15: Graph representing data collected in the *Themeda triandra* belt in two seasons (June 2016 and December 2016) 2 m x 2 m low.

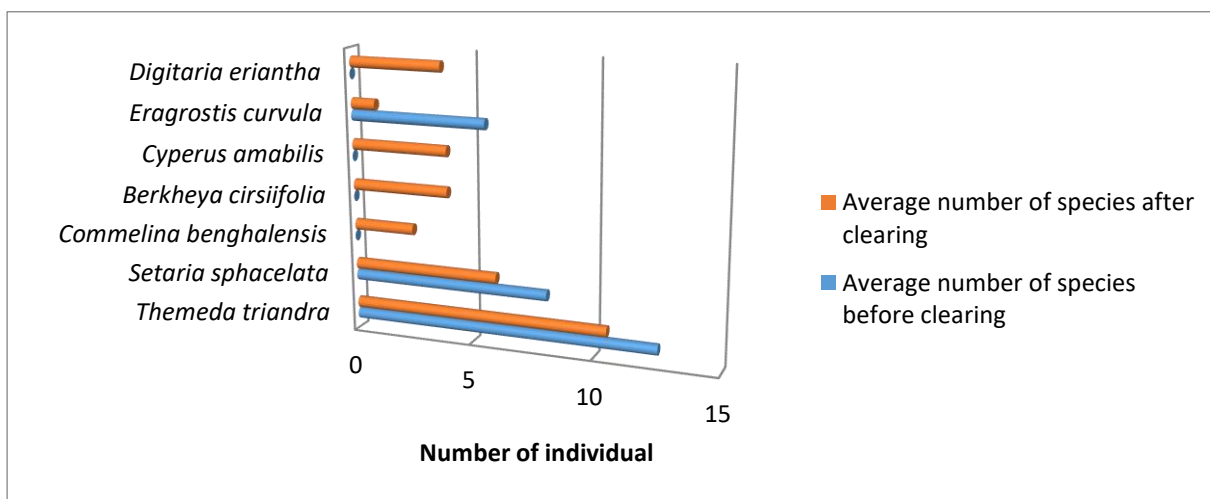


Figure 16: Graph representing data collected in the *Themeda triandra* belt in two seasons (June 2016 and December 2016) 2 m x 2 m high.

3.4 Intensities graphs

The Graphs below represent different intensities of *T. triandra*, *S.africanus* and *C.amabilis* with the mean representing the average of total species that were found in each quadrat after disturbance, standard minimum, maximum and sum of vegetation cover, regrowth frequency and number of individual in the high and low intensely disturbed site.

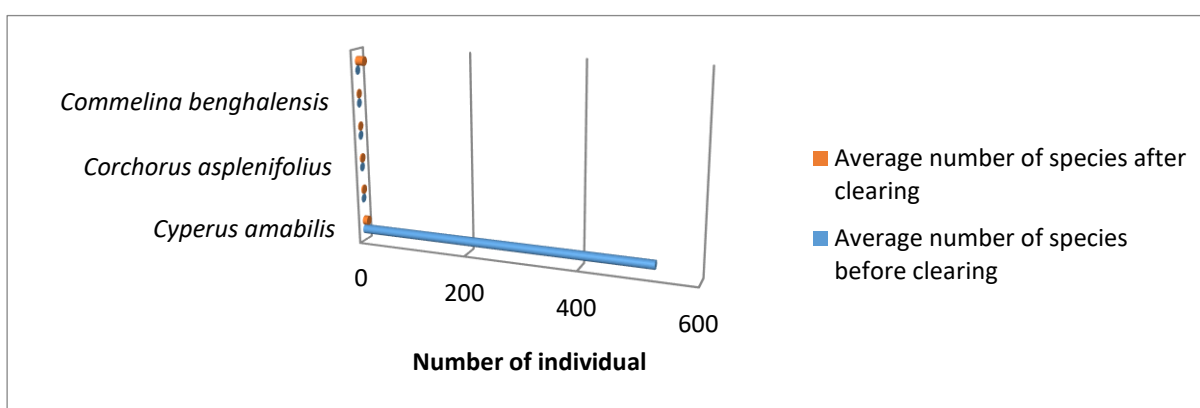
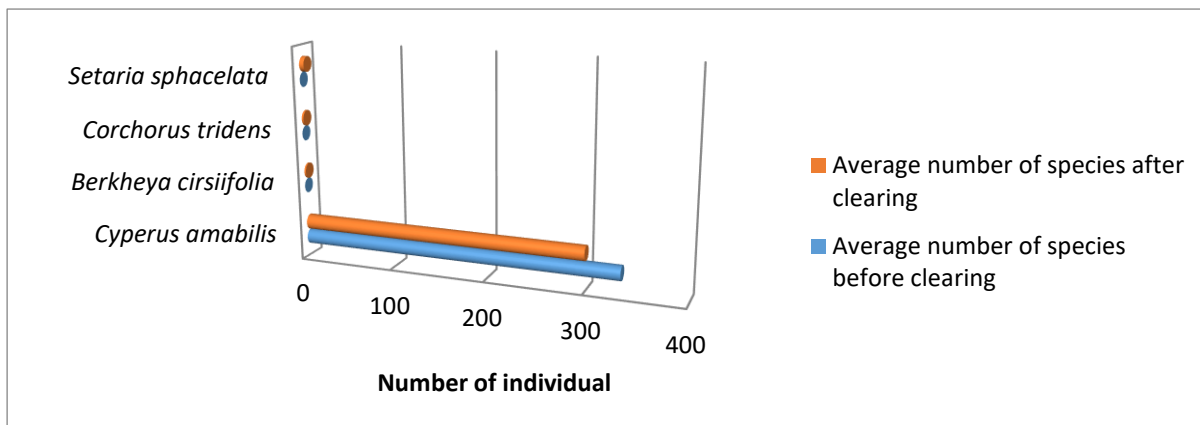
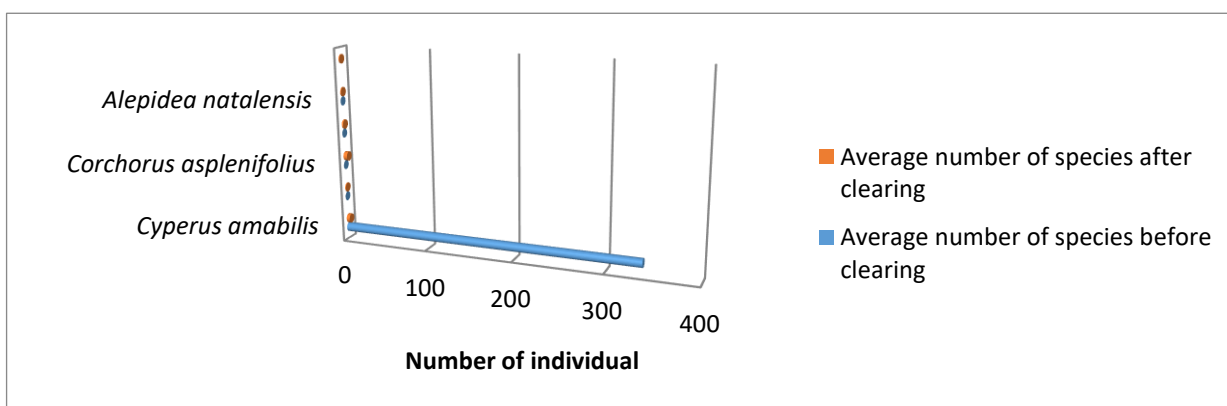


Figure 17: Graphs representing data collected in the *Cyperus amabilis* belt in two seasons 1x1 low and 2x2 high



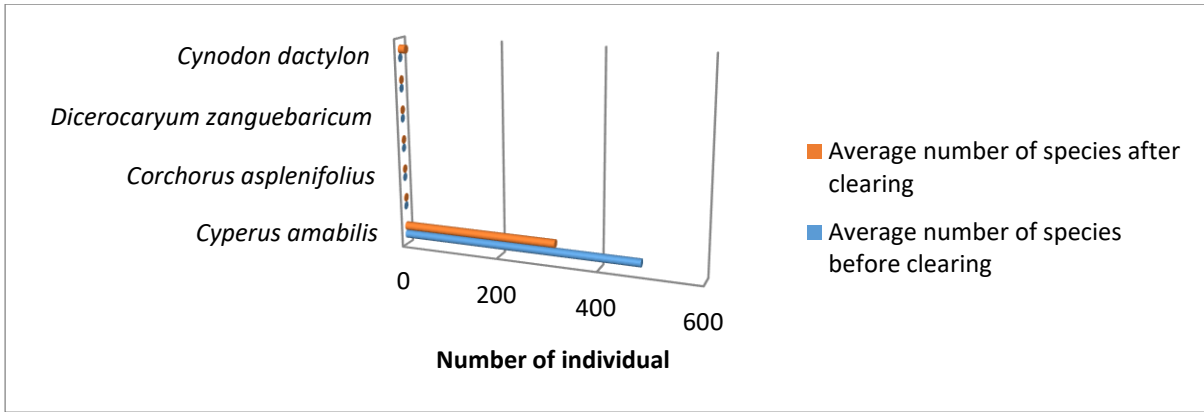


Figure 18: Graphs representing data collected in the *Cyperus amabilis* belt in two seasons 1x1 low and 2x2 high.

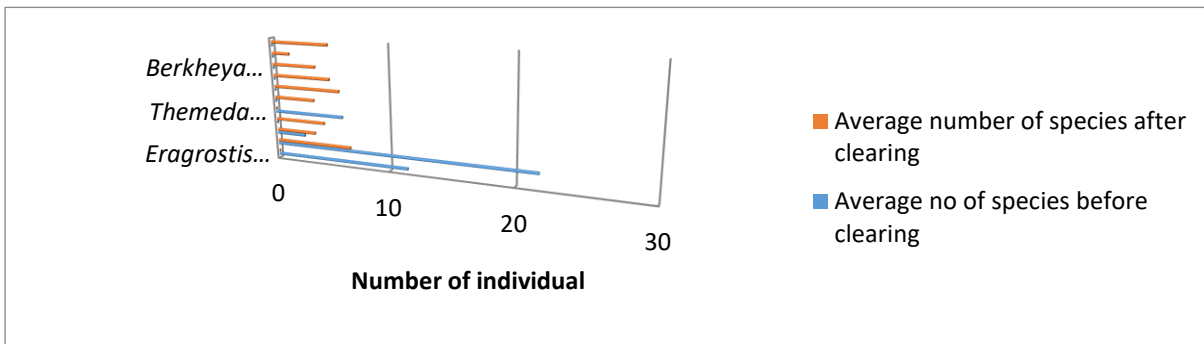
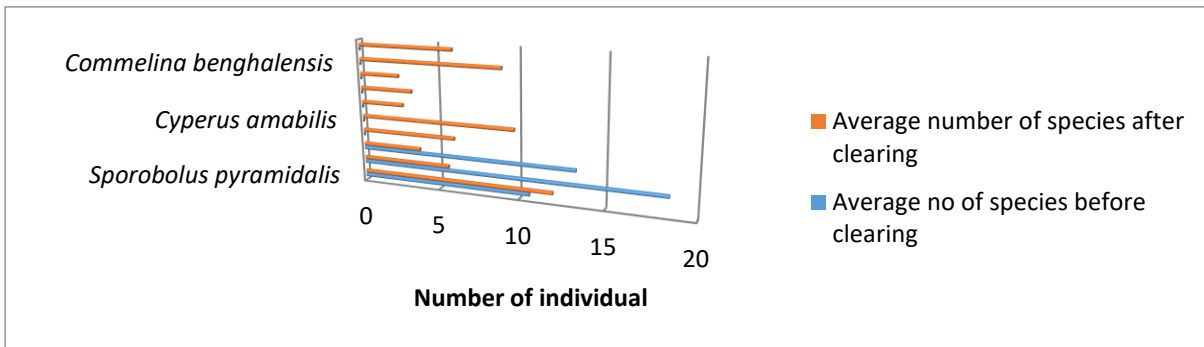


Figure 19: Graph representing data collected in the *Sporobolus africanus* belt in two seasons 1x1 low and 2x2 high.

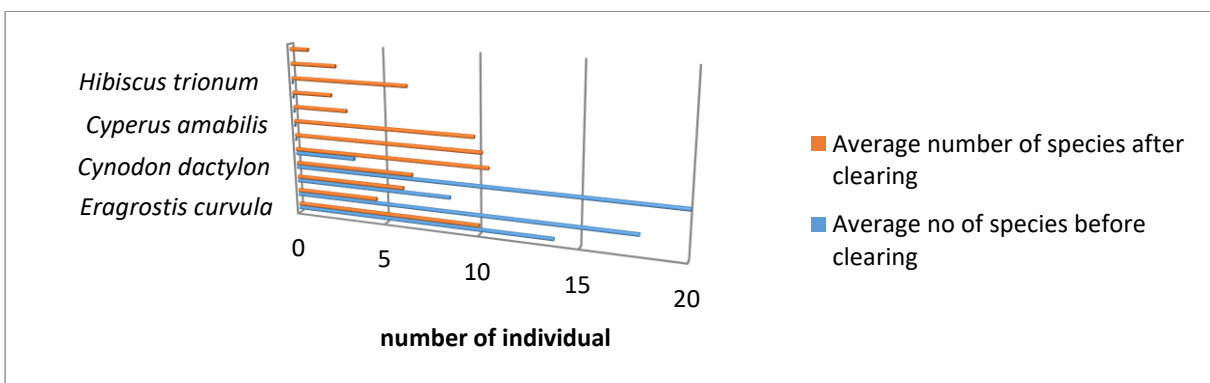
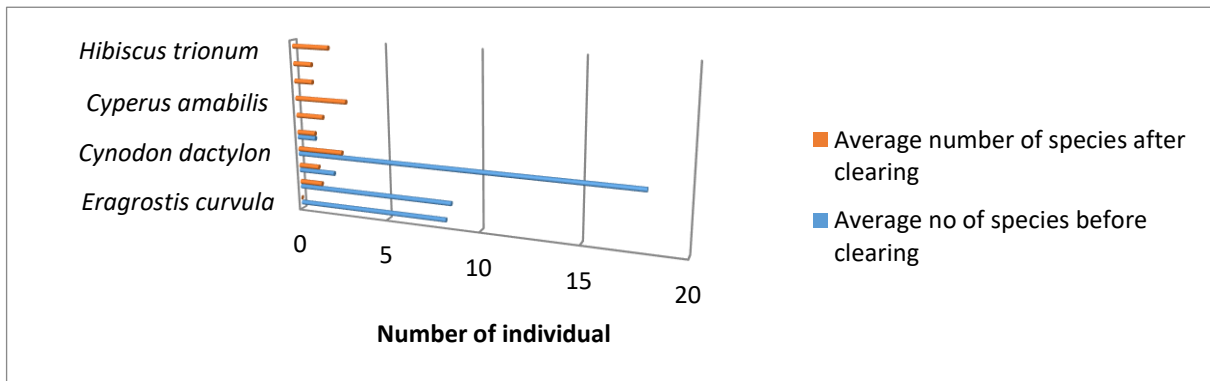


Figure 20: Graph representing data collected in the *Sporobolus africanus* belt in two seasons 1x1 high and 2x2 low.

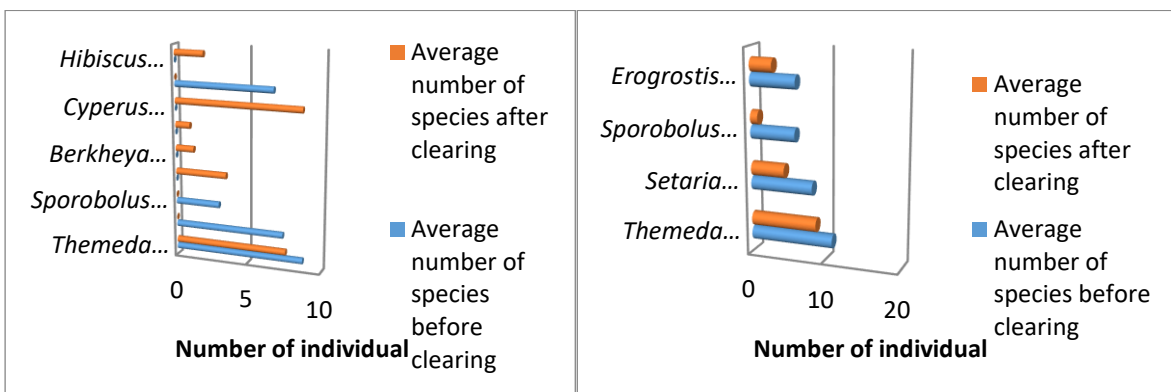
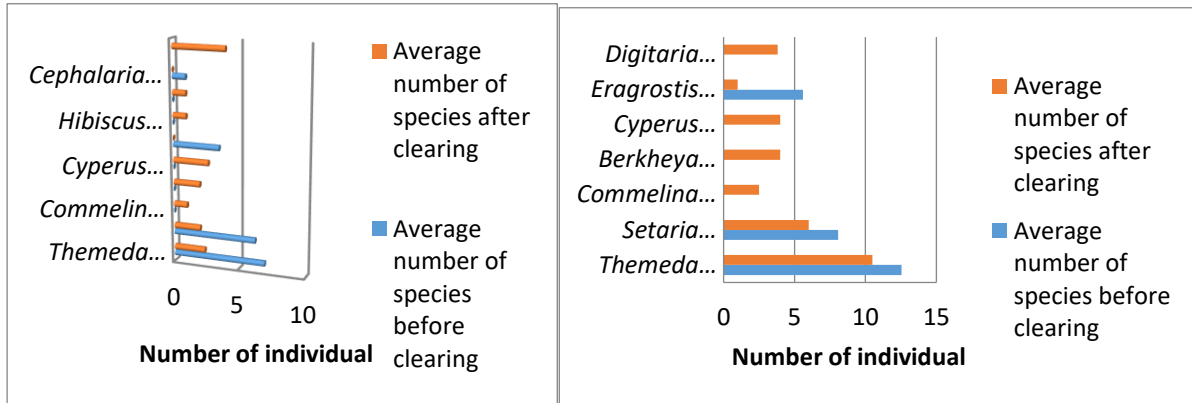


Figure 21: Graph representing data collected in the *Themeda triandra* belt in two seasons 1x1 low and 2x2 high.



Chapter 4

DISCUSSION

Disturbance is like a key component of all ecosystems (Fraterrigo and Rusak 2008). It affects every level of biological organization and spans a board range of spatial and temporal scales. Disturbance can be either natural or anthropogenic and either endogenous or exogenous, disturbance are inherently diverse (White. 1979 and Jentch. 2001). Not surprisingly, ecosystem responses to disturbance are also enormously diverse. Within ecosystem, disturbance may have non–uniform effects due to the fact that ecosystem are themselves heterogeneous with respect to their abiotic characteristics and history. Among ecosystem, differences in the physical environment and biota determining the processes that control ecosystem dynamics may results in wide variation in ecosystem are response (Fraterrigo and Jentsch. 2008).

The most commonly cited definition is, “any relatively discrete event in time that disrupts ecosystem, community or population structure and changes resource substrate availability or the “physical environment” (White and pickett.1985). Within this definition there is broad range of events and processes that will lead to these sorts of changes. The range can be described by the intensity, frequency, duration, predictability, distribution and synergism of any disturbance regime (Sousa. 1984, White and White and Pickett. 1985).

The intensity of disturbance describes its greatness and severity. Frequency is the mean number of disturbance in a unity of time. Duration addresses the temporal extent of the disturbance. Important distinction between disturbance come with recognition

that some anthropogenic disturbance last a long time, whereas disturbance that we might call “Nature” are shorter and organisms may adapt to the disturbance.

Distribution of disturbance is significant in invasion because it describes the size and spatial extent of the disturbance. Finally synergism describes whether a disturbance precipitates or exacerbates further disturbance.

Disturbance commonly enhances the abundance and distribution of exotic plants. The positive role of disturbance in some plant invasions appears to help many newcomers to establish nearly mono-specific stands. Disturbance of grassland communities is recognized to accelerate the establishment and invasion of exotic plant.

Propagule pressure is also widely recognized as an important factor that influences invasion success (Davis *et al.* 2000). Previous studies suggest that the probability of successful invasion increases with the number of introduction attempts, with introduction rate and with proximity to existing populations of invader. Moreover, propagule pressure may influence invasion dynamics after establishment by affecting the capacity of non-native species to adapt to their new environment. Resource availability is another key factor known to influence invasion success and process that decreases or increases resources availability and therefore has strong effects on invasion. Resource re-emption by species generates biotic resistance to. Consequently, physical disturbance can facilitate invasion by reducing competition for limiting resources. In most community’s disturbance occur via multiple mechanisms and the disturbances created by different agents vary in their intensity and frequency. In order for invasion to be successful, propagule arrival must coincide with the availability of resource needed by invading species. Therefore, the interaction between propagule pressure and that influence resource availability will ultimately determine invasion.

Similar or different disturbance occurring at different intensities and different times can be patchy. Despite the fact that fires, particularly that high intensity can reduce propagule availability and species may vary in dispersal capacity (Turner *et al.* 1998). Such indirect effects of disturbance are like to alter variability in unique ways, and it is vital to consider them when predicting changes in variability following disturbance. Not all individuals of species area are affected equivalently. Depending on the time between burns, some species may be able to complete their life cycles or produce before the next event. Survivors may be present in some, but not all areas affected by disturbance and the environment may be changed in different part of the area affected by a large scale disturbance. Thus, diversity and heterogeneity at the landscape level are often enhanced by natural large-scale disturbances. Temporal heterogeneity of disturbance may be predicable or unpredictable. If it is predictable, it can thus favour certain type of species. For example large lightning initiated fires in cape town tend to occur at certain time of year this were said to favour the growth and survival of some plant species, for example, Wire grass (*Aristida beyrichiana*) is recognized to flower primarily after growing, but such species have mechanisms to survive the interval between successive disturbance (Sheridan *et al.* 1997, Schuyler. 1999).

Review of literature indicated that recruitment strategy and trophic status are key factors influencing variability over time, and thus among the primary determinants of indirect effects. Recruitment strategy directly affects how species colonize space following disturbance. In a spatial context, the ability to regeneration strategies that require the dispersal of propagule or organisms may increase or decrease population variability over time (Mou *et al.* 2005). Increase spatial variability tends to rise when species have limited dispersal of capacity, reflecting the patchy distribution of remnant population. Decrease in spatial variability occur when species have the capacity for

widespread dispersal because this promotes an even distribution of individual (Ranta *et al.*, 1998, Reed *et al.* 2000 and Liebhold *et al.* 2004).

Disturbed areas are more easily invaded by native or exotic species than undisturbed area (Elton 1958, Hobbs and Huennneke 1992 and Mack *at al.* 2000), but this effect is found primarily under more productive condition. Environment that are both productive and disturbed, such as agricultural or riparian area, often have serious exotic problem cause by dominance of the invading species. Obviously any particular disturbance such as fire, flood or ice storm, will have different effects on individual grass that in species size and other properties (Houston. 2004). For example, ground fire in Savanna is likely cause mortality of grass seedlings, but have no types of mature grass. Because of these differential effects the consequences effects on native versus exotic species will depend on the particular adaptation of the grass species involved (Houston. 2004). The growth of exotic grass is already reduced by competition or other cause of reduction can have strong negative effects on the population of exotic grass species (McEnonyand Coombes.1999).

The specific details of which native and exotic species increase or decrease in response to the treatment will depends on the particular adaptation of each species in relation to the local environment condition, particularly and disturbance. In fire adapted vegetation, such as Mediterranean climate shrublands prevention of fire typically lead to the decrease in the abundance and diversity of small adapted species and an increase in the abundance of species that are likely to be larger in size and better competition in the absence of fire (Barro and Conard. 1991, Sax. 2002 and Keeley and Fotheringham. 2003); this suggest that at least in some case the invasive exotic species of disturbed sites species. Unfortunately there are numerous example of fire

adapted exotic species, generally grasses that invade fire sensitive vegetation and create fire regime that severely impact native species.

Control of exotics through manipulation of disturbance will inevitably reduce the abundance of some native species as well which will require careful monitoring and adaptive management. In a study of fire by Italian Grapow and Blasi 1998 “the urban exotic species increase in their absolute and relative contribution to the flora along a gradient of increasing disturbance of exotic herbaceous species” (Sax. 2002). When extreme disturbance regime such as cultivation is terminated and natural vegetation allowed to re-generate, there will generally be a “succession” of invasive species that changes with frequency.

The effects of disturbance vary greatly in intensity and frequency. These factors of disturbance regime often influence subsequent patterns of secondary succession within disturbed generated quadrats or area of an open space. In the once cleared and frequently cleared quadrat, this could also be observed because the types of plant species that have invaded are not all the same.

Species such as *Themeda triandra*, *Sporobolus africanus*, *Setaria sphacelata*, *Cyperus amabilis* *Eragrostis curvula*, and *Digitaria eriantha* are the co dominant of the chosen kites at Nylsvlei Nature Reserve because they co dominant the quadrat before cleared.

Species such as *Cyperus amabilis*, (table 02) appeared before clearing and after clearing. The reason might be that these species ability to accumulate enough nutrients for re-appearance, also there was enough moisture for them has to regenerate. Some species such as *Setaria sphacelata*, *Eragrostis curvula*, *Sporobolus pyramidalis* and *Themeda triandra* (table 19) could have been eaten by animals or

insects such as locusts or else their growing points (Meristematic tissues) are situated in such a way that once they are cleared , they are totally removed. Summer with low moisture in areas such as wetlands dominant and co dominate wait until moisture is enough for them to regenerate and frequent clearing is hence not an advantage for them to quickly re-establish.

Species that re-appeared all the time show that they are capable of quickly regenerating. They probably require less time to re-appear than that required by most dominant and co dominant species that failed to re-appear at first clearance. These species might be having high powers of dispersal and faster growth rates; they do not totally disappear in the system by clearing once using low intensity. Other reason might be that they possess greatness vegetative growth, their growing points were not damaged by high and low intense disturbance, and their stems that grow below the ground are able to form new plants and hence send out new leaves or shoots from close to the ground surface. This can be seen on the response of *Cyperus amabilis* that are capable of re-appearing all the time (Table 03).

Species such as *Corchorus asplenifolius* and *Berkheya cirsiifolia* (Table 05) were not there before clearing but after clearing they appeared. This suggests that opening the spaces promotes a successful recruitment of seedlings of new species that were not there before clearance and germination of their seeds was favoured because of the availability of enough moisture, light and space. If disturbance continues to happen every season, the system will consist of only those species that are capable of regenerating and germinating quickly, they colonize faster than the initial residents.

Comparing the rainfall amount between two seasons, one can realise that diversity of species differ a little. Winter season is characterised by low rainfall and moisture

content is low. Therefore, there is no competition between the original residents and the newcomers or opportunists because the newcomers exploit the little resources available whereas the dominants would regenerate under relatively high resource situation. Once gaps are created, seeds and seedlings that were dormant or prevented to establish will soon appear, while the initial species will be taking time waiting for enough resources to accumulate. Such is an advantage of those species that are not good competitor for allowance to recruit. This implies that allowing more time for new species to appear, promotes species diversity in wetland areas. An introduction of Forbs and those species that were not there before, like *Commelina benghalensis* shows a success of recruitment for these new species.

Summer season is a season of high rainfall and soil has high moisture content. Removal of dominant species did not bring about many new recruits of the new different species. Species that are dominant quickly re-appeared before many new comers could be seen. This is probably because the area has large quantities of nutrients and hence no waiting time for dominants to re-establish is necessary and such environments are accordingly not conducive for the establishment of opportunists. Some species like forbs appeared once and die after clearing whilst others like *Corchorus asplendifolia* appeared only when enough time was given for them to recruit.

The above suggests that species diversity in summer season might never be high. It may also be assumed that summer seasons are high in nutrient content. The few new comers that appeared after clearing might imply that they are ephemerals that complete their life cycles in few weeks' time and also that they may be calcicoles.

According to the intermediate disturbance hypothesis, too high or too low intensity of disturbance brings about low species diversity. The probability that a site would be re-populated decrease with the intensity of disturbance.

Some species that appeared before clearing did not re-appear at all after clearing and some did re-appear in the quadrats that were cleared once. Opening the gaps for recruitment of newcomers was initiated because species increased in number and also in diversity. This shows that the more intense the disturbance, the more it is going to bring about high species diversity and do away with the dominance of a single species.

There is the possibility that human-cause disturbance register further on all scale (intensity, frequency, duration, predictability, distribution and synergism) than natural disturbance, but as yet there is no concrete evidence for this.

The biotic and abiotic dichotomy distinguishes between physical and biological forms of disturbances. Abiotic disturbance are those forces that act outside of the biological realm, for example wind, fire, drought, floods and cyclone. Biological disturbance on the other hand are mediated by living organisms and include predation, herbivory, rooting behaviour, including anthropogenic force mentioned above

The final dichotomy separates disturbance into either endogenous or exogenous, meaning those that originate from within the disturbed system and those from outside. Endogenous disturbance has a historical and evolutionary presence in the system and produce change from within (such as successional force or predation). In contrast, exogenous disturbance are those that lie outside the evolutionary range the system has experienced such as volcanic eruption.

Some definitions insist that disturbance is a process rather than a discrete event event or process, it depends on perspective and life span.

A Wind ecosystem, a hurricane is an event that removes some grass and creates substrate and increased light availability for young or newly arriving grass to establish. The grass that establish in these clearings may depend on the seed banks and dispersal frequencies between habitat patches. For the entire community of grass the hurricane is, therefore, an event. For seed moved through cyclone, winds and water to a newly cleared patch of land, it is perhaps of a process.

The fact that species *Cyperus amabilis* in the waterlogged clayey area showed a high number of vegetation cover might be due to the fact that clearing created suitable micro habitat for these species to invade.

The results shows that under low intensity of disturbance, quadrats have the highest number of species diversity and species abundance as contrasted to low vegetation cover in high intensely disturbed quadrat.

The fact that *Cyperus amabilis* responded better under low intense disturbed quadrat might be attributed to the incomplete removal of their individual species thereof. Such possibly prevented individuals of other species from establishment in the quadrat. On the other hand, the less response of *Themeda triandra* in low intensely distributed quadrat might be because of the injury caused to them during disturbance. The other thing is that *T. triandra* was found on sandy soil which hold relatively very little water and nutrients. Because of the less water holding capacity of sandy soil, it was difficulty for the *T. triandra* species that were found growing in the cleared quadrat which were originally occupied by *T. triandra* the fact species that were found in low disturbance quadrant were having the highest number of vegetation cover might be due to the fact that during land clearing the propagules of the original species were left behind and did not allow enough microsites for the new species to occupy the quadrats.

CHAPTER 5

CONCLUSION

One is tempted to provisionally conclude that the results of the current study contradicts the intermediate hypothesis. This is because fairly high species diversity was a result during summer season. What was observed in winter might also mean fair high species diversity.

All natural communities probably experience disturbance at some spatial and temporal scale. Historically its role in community dynamics has been overlooked, but now there is a growing realization that disturbance may play an important role in the community dynamics i.e. competition and predation, which have received far more empirical and theoretical attention from ecologist. The interplay between disturbance and these biological processes seem to account for a major portion of the organization and spatial patterning of natural communities.

Disturbance by clearing wetland grass belts of Nylsvlei Nature Reserve has influenced patterns of secondary succession, enhanced species diversity by freeing resources for the less competitive species and has increased the number of species within the disturbed belts.

High rainfall seasons contain high soil moisture content, and in many cases such season are rich in nutrient content and hence dominant and co-dominant species thereof would persist; species diversity would therefore always be low. In winter season, soil moisture content is low, species diversity is high because the dominant species take a longer time to re-appear and such a long time which is taken is an advantage of seeds of ephemeral plant species to germinate.

Size of the quadrat also played an important role in recruiting new neighboring species. It was easier for new species to invade 1 m x 1 m faster, due to the sporophyte phase seen hanging over the cleared space.

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