

**Relative abundance and habitat preference of *Stipagrostis lutescens*
around Namib Desert Environmental Education Trust (NaDEET)
office area.**



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Abstract

The Namib Desert has different vegetation, with different organisms adapted to live in these vegetation. This study concentrated entirely on grass species especially *Stipagrotis lutescens* with regards to its distribution and relative abundance around Namib Desert Environmental Trust (NaDEET). The study was suggested by NaDEET management because of the change in distributions and an increase in number of *S. lutescens* in the area. The study was carried out on an area of about 10 km (5km north and 5km south) of NaDEET base area. Systematic random sampling was used and a 100 m transect was laid in every 400 m measured with global positioning system (GPS). Grasses which were in contact with the measuring tape were recorded from the first point it get in contact with the tape to the last point of contact. The average percentages of canopy cover for each grass in each habitat was determined. Notes were also done regard the utilisation of each grass by small or large herbivores. The study found out that *S. lutescens* is only occurring on the dunes habitat but not on sandy plains. Canopy covers of each habitat were also determined and the results showed that plains habitat had the highest canopy cover of 8 % but had less species richness. Dunes and inter-dunes were the most represented when it comes to species richness. *S. ciliata* was the dominating species on sandy plains and inter-dunes while *Cladodaphis spinosa* was the dominating species on the dunes vegetation. *Stipagrotis lutescens* also appeared to be utilised by large herbivores; 40 % of the recorded individuals were utilised.

Introduction

The Namib Desert is believed to be the oldest true desert in the world (Seely, 1987). The area stretches from Oliphant River (32° S) in Southern Namibia to San Nicolai River (14°S) in southern of Angola (van Damme, 1991), an area of about 2000km long and 200 km wide. When one look at the Namib Desert ecosystem it seems as it does not support life but a closer look at it shows that there are variety of living organisms can be identified and most of them are endemic. Majority of the animal are nocturnal (van Damme, 1991), while Seely (1987) states that plants have certain adaptations which help them to survive harsh conditions of the Namib.

Grasses play important roles in ecosystems and deserts are not an exception. Due to windy conditions of the Namib Desert, grasses are therefore very important with

forming ground cover which reduce rate of soil erosion. They form the base of desert food chains where it is either utilised as fresh or dead. Apart from that, grass holds the soil together and improve its resistance against wind and water erosion. Grasses can also be used by animals as refuge from predators and hot/cold weather (Van Damme, 1991). Grass species occupying a habitat influence that particular area in different ways. Grass types are also indicators of veld conditions, whether the veld is in a good or bad condition. This also applies in the Namib Desert. The Namib is inhabited by grass species such as *Stipagrostis sabulicola* (Kalahari sour grass), *Claradoraphis spinosa* (Ostrich grass) and *Centropodia glauca* (Gha grass) especially on the sandy areas (dunes) whereas *Stipagrostis ciliata* (Tall bushman grass) and *Stipagrostis obtusa* (Short bushman grass) are more on the sandy plains. Another but not so common species of the *Stipagrostis* family found in the area (commonly in the Southern Namib) is *Stipagrostis lutescens*, which is a woody perennial grass with stiff leaf blade and its height is between 70 cm-120 cm. Klaassen and Craven (2003) describes *S. lutescens* as a perennial grass found mostly on the dunes hillsides and it is near endemic to the Namib Desert.

Kingdom	Plantae
Class	Magnoliophyta
Order	Poales
Family	Poaceae
Genus	<i>Stipagrostis</i>
Species	<i>S. lutescens</i>

Fig 1: Classification of *S. lutescens* according to Tropicos Resource.

Stipagrostis lutescens has been observed to grow on the dune slopes, mostly eastward facing slopes some kilometres away from Namib Desert Environmental Education Trust (NaDEET) base (office) area (Andreas Keding, personal communication. 13 February 2013). In recent years it has been noticed that it is spreading in this area and at some point it's also growing on the sandy plain. Van Damme (1991) states that *S. lutescens* grows almost on dunes together with other two grasses belong to the same genus, *S. sabulicola* and *S. namaquensis*. This could be because the seeds are dispersed by factors such as wind, which is

experienced in the area throughout the year, and/or by birds, which use grasses to build their nests. With prolonged dry conditions and low rainfall, it is very difficult for new grass to germinate. Seely (1987) states that, grasses from *Stipagrostis* genus produce seed in hard covers which enable them to survive and lay dormant during draught season, only geminate when the conditions are favourable. This can be the results of *S. lutescens* increased in number of individual since the area is reported to receive an above average rainfall since 2008 (The Barking Gecko, 2011)

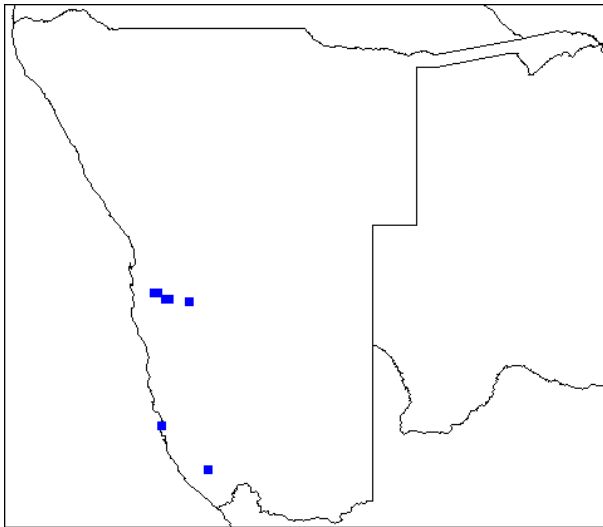


Fig 2: Distribution map of *S. lutescens* in Namibia according to De Winter

Aims and Objectives

This project was aimed at gaining an improved understanding with regard to relative abundance and current habitat preferred by *S. lutescens* and, it's distribution around NaDEET office area.

The objectives to achieve the above-mentioned goal were to:

- determine the habitat preferred by *S. lutescens* around NaDEET
- establish the grass species dominating in the two habitats plains and dunes
- determine distribution and relative abundance of *S. lutescens* around NaDEET
- determine utilisation of *S. lutescens* by herbivores (small and large)

- determine canopy cover of grass in each habitat

Study area

The study was carried out at area around NaDEET base (office). NaDEET is a small non-profit private organisation found on the eastern edges of the dunes in the NamibRand Nature Reserves with the main aim of educating Namibians on how to live a sustainable lifestyle in the Namib Desert. NaDEET is located on the former farm known as Die Duine, one of the fifteen farms which make up NRNR.

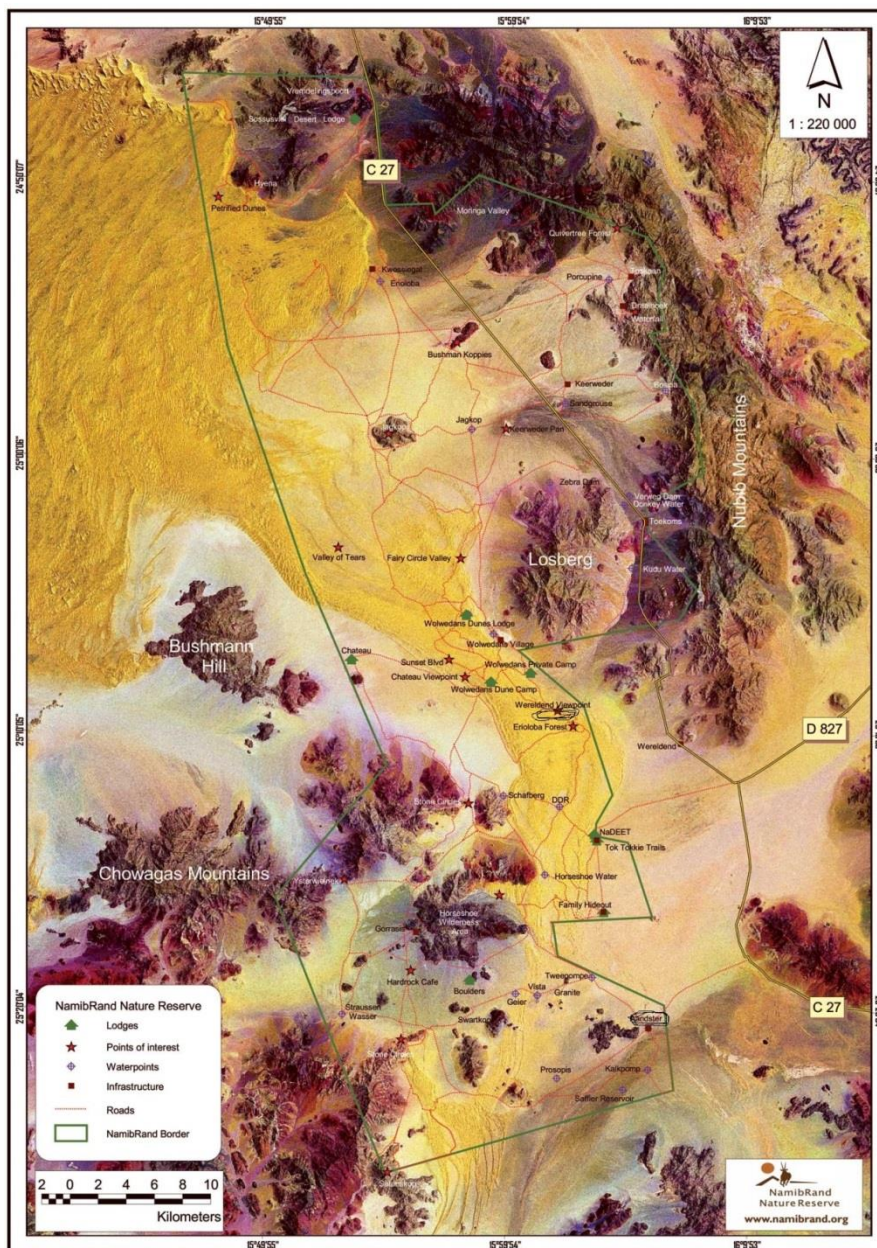


Fig 3: Aerial view of NamibRand Nature Reserve where NaDEET is (NaDEET Gallery)

NaDEET is within the Semi desert and savannah biome vegetation zones. The woody plants found in the area include camel thorn (*Acacia erioloba*), candle pod acacia (*A. hebaclade*), smelly shepherd tree (*Boscia foetida*), bitter bush (*Pechel-Leoschea leubnitziae*) and brittle thorn (*Phaeoptilum spinosum*). Close to NaDEET, big mammals such as oryx (*Oryx gazelle*), springbok (*Antidorcus marsupial*), bat-eared fox (*Otocyon megalotis*), Cape Hare (*Lepus capensis*) can be seen in the surrounding while birds found in the surrounding are: Ostrich (*Struthio camelus*), Lapped-faced vulture, SouthernPale Chanting Goshawk (*Melirax canorus*), sociable weaver (*Philetaurus socius*), scarly feathered finch (*Sporopipes squamifrons*), Namaqua sandgroove (*Pterocles namaqua*), Dune Lark (*Calendulauda erythrochlamys*). The area is also well represented in the reptile class of classification, common barking gecko (*Ptenopus garrulus*); Namib dune gecko (*Packdactylus rangei*), wedged-snouted lizard (*Meroles cuneirostris*), cape cobra (*Naja nivea*), horned adder (*Bitis caudalis*), Namib sand snake (*Psammophis namibensis*) and side winding adder (*Bitis perigueyi*) are all common around this area. A variety of insects majority of which from Teneriobidae family and arachnid are also found in the area.

The area is characterised by two different types of vegetation namely sand dunes and sandy plains areas. Dunes valley is a third habitat which is an area found between two or more dunes. The soil is very poor in nutrients Seely & Pallets, (2008), because of slow weathering process and the decomposition of organic matter.

Climate is that typical of the desert, marked with low irregular rainfall with a range of 15-150 mm mostly during summer. Temperature is usually high during the day and drops very low during the night. There is no open water in the area one of the characteristics of the desert. The area also receives moisture in form of dew and fog which are of greater importance than rain (Van Damme, 1991) because they are received more often. Desert animals have different forms of fog harvesting to make utilise this water. *Stipagrostis sabulicola* is one of the grass species adapted to live on the dunes in the Namib Desert, unlike *S. lutescens*, it is well known for watering itself with fog water from the leaves.

Method and Materials

There was a change in method used during this study because the proposed method was not going to deliver the required results. Systematic random sampling was used instead of random sampling using quadrats at each sample spot.



Picture A



Picture B

Figure 4: Two main habitats found around NaDEET, picture A Sandy plains habitat and Picture B dunes habitat. (Photo: Sem Shilongo)

The study was carried out during summer season, between April and June and an area of about 10 km (5 km north and 5 km south) of NaDEET base area and it was about 1 km in width was used as a study area. Within this area, three distinct vegetation namely sandy plains, dunes and inter-dunes can easily be identified. Since the study was mainly focusing on dunes and sandy plains, inter-dunes (area between well-established dunes) was also included, this happened because the 400 m from the previous transect might fall on this habitat. Instead of ignoring it, records were also taken and analysed with the rest of the data from other two habitats. Each habitat was sampled separately by lying transect at each 400 m from the start point, which was the 5 km from base, measured with vehicle odometer. A 50 m measuring tape was used to measure the length of each transect, this distance was doubled at each point to make up 100m which was required for each transect. A standard Global Positioning System was used to mark off sampling points and measure the distance between transects. A spade was used to dig out some of the grasses in the two habitats during field observation.

The 100m line was laid in a straight line and all grass species in contact with the line were recorded. Started at the point where that particular grass made contact with the line to its last contact point on the line. This was to measure the canopy cover of each grass recorded for each transect. Note was also made on each grass to

observe if that grass has been utilised in any way, either by large or small herbivores
Area covered per species for each transect was calculated by adding up canopy for all grass species recorded for that transect, and it was expressed as percentages of total length 10 000 cm (100 m) for each transect.



Fig 5: materials used during the research project from top vehicle, 50 m meter, GPS and a spade. (Photo: Sem Shilongo)

Since the grass species recorded on the sandy plains habitat were the same, and none included the study species, only 21 transects were laid instead of 25.

A total of 51 transects were laid between the three habitats, 25 on dune, 21 on sandy plains, only 5 were laid on the dunes valleys.

Results

Dunes Habitat

Overall grass canopy cover was low. Less than 4 % of transects recorded more than 5 % of canopy cover. Four grass species were recorded on this habitat namely, *S. lutescens*, *S. sabulicola*, *S. ciliata*, *C. glauca* and *C. spinosa* which was dominating in most of transects. *Stipagrostis lutescens* was dominating the first 6 transects,

(that's 5 km south NaDEET base). From transect 7 it totally disappeared from the records. For this reason the results for the dunes were divided into two rather than show than show the mean of all transects. Most *S. lutescens* plants recorded were fully grown of, which an individual can occupy canopy cover of more than 1m. In the 1st 6 transects were *S. lutescens* had an average of 8.3 % cover.

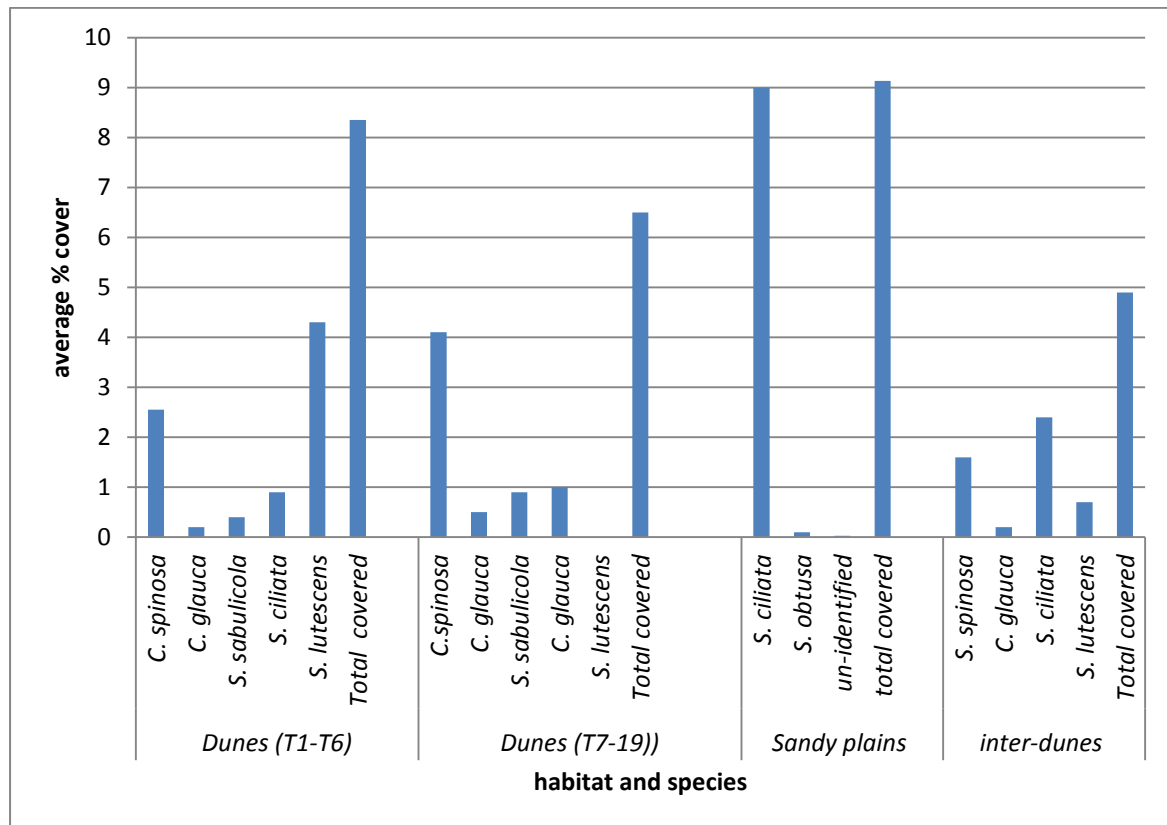


Figure 6: Average canopy cover of grass species found in the three habitats

Plains Habitat

No single *S. lutescens* was recorded on the plains habitat during this study even though it is known to be spreading in this habitat too. Only two grass species were recorded which were *S. ciliata* and *S. obtusa*, some grass plants were recorded as unknown because they were totally chopped off at the base by termites and created a bare patch. All the laid transects had mostly above 8 % canopy cover. *Stipagrostis ciliata* was the main grass species in all transects with mean of 8.2 % cover and appeared alone in some of transects with *S. obtusa* appearing in few transects with mean cover of 1.7 % only. It looked like no large herbivores utilising it but termites

and other insects have used some of it, especially the culms. When it comes to species richness, the study has only record two for the 21 transects.

Dunes valley (inter-dunes)

This appeared to be the most vegetated habitat when compared to the other two but only 5 transects were laid here, this result may not be reliable. The study record four different grass species: *S.lutescens*, *C. glauca*, *S. ciliate* and *C. spinosa*. This area is more like an ectone, with a combination of grass species found both on the dunes and sandy plains habitat. Again *S. ciliate* was dominating in most of transects but the appearance of different individuals changes from transect to transect. *C. glauca* was recorded more on the inter-dunes on the northern part of NaDEET base area.

Canopy covered of grasses also changed with transect but most of transects record more than 7 % of area covered.

A closer look at the growth format of *S. lutescens* and *C. spinosa* which is dominating on the dunes habitat indicates that *C. spinosa* has more deep roots formation (more than 10 cm deep). Deep roots might assist and give advantages of being with access to deep ground moisture most of the time as the surface moisture dry up very quickly due to heat from the sun. On the other hand, *S. lutescens* roots formation, it grows more close to the surface but it forms a very thick network of roots intercepting each other. This form of roots can assist it to survive on the dunes habitat as *C. spinosa* does. The recent increase of *S. lutescens* in the area can be because of rain, more moisture was available and reachable by its roots most of the time. If *S. lutescens* has to settle on the plains area, it does not stand a chance of surviving longer. The plains soil is very shallow and does not hold moisture for a long time compared to the dunes.



Picture A



Picture B



Picture C

Figure 7: Root systems of (A) *S. lutescens*, (B) *S. ciliata* and (C) *C. spinosa*. (Photo: Sem Shilongo)

Field observation also shows that, 40 % of the 22 *S. lutescens* recorded were utilised by large herbivores. Evidence shows that Oryx is one of them, but no preference was made between individual plants regard the age and condition. Other plants were also utilised, *C. glauca* by large herbivores while *S. ciliata* and *S. obtusa* were more preferred by small herbivores



Figure 8: *S. lutescens* grazed by large herbivores. (Photo: Sem Shilongo)

Discussion

The reason why *S. lutescens* distribution is restricted to the southern part and only 5 km away from NaDEET is possible because of changing rainfall patterns and only a matter of time before it spreads to northern part of NaDEET base. In 1975-76 the Namib Desert received over 80 mm rainfall. After that a studies were done in 1985 and 1991 to observe how the ecosystem react to rainfall. The study which done in 1976 showed that there was an increase in plant covers on the Namib dunes area. Similar studies which were done in 1985 and 1991 show different results with a huge decrease in distribution and biomass production. The Namib is well known for its windy conditions, wind is the main agent of seed transport from one area to another, settle and produce new plants during years of good rainfall.

It was noted that after 15 mm of rainfall recorded at the beginning of April *S. lutescens* started flowering after 2-3 weeks while *C. spinosa* started very late. This suggests that *S. lutescens* reacts fast to the availability of moisture in the ground. Other grasses such as *S. ciliata* also reacted fast but not by producing inflorescent,, but developing new fresh leaves at the base.

Stipagrostis lutescens is increasing in number in the area around NaDEET office but only on the dunes habitat. There was no new finding about a change in its distribution patterns to include the sandy plains. The plains habitat has good base cover compared to other habitats and it is poor when it comes to species richness, with only two species recorded. Dunes vegetation was least covered but the species richness was more with four grass species recorded. *Stipagrostis ciliate* is the dominating species on sandy plains and inter-dunes while *Claradoraphis spinosa* is the dominating species on the dunes vegetation. Seely and Louw (1980) did a study about the effects of rainfall on the part of Namib Desert ecosystem and found out that dunes slope are more productive followed by inter-dunes, but it was different with this study. The report also state that dunes respond very quickly to rainfall and it increases distribution of individual plants. Field observations of this study also shows that *S. lutescens* plants close to the sandy plains habitat don't look the same to those deep in the dunes. The plants which are deep in the dunes look fresher (greenish to yellow) while the ones which are close to the sandy plains are greyer

and looks dead. This can add to a statement made earlier in this report that *S. lutescens* is more of a dunes grass.



Picture A



Picture B

Figure 9: Pictures of *S. lutescens* with A on the edge of the dunes while on the dunes (Photo: Sem Shilongo)

Stipagrostis lutescens spreading in the area is adding to the number of few grass species which are adapted to survive the harsh environment of the Namib Desert. With it spreading in the area, it plays a major ecological role in the desert ecosystem. This includes binding the dunes sand together which is more vulnerable to wind which is common in the area. Observations also show that it has been used at some point by large herbivores. Since it is a perennial grass (Klaassen & Craven, 2002), it is going to be a good source of food to large and small herbivores throughout the year. It grows more close to the ground and thus provides shelter to small desert animals and traps food materials for insects such as the Toktokkies (Teneriodidae family). The old dead plants can contribute to developing the desert soil by getting decomposed and form manure which can be utilised by animals and other plants as nutrients.

With current information about *S. lutescens*, one can see that it has characteristics of a climax grass because it is a perennial grass found on well-developed vegetation. This is a characteristic of many of the climax grasses. The study did not find any relevant fact to prove but it is standing as a base line for similar follow up studies.

Recommendations

Little information is known about the study species, most of the stated assumptions need to be proved. A follow up study is recommended after a period of 2-4 years to

give the field enough chance respond to different weather conditions and see if there will be any change in *S. lutescens* distribution. Conclusions need to be drawn based on the ecological status and utilisation of this grass by herbivores; similar studies need to be done in different seasons since this study was done in summer, comparison can be done with other seasons and *S. lutescens* is expected to be utilised more in other seasons than in summer.

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APPENDIX 1

Transect Number	Base cover(%)	Note	<i>C. spinosa</i> (%)	<i>C. glauca</i> (%)	<i>S. sabulicola</i> (%)	<i>S. ciliat</i> (%)	<i>S. lutescens</i> (%)	% of area covered
1	7.53		2.1	0	0	0.87	4.56	7.5
2	8.28	<i>S. lutescens</i> grazed by large herbivores	0.91	0	1.34	0.56	5.47	8.2
3	8.82		3.20	0.45	0	0.67	4.50	8.8
4	9.27		2.38	0	0	0.98	5.91	9.2
5	9.06	<i>S.lutescens</i> is flowering	3.24	0	1.32	1.18	3.32	9.0
6	7.92		3.47	0.78	0	1.46	2.21	7.9
7	7.88		3.38	0.56	2.96	0.98	0	7.8
8	6.72		4.65	0.68	0	1.39	0	6.7
9	5.99		3.38	0	1.21	1.40	0	6.0
10	8.17	<i>C. spinosa</i> flowering	4.92	0	2.09	1.16	0	8.2
11	6.66		4.27	0.67	0.92	0.80	0	6.7
12	7.38		4.10	0	2.03	1.25	0	7.4
13	7.84		4.57	0.34	1.95	0.98	0	7.8
14	5.84		4.24	0.41	0	1.19	0	5.8
15	4.09		3.29	0	0	0.80	0	4.0
16	6.4		3.37	0.78	1.09	1.16	0	6.4
17	4.93		3.28	0.70	0	0.95	0	4.9
18	6.89		4.24	0.45	1.07	1.13	0	6.8
19	5.56		3.57	0.78	0	1.21	0	5.5
20	7.16		4.25	0.46	1.30	1.15	0	7.2
21	6.7		4.54	0.89	0	1.27	0	6.7
22	6.45	<i>C. glausa</i> is grazed by large herbivores	3.61	0.80	1.28	0.76	0	6.5
23	6.33		5.07	0.25	0	1.01	0	6.3
24	6.91		5.23	0.44	0	1.24	0	6.9
25	6.84		4.01	0	2.09	0.74	0	6.8
Average (%)	7.03		3.7	9.4	0.82	1.05	1.03	7

Table 1. Average canopy cover and % covered for each species in each transect on the Dunes Habitat

APPENDIX 2

Transect number	Total base cover (%)	Note	<i>S. ciliata</i> (%)	<i>S. obtuse</i> (%)	<i>S. lutescens</i> (%)	Unidentified (%)	% covered
1	8.77		8.26	0.51	0		8.7
2	8.11		8.11	0	0		8.1
3			9.12	33	0		9.4
4	8.09	Chopped at the base by small herbivores	7.65	0	0	0.44	8.0
5	7.89		7.56	0.33	0	0	7.8
6	8.95		8.95	0	0	0	8.9
7	9.06		8.63	0.43	0	0	9.1
8	8.58		8.58	0	0	0	8.5
9	7.56	<i>S. ciliata</i> is used by invertebrate	7.12	0.44	0	0	7.5
10	8.23		8.23	0	0	0	8.2
11	8.72		8.41	0.31	0	0	8.7
12	9.24		9.24	0	0	0	9.2
13	7.89		7.89	0	0	0	7.8
14	8.66		8.23	0.43	0	0	8.6
15	8.34		8.34	0	0	0	8.3
16	8.73		8.51	0.22	0	0	8.7
17	7.65		7.65	0	0	0	7.6
18	8.77	Cut off at base by small herbivores	8.56	0	0	0.21	8.8
19	9.03		9.03	0	0	0	9.0
20	7.89		7.33	0.56	0	0	7.9
21	8.74		8.61	0.13	0	0	8.7
Average (%)	8.4		8.2	1.7	0	0.03	8.4

Table 2: Mean and % cover for each species in each transect on the Sandy Plains Habitat

Appendix 3

Transect Number	Total base covered (%)	Note	<i>C. spinosa</i> (%)	<i>C. glauca</i> (%)	<i>S. ciliata</i> (%)	<i>S. lutescens</i> (%)	% covered
1	6.05		2.33	0.95	1.43	1.34	8.2
2	5.75		1.32	0.87	3.56	0	7.8
3	6.54		2.37	0.83	3.34	0	8.1
4	7.55		2.76	1.12	3.67	0	7.2
5	8.53		1.78	1.92	4.83	0	7.9
Average (%)	6.8		2.1	1.1	3.3	0.2	7.8

Table 3: mean and % covered for each species in each transect on the inter-dunes habitat