NAMIBIA UNIVERSITY OF SCIENCE AND TECHNOLOGY

Project report:

Biodiversity around different growth forms of Camel thorn (*Acacia erioloba)* in the vicinity of NaDEET Centre

Photo: John Amanyanga

Student Name: John Amanyanga

Student number: 212078526

Mentor: Elia Shikukumwa

Tutor: Richard Kavari

School of Natural Resources and Spatial Sciences

Department of Natural Resources and Agricultural Sciences

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NaDEET Learning & living for a sustainable future

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Abstract

This study was carried out in the southern pro-namib desert to find out biodiversity of Camel horn (*Acacia* erioloba) trees. A number of 12 *A. erioloba* trees were sampled randomly, six of the trees were standing upright and the other 6 have fallen. Pitfall traps were set around the stem of each tree. A total of 58 species were recorded from the sampled area (3.5 km^2). It was found that most of this species were sampled from the fallen trees; however both growth forms had an average Shannon index score. The study shows that the fallen tree has an equally important role in the ecosystem as any other tree.

1. Introduction and Background

The Namib Desert is a rather harsh environment for organisms to survive in, plants and animals have consequently developed various behavioural and structural adaptations to withstand this harsh environment and survive for generations to come (World Wildlife Fund, 2017). Organisms have to adapt to rapid temperature changes from hot days to cold nights and the scarcity of water, this also forces organisms to depend on each other for survival and have formed rather complex food webs (Gary, 1991). One of the organisms that is well adapted and has a strong role in the ecosystem is the Camel thorn tree (*Acacia erioloba).* This tree belongs to the Fabaceae, subfamily; Mimosoideae, and it is the most widespread tree in Namibia (Curtis & Mannheimer, 2005). It is adapted to various climates throughout Namibia including those of the pro-namib desert. *A. erioloba* grows as a single tree or a shrub which can range from 1-20 m in height, it has twice compounded leaves that prevent it room losing a lot of water via transpiration and a pair of white thorns to reflect off excess sunlight and also reduce browsing. This tree grows in almost any habitat ranging from plains, dry river beds, rocky ground but the most preferred habitat is deep sandy soil (Curtis & Mannheimer, 2009). *A. erioloba* can easily be identified by looking out for its grey kidney-shaped fruit (pod) that is unique to it.

The camel thorn tree is an important support base for other biodiversity (Encyclopedia of life, 2017). It has various uses both for human and animals; for instance the wood is collected for firewood and fencing poles (Powell, 2001 as cited in Seymour & Milton, 2003). It is ecologically important for birds such as sociable weavers, white browed sparrow-weavers and various owls which were recorded nesting in the large trees. The holes in the trunk cavities under the bark provide micro habitats for a wide range of small organisms such as insects, arthropods and lizards (Curtis & Mannheimer, 2005). The tree provides shade and forage for wildlife and domestic animals that mainly rest under them during the hottest time of the day (Deana, Miltona & Jeltschb, 1999). In this part of the desert Oryx (*Oryx gazelle*) and *A. erioloba* have developed a symbiotic relationship where the Oryx receives shade and food from the tree and the tree gains nitrogen from the Oryx droppings and seed dispersal in return (E. Shikukumwa, personal communication, 10 March 2017). In 1988 a study was done in the Kuiseb River Valley to find interaction between mammalian herbivores, bruchid beetles and the seeds of *A. erioloba* (Mey, 1988). It was found that bruchid beetles feed less on the canopy held pods than on the ground pods. Seed germination of *A. erioloba* was higher when the seed passed through a mammal's digestive system, than an untreated control seed, germination is almost zero for a seed that was fed on by bruchid beetles. The study supports that there is a mutualistic relationship between mammal herbivores and *Acacias* (Hoffman, Cowling, Douie, & Pierce, 1989). But even though this tree species is widespread and common, it is a slow growing tree (Encyclopedia of life, 2017). Schachtschneider & February (2013) said the survival of *A. erioloba* is being threatened by Mesquite tree (*Prosopis glandulosa*), which is an alien plant. *P glandulosa* outcompete *A. erioloba* in the river beds, thus slowing its rate of recruitment. In some areas in southern Africa the rate of wood harvesting from *A. erioloba* is considered to be unsustainable (Anderson & Anderson, 2001; Powell, 2001; Milton *et al*., 2002; Raliselo, 2002 as cited in Seymour, 2004). The seeds germinate after good rains but then these seedlings barely survive the dry season (Seymour, 2003).

At the Namib Desert Environmental Education Trust (NaDEET) *A. erioloba* plays an important role in the survival and maintenance of biodiversity of the area, it is the most common tree in the area (Ehrenbold & Keding, 2015). It is mostly found in the dune valleys and a few grow on the actual dunes, often not exceeding 8 m in height. Biodiversity in the area at the moment is considerably low due to drought that lasted three consecutive years (V. Keding, personal communication, 18 January 2017). The few mm of rain that was received in late February and early March has boosted the number and activity of the organisms for a short period. There was barely any green grass or shrub available for animals to feed on; however *A. erioloba* the trees in the area have green and therefore many organisms were attracted to them, most of these trees are similar in height and size and may be of the same age group. This made studying them easier and yield fair results of interest. There were however also some very large ones. The interest in the area was that the Camel thorn trees seem to have two different types of growth forms since some are upright standing and others have fallen over and continued growing. Natural catastrophic events such as windstorms cause the trees to fall as it exposes the lateral roots resulting to lose of stability (Maser, 1984); the trees are still able to grow since some of their long tap roots are still in the ground and water can be taken up water normally. These two growth forms actually create new conditions around the tree even though it is the same species (V. Keding, personal communication, 5 April 2017). This model might bring thought to someone that there is higher biodiversity in the fallen trees than the standing trees. Maser (1984) found out that fallen trees offer a relatively cool, moist habitat for small animals and a substrate for microbial and root activity, and so fallen trees are naturally part of the environment.

This research project looked at the biodiversity that is supported by each growth form and find out if there were any differences in biodiversity. Biodiversity is the variety of life in the world including all plants, animals, micro-organisms and the ecosystem they form (Australian Museum, 2015). There is a lack of empirical data on this specific research, hence the importance of this study here at NaDEET. The results of this study will provide information that will enhance the understanding of the role of the Camel thorn tree as a keystones species, in the Namib Desert ecosystems. This information will build up on known knowledge about logs. This information will be useful for NaDEET Centre as it can be shared with the participants that visit the centre and go on dune walks (Ehrenbold & Keding, 2015).

Seymour (2004) did research on *A. erioloba* in the Kalahari savannah near Kimberly (South Africa). A series of experiments were done to see what the influence of supplementary water, protection from herbivores, and competition with grass, has on *A. erioloba* sapling growth. The results showed that there was no difference in the height increase between saplings that received additional water or no water because they found the saplings to be having deep roots. There was also no difference in the height increase for saplings that were protected from or not protected from herbivory. But an interaction was found between additional water and protection from herbivores because the grasses out competes the sapling for water and sunlight ultimately reducing the growth rate. The study supports that *A. erioloba* is adapted to getting its water from deep underground and therefore the fallen trees can still grow.

1.1 Aims and Objectives

This project aimed to finding out if there is a difference in the biodiversity around the trees that are standing upright and the tree's that have fallen. It further aimed to find out how *A. erioloba* performs its keystone species role.

In order to achieve the aim of the project, the following objectives were formulated:

- To determine the species richness around the trees.
- To determine the species abundance on the trees and around
- To determine the diversity for each growth form.
- To ascertain if there are any similarities or differences between the species richness and abundance of the sites (trees).
- To develop a summarized food webs for each growth form of *A. erioloba.*

Hypothesis

H_0- There is no significant difference in the biodiversity supported by the upright standing *A. erioloba* and the fallen *A. erioloba.*

H_A- There is a significant difference in the biodiversity supported by the upright standing *A. erioloba* and the fallen *A. erioloba.*

1.2 Study area

The study was conducted in the southern part of the Namib Desert. The main study area was a 3.50 km^2 area in the dune valleys at the NaDEET centre coordinates 25.2269° S, 16.0613° E, on farm Die Duine within the Namib Rand Nature Reserve. The area is surrounded by inselbergs namely the Losberg and Horseshoe Mountain. Farm Die Duine is located in the dune belts between these mountains. Average temperatures range from -2 to 40 degree Celsius and the average rainfall is 120 mm per annum (M. Tindall, personal communication, 17 February 2017). Wind can pick up at any time during the day or at night. The flora is mainly arid adapted grasses such as *Cladoraphis spinosa* (Ostrich grass) that grows on the dunes and *Stipagrostis ciliata*, trees such as *A. erioloba and Boscia foetida* are the most abundant. Fauna in the area range from large mammals such as *Oryx gazelle* and Mountain zebra (*Equus zebra hartmannae)* to small mammals such as the Grant's Golden Mole *(Eremitalpa granti)* and Four-striped Grass Mouse (*Rhabdomys pumilio)*, insects are mainly Tenebrionid beetles that roam freely around with their different adaptation techniques.

Snakes and Reptiles such as the horned adder (*Bitis caudalis*) and Smith's desert lizard (*Meroles ctenodactylus*) were recorded; scorpions are also common in the area (Ehrenbold & Keding, 2015). Birds found in the area include the Namaqua sandgrouse (*Pterocles namaqua*), Sociable weavers (*Philetairus socius*), Ostrich (*Struthio camelus*) and the endemic Dune lark (*Calendulauda erythrochlamys*) (Wolvedans, 2017).

Figure 1: Arial photo of study area

2. **Methods and Materials**

In the area around NaDEET, on farm Die Duine, three dune valleys were selected with the assumption that the whole area is similar (figure 1). In these valleys, 6 Camel thorn trees that are standing upright and 6 fallen Camel thorn trees were selected (figure 1)(Appendix A). Each tree was assigned a code (F2 or S5) meaning Fallen 2 or Standing 5 and their GPS coordinates were taken down using a GPS to improve accuracy, and to determine the size of the study area that was 3.50 km^2. These sites were then inspected by identifying type and number of grasses around each site and any other interesting observations such as faeces/ and or bird nests were considered and recorded on the data-sheet.

All these Meta data sets were recorded onto the clipboard and then typed into the datasheet (Appendix A).

A week prior to the first traps the study sites were prepared for trapping, by clearing a 15 cm wide belt around the tree using a spade and this belt was 2 m away from the trunk (Appendix A); this belt was only cleared once. Setting of traps was done ones a week for two consecutive days (48 hours), and set just before sunset. Eight pitfall traps were set at each site as they can cover the entire trunk circumference with ease, these pitfall traps were spaced out evenly 1 m apart for standing trees and 1 m apart for the fallen trees, and placed within the belt area around each tree stem.

The traps were then checked two times per day on the following day, in the morning and in the late afternoons, to help find the maximum number of species found on each tree, plus to avoid killing the organisms if they are traped for too long. The weather condition was recorded before checking of traps and binoculars were used to identify the birds visiting the tree. Each time when a site was visited the first thing done was to identify the animal's tracks on the ground before they are trampled and do closer inspection of the trunk, branches and leaves to record what lives there. There after the pitfall traps are emptied with a sieve as there may be some animals buried under the sand found in the traps (E. Shikukumwa, personal communication, 9 February 2017). The species in the traps are identified and counted before recording it onto the clip-board; the traps are set again to capture the diurnal organisms.

Once all the data have been collected and recorded, it was summed up and analysed to find out about the species richness and abundance. The summarized data was used to create a food web and calculating the diversity index for each tree growth type. A t-test for independent samples was conducted to test for significance of the sampled means.

Species diversity occurs at different levels and is mostly used in monitoring ecological changes; it is often given in the form of an index. The Shannon–Wiener index is one of many diversity indices used and it is based on the concept of evenness between species richness and abundance (Fedor & Spellerberg, 2013). The Shannon-Wiener diversity index was used to determine if there is any significant difference in biodiversity between the fallen and standing tree.

This diversity index was calculated using:

–H'= | | {pilog (pi)}

Were (pi) is equal to

$$-pi = \frac{\text{number of individuals of a species}}{\text{total number of individuals}}$$

3. **Results**

A total of 2068 individual organisms were observed from 58 species. A proportion of 54.45% were collected from fallen trees, and 942 (45.55%) were collected from standing trees. Considerably there was higher species richness in fallen trees compared to standing trees, 5 species different (figure 4). The fallen trees also had higher species abundance (figure 5).

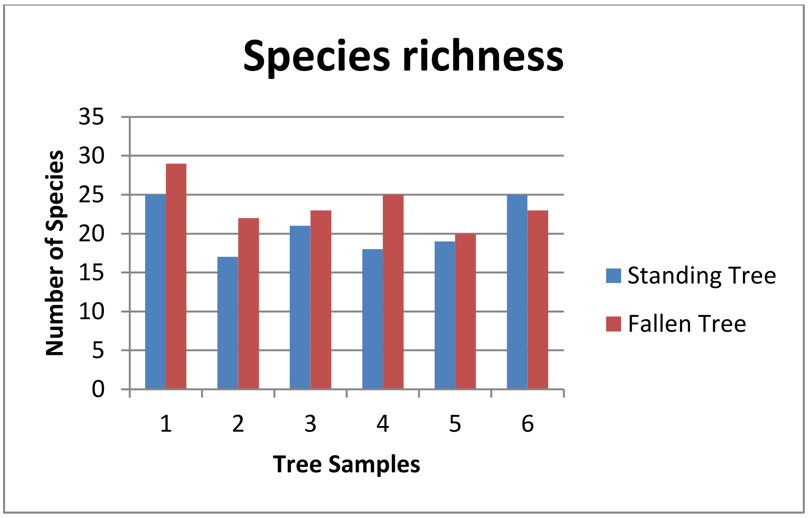

Figure 4: Species richness per tree pair.

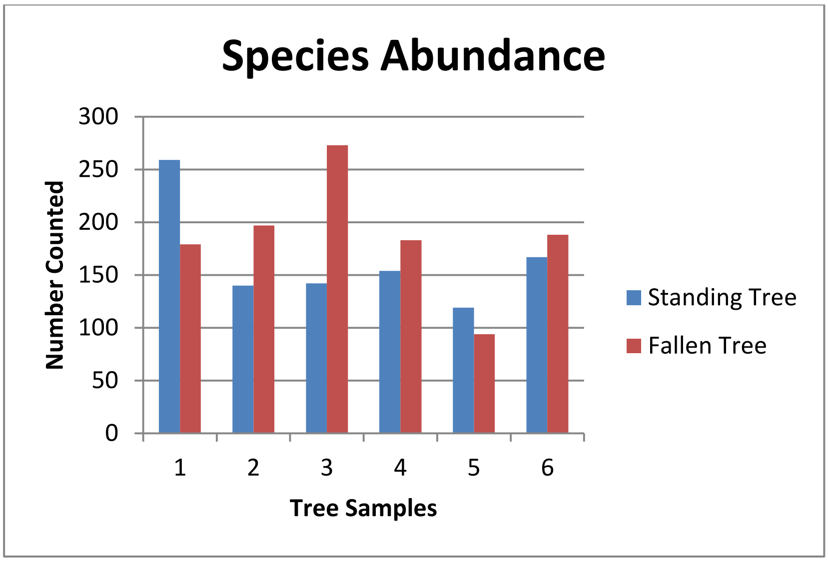

Figure 5: Species abundance per tree pair.

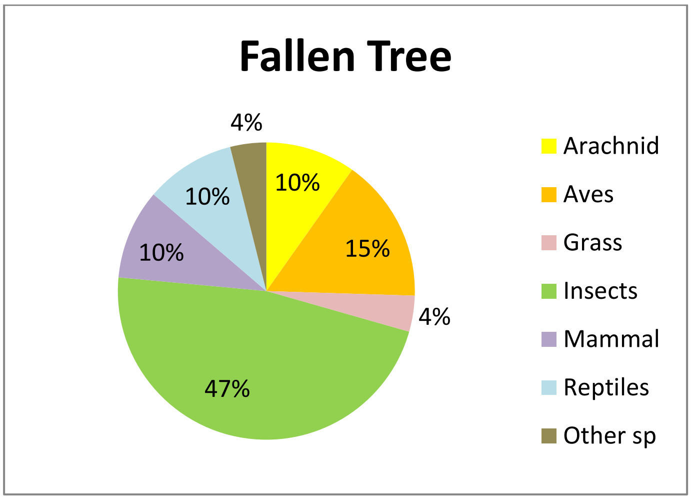

Figure 6: Percentage of species classes on fallen tree

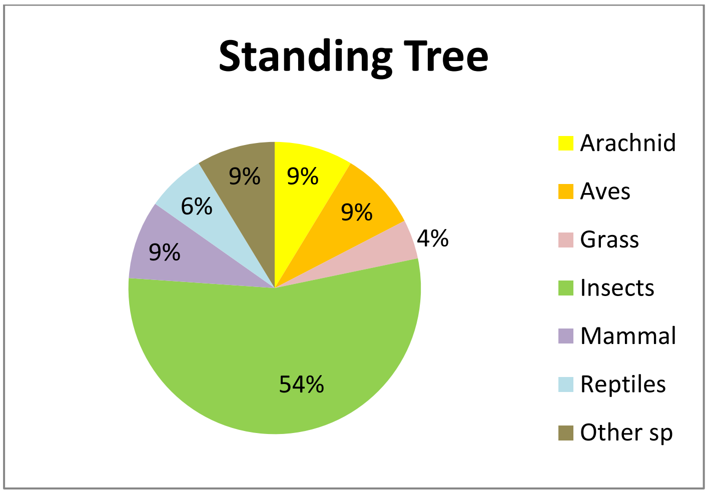

Figure 7: Percentage of species classes on standing tree

The pie chart indicates that insect made up 50% of the species captured for both fallen and standing trees (figure 6 & figure 7). On fallen trees 8 (15%) bird species were observed while arachnid, mammals and reptiles each made up 10% of species; grass made up 4%. Other species observed were Devil's thorn and Roundworm (figure 6). Birds, arachnids and mammals each made up 9%, on standing trees, reptiles 6%, grass made up 4%. Other species observed were Devil's thorn, Hermannia shrub, Tsamma melon and Termites sp (figure 7)

The fallen tree had a total species richness of 51, while the standing tree had a richness of 46 (Appendix B). Insects were the most abundant species in both standing and fallen trees, Sugar ants and Dawitsirab (Carpenter ant) and made up most of this abundance; both trees had the same grass species growing around them. Similar species of Reptiles, Birds and Arachnid were observed in both trees with significantly higher observations on the fallen trees (Appendix B). Arachnids such as the white-lady spiders were only found at the fallen trees and birds such as Vultures were only recorded in the standing tree. The Diversity index for the fallen trees was (H= 2.929023) and for the standing tree (H=2.812871) (Appendix C).

T-test

Group Statistics

	VAR00002	N	Mean	Std. Deviation	Std. Error Mean
VAR00001	Standing Tree	6	20.67	3.266	1.333
	Fallen Tree	6	23.67	3.077	1.256

Independent Sample Test

t-test for Equality of Means

					95% Confidence Interval of the Difference	
T	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
-1.638	10	.133	-3.000	1.832	-7.082	1.082
-1.638	9.965	.133	-3.000	1.832	-7.084	1.084

The results of the t-test show P= 0.133 is greater than alpha (0.05), therefore we retain the null hypothesis that there is no significant difference in biodiversity between the growth form.

4. **Discussion**

This study confirmed that there is difference in biodiversity found on the growth forms, from the results (figure 4) the fallen trees had more species richness compared to the standing trees; out of the 12 sites only S1 and S6 had higher species richness on them (25). F1 had 29 species recorded on it and this was slightly an outlier because all the other trees had 25 or less species recorded on them, this resulted from external factors of fallen 1. Grey-backed sparrow larks were recorded nesting in F1 and signs of a Cape cobra were observed by its molten skin. The snake may have been attracted to the bird nest. Standing 2 had the least number of species (17) this can also be explained by the external factors, since S2 was growing at a base of a dune limiting factors mentioned by Seely & Louwt (1989) such as water, nitrogen, phosphorus content and the stability of the soil could influence the tree; Dune soil is poor in nutrients (figure 4). The mean number of species for fallen trees was 23.67 while the mean for standing trees was 20.67 and this shows that the fallen trees had higher species richness than the standing trees. The fallen trees also had higher total species abundance which one would expect because of the high species richness. The average species abundance in relation to all species was 164 for standing trees and 187 for fallen trees (figure 5). Both graphs are showing the same outline that the fallen trees had more species richness and abundance than the standing trees (figure 4 & 5). The fallen tree consist of a dead section and a living section, the dead section is gradually decaying overtime due to microbial and decomposer activity, this opens up the dead bark and creates larger openings that provide habitats for more diversity such as a home for small mammals (Maser, 1984).The standing tree lacks this large opening and this explains why more than 50 % of its diversity was from class insects (*figure* 7). The fallen tree however also had 47% class insect and this is due to the desert environment being very rich in invertebrates. According to study conducted by

Masser (1984) wood-dependent insects such as termites and dawitsirab ants tunnel within fallen tree and devour the woody tissue.While most of the standing trees had exposed lateral roots, most of them died and were conceivably also being utilized by the termites and dawitsirab ant. This explains why the standing tree had higher abundance in dawitsirab ants (Appendix B). Oryx was the antelope mammal recorded during the study. At the standing trees it was observed that the Oryx visit the trees mainly for shade and sometimes trampled over the pitfall traps; however the Oryx that visited the fallen trees left signs of chewing off the small branches. These Oryx were also able to shake the trees branches and cause the pods to fall on the ground, they ate these pods. There was little observation of Oryx exploiting the fallen tree for its shade. These two behaviours of the Oryx indicate that the fallen tree was an easier food source than a standing tree. The fallen trees branches were closer to the ground and antelope spp could access them, unlike the for the standing trees branches that were higher up. More indication of this concept was that the ground covered by the standing trees crown was bare compared to fallen trees; this could be caused by large animals resting under them such as an Oryx. The ground surrounding the fallen tree had higher density of grass, this supports that Oryx mostly feed off these trees and not rest under this trees. During the study Cape Vultures were recorded on the standing trees, it was observed that they only land on the taller trees.

The higher grass density attracts diversity and creates more food webs. Some food-webs found during the study were: northern harvester termites feed on the roots <u>of</u> S. ciliata, golden mole feeds <u>off</u> the termites and the Southern pale-chanting goshawk feeds on the golden mole. Another was the Hairy-footed gerbil feed <u>of</u> the seed of the grasses, and the Cape fox feeds <u>of</u> the gerbils. This is just part of the food web created by the Camel thorn trees. The micro-habitats created by this trees are important to the Desert biome as organisms manipulate them for survival, The difference found in species richness between the growth form are due to the differences of these micro- habitats; The standing Camel thorn trees micro- habitats change frequently due to temperature change of the air around the trees, and therefore to not remain constant. However the fallen Camel thorn tree creates a stable habitat as the temperature around the tree fairly remains constant since it is closer to the ground (W. Adank, personal communication, 09 June 2017). More organisms will be found in the more constant environment. Despite all the difference in biodiversity found between the results the fallen and standing trees both trees actually play an equally important role in the ecosystem. This was found through the analysis of the data, the diversity index value for the fallen tree

H= 2.93 and for the standing tree H= 2.81 (Appendix B), both this values indicate that the area has good diversity and looking at both index values they are very similar. This tells us that the fallen and standing have trees that are related in diversity. The results from the t-test ascertain that the differences between the number of species found on standing and fallen trees are not significant enough to be different. Despite the statistics and growth forms these research shows the importance of Camel thorn trees to their ecosystem, the trees support high numbers of species and maintain biodiversity of the desert biome.

4.1Conclusion and Recommendations

The desert is harsh but yet full of life, the camel thorn interacts with almost all the species found in the area, on average a tree interacted with 22 species. For the desert ecosystem this is a very high number. The Camel thorn tree is truly a keystone species despite the growth from and the changes in conditions created around the tree. Wood harvesting in developing countries is still on the rise, the demand for fire wood is increasing. The camel thorn trees in the Namib Rand Nature Reserve are protected by the reserve but what about in other parts of the country. The fallen tree is more likely to be chopped up for wood than a standing tree because it is presumed to be dead and not important. The project however show us that the fallen tree has high biodiversity on it. This knowledge needs to be spread out there and NaDEET is no other better place to educate the participants and communities, so the message can be spread .This is all in effort to finally stop loss of biodiversity and deforestation worldwide.

4.2 Limitation

The availability of fallen trees in the area limited the research since I could not increase my fallen tree replicates. Another limit to my study was using signs and tracks as a method of data collection bring its own problems such as one could not tell how many individuals they were just by using tracks (indirect methods), or whether the animal all the animals recorded interacted with the trees or not.

5. Acknowledgment

I would like to acknowledge Victoria Keding, Director of NaDEET; Andreas Keding, Technical director of NaDEET; Murry Tindal, Control warden of Namib Rand Nature Reserve for helping me with literature, Elia Shikukumwa, my mentor, Mr Richard Kavari from NUST, my tutor, Mr Helmut Tjikurunda, from NUST, my tutor, Elizabeth Lammert, NaDEET homestead manger; Willem Swartbooi, Technical foreman for helping in the field and to identify tracks.

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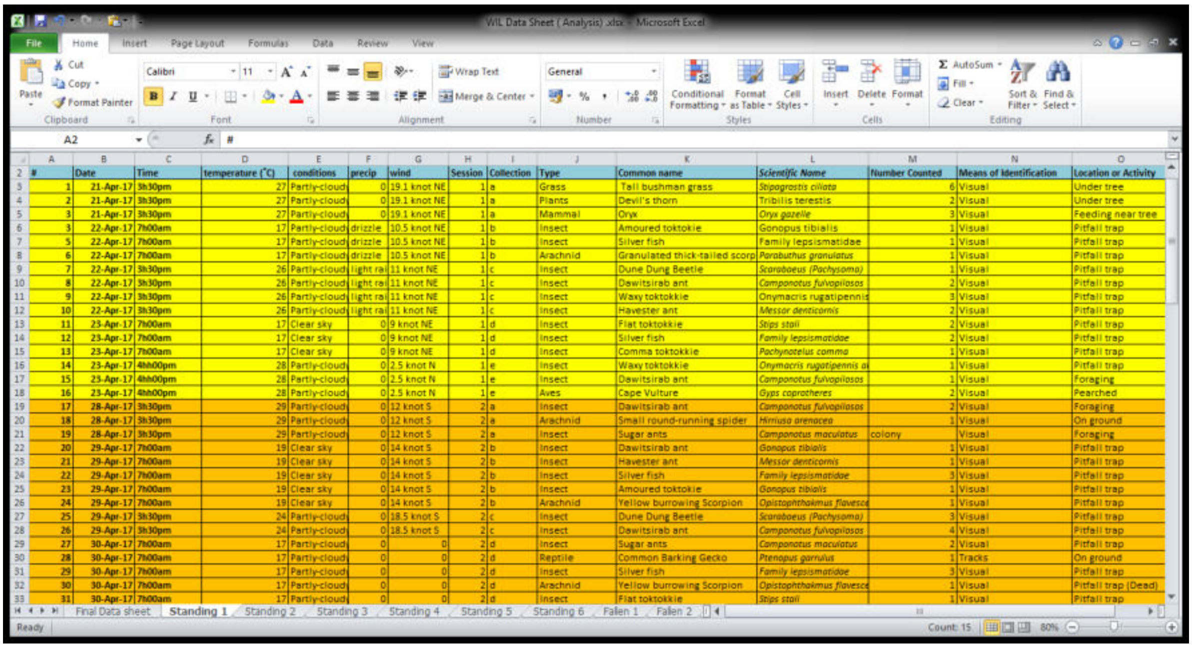
Appendix A

Figure 1: Picture showing a fallen Camel thorn tree

Figure 2: Picture showing a two meter belt around study side standing 2



#	Date	Time	temperature (˚C)	conditions	precip	wind	Session	Collection	Type	Common name	Scientific Name	Number Counted	Means of Identification	Location or Activity
1	21-Apr-17	3h30pm	27	Partly-cloud	0	19.1 knot NE	1	a	Grass	Tall bushman grass	*Stipagrostis ciliata*	6	Visual	Under tree
2	21-Apr-17	3h30pm	27	Partly-cloud	0	19.1 knot NE	1	a	Plants	Devil's thorn	Tribilis terestis	2	Visual	Under tree
3	21-Apr-17	3h30pm	27	Partly-cloud	0	19.1 knot NE	1	a	Mammal	Oryx	*Oryx gazelle*	3	Visual	Feeding near tree
3	22-Apr-17	7h00am	17	Partly-cloud	drizzle	10.5 knot NE	1	b	Insect	Amoured toktokie	Gonopus tibialis	1	Visual	Pitfall trap
5	22-Apr-17	7h00am	17	Partly-cloud	drizzle	10.5 knot NE	1	b	Insect	Silver fish	Family lepsismatidae	1	Visual	Pitfall trap
6	22-Apr-17	7h00am	17	Partly-cloud	drizzle	10.5 knot NE	1	b	Arachnid	Granulated thick-tailed scorp	*Parabuthus granulatus*	1	Visual	Pitfall trap
7	22-Apr-17	3h30pm	26	Partly-cloud	light rai	11 knot NE	1	c	Insect	Dune Dung Beetle	*Scarabaeus (Pachysoma)*	1	Visual	Pitfall trap
8	22-Apr-17	3h30pm	26	Partly-cloud	light rai	11 knot NE	1	c	Insect	Dawitsirab ant	*Camponotus fulvopilosos*	2	Visual	Pitfall trap
9	22-Apr-17	3h30pm	26	Partly-cloud	light rai	11 knot NE	1	c	Insect	Waxy toktokkie	Onymacris rugatipennis	3	Visual	Pitfall trap
10	22-Apr-17	3h30pm	26	Partly-cloud	light rai	11 knot NE	1	c	Insect	Havester ant	*Messor denticornis*	2	Visual	Pitfall trap
11	23-Apr-17	7h00am	17	Clear sky	0	9 knot NE	1	d	Insect	Flat toktokkie	*Stips stali*	2	Visual	Pitfall trap
12	23-Apr-17	7h00am	17	Clear sky	0	9 knot NE	1	d	Insect	Silver fish	*Family lepsismatidae*	2	Visual	Pitfall trap
13	23-Apr-17	7h00am	17	Clear sky	0	9 knot NE	1	d	Insect	Comma toktokkie	*Pachynotelus comma*	1	Visual	Pitfall trap
14	23-Apr-17	4hh00pm	28	Partly-cloud	0	2.5 knot N	1	e	Insect	Waxy toktokkie	*Onymacris rugatipennis a*	1	Visual	Pitfall trap
15	23-Apr-17	4hh00pm	28	Partly-cloud	0	2.5 knot N	1	e	Insect	Dawitsirab ant	*Camponotus fulvopilosos*	1	Visual	Foraging
16	23-Apr-17	4hh00pm	28	Partly-cloud	0	2.5 knot N	1	e	Aves	Cape Vulture	*Gyps coprotheres*	2	Visual	Pearched
17	28-Apr-17	3h30pm	29	Partly-cloud	0	12 knot S	2	a	Insect	Dawitsirab ant	*Camponotus fulvopilosos*	2	Visual	Foraging
18	28-Apr-17	3h30pm	29	Partly-cloud	0	12 knot S	2	a	Arachnid	Small round-running spider	*Hiriusa arenacea*	1	Visual	On ground
19	28-Apr-17	3h30pm	29	Partly-cloud	0	12 knot S	2	a	Insect	Sugar ants	*Camponotus maculatus*	colony	Visual	Foraging
20	29-Apr-17	7h00am	19	Clear sky	0	14 knot S	2	b	Insect	Dawitsirab ant	*Gonopus tibialis*	1	Visual	Pitfall trap
21	29-Apr-17	7h00am	19	Clear sky	0	14 knot S	2	b	Insect	Havester ant	*Messor denticornis*	1	Visual	Pitfall trap
22	29-Apr-17	7h00am	19	Clear sky	0	14 knot S	2	b	Insect	Silver fish	*Family lepsismatidae*	3	Visual	Pitfall trap
23	29-Apr-17	7h00am	19	Clear sky	0	14 knot S	2	b	Insect	Amoured toktokie	*Gonopus tibialis*	1	Visual	Pitfall trap
24	29-Apr-17	7h00am	19	Clear sky	0	14 knot S	2	b	Arachnid	Yellow burrowing Scorpion	*Opistophthalmus flavesce*	1	Visual	Pitfall trap
25	29-Apr-17	3h30pm	24	Partly-cloud	0	18.5 knot S	2	c	Insect	Dune Dung Beetle	*Scarabaeus (Pachysoma)*	3	Visual	Pitfall trap
26	29-Apr-17	3h30pm	24	Partly-cloud	0	18.5 knot S	2	c	Insect	Dawitsirab ant	*Camponotus fulvopilosos*	4	Visual	Pitfall trap
27	30-Apr-17	7h00am	17	Partly-cloud	0	0	2	d	Insect	Sugar ants	*Camponotus maculatus*	2	Visual	Pitfall trap
28	30-Apr-17	7h00am	17	Partly-cloud	0	0	2	d	Reptile	Common Barking Gecko	*Ptenopus garrulus*	1	Tracks	On ground
29	30-Apr-17	7h00am	17	Partly-cloud	0	0	2	d	Insect	Silver fish	*Family lepsismatidae*	3	Visual	Pitfall trap
30	30-Apr-17	7h00am	17	Partly-cloud	0	0	2	d	Arachnid	Yellow burrowing Scorpion	*Opistophthalmus flavesce*	1	Visual	Pitfall trap (Dead)
31	30-Apr-17	7h00am	17	Partly-cloud	0	0	2	d	Insect	Flat toktokkie	*Stips stali*	1	Visual	Pitfall trap

Figure 3: Screenshot of Data Sheet

Appendix B

Table 1: Abundance (number of individuals trapped) among the two growth forms and the Shannon diversity index score. (Yellow = arachnid, Orange = aves, Pink = grass, Green = Insects, Purple = mammal, Brown = other sp, Blue = reptiles).

Fallen	
Small round-running spider	15
White lady spider	7
Yellow burrowing Scorpion	4
Granulated thick-tailed scorpion	1
Sun spider	1
Cardinal Woodpecker	1
Dune lark	2
Grey-backed Sparrow Lark	9
Scaly feathered finch	5
Sociable weavers	17
Southern Pale Chanting Goshawk	3
Tractrac chat	5
Yellow canary	1
Gha grass	19
Tall bushman grass	108
Armoured toktokkie	105
Blotched long-horned Antlion	38
Brush jewel beetle	2
Burrowing Ground Beetle	1
Comma toktokkie	2
Dawitsirab ant	116

Standing	
Granulated thick-tailed scorpion	2
Small round-running spider	16
Sun spider	1
Yellow burrowing Scorpion	10
Cape Vulture	2
Southern Pale Chanting Goshawk	2
Sociable weavers	28
Scaly feathered finch	3
Gha grass	9
Tall bushman grass	57
Armoured toktokkie	37
Blotched long-horned Antlion	72
Brush jewel beetle	1
Comma toktokkie	8
Dawitsirab ant	148
Dune Cricket	2
Dune Dung Beetle	28
Flat toktokkie	21
Orange flightless wasp	1
Fly	1
Harvester ant	14

Dune Dung Beetle	55
Flat toktokkie	96
Harvester ant	8
Miniature dung chafers	14
Moth	2
Mouldy toktokkie	6
Namib Dune ant	2
Nara cricket	10
Orange flightless wasp	2
Racing striped toktokkie	5
Red-banded Blister Beetle	1
Woolyshaffer	2
Side striped toktokkie	11
Silverfish	96
Sugar ants	153
Tree Locust	6
Vinegar Beetle	1
Waxy toktokkie	95
Common genet	4
Oryx	27
Cape fox	2
Cape Hare	1
Hairy-footed gerbil	4
Devil's thorn	8
Wedge snout-lizard	1
Cape cobra	1
Namib Sand Snake	1
Western Three-striped skink	7
Kalahari tree skink	41
Roundworm	2
Total	**1126**

Lunate Ladybird	1
Miniature dung chafers	2
Mouldy toktokkie	10
Namib dune ant	3
Racing striped tokktokie	1
Red-banded blister beetle	1
Side striped toktokkie	28
Silverfish	95
Sugar ants	170
Waxy toktokkie	30
Tree Locust	1
Vinegar Beetle	1
Waxy toktokkie	53
Yellow and Black stripes	1
Cape Hare	1
Cape Porcupine	2
Genet	1
Oryx	24
Devil's thorn	2
Hermannia	1
Tsamma melon	1
Wedge snout-lizard	1
Common Barking Gecko	2
Kalahari tree skink	44
Northern Harvester termite	3
Total	**942**

Appendix C

Table showing how the Shannon Wiener-Index was calculated.

Fallen		n/N	pi	lnpi	pi ln pi
Small round-running spider	15	0.013321	0.013321492	-4.31838	-0.05753
White lady spider	7	0.006217	0.006216696	-5.08052	-0.03158
Yellow burrowing Scorpion	4	0.003552	0.003552398	-5.64013	-0.02004
Granulated thick-tailed scorp	1	0.000888	0.000888099	-7.02643	-0.00624
Sun spider	1	0.000888	0.000888099	-7.02643	-0.00624
Cardinal Woodpecker	1	0.000888	0.000888099	-7.02643	-0.00624
Dune lark	2	0.001776	0.001776199	-6.33328	-0.01125
Grey-backed Sparrow Lark	9	0.007993	0.007992895	-4.8292	-0.0386
Scaly fearthered finch	5	0.00444	0.004440497	-5.41699	-0.02405
Sociable weavers	17	0.015098	0.015097691	-4.19321	-0.06331
Southern Pale Chanting Gosh	3	0.002664	0.002664298	-5.92781	-0.01579
Tractrac chat	5	0.00444	0.004440497	-5.41699	-0.02405
Yellow canary	1	0.000888	0.000888099	-7.02643	-0.00624
Gha grass	19	0.016874	0.016873890	-4.08199	-0.06888
Tall bushman grass	108	0.095915	0.095914742	-2.3443	-0.22485
Amoured toktokkie	105	0.09325	0.093250444	-2.37247	-0.22123
Blotched long-horned Antlio	38	0.033748	0.033747780	-3.38884	-0.11437
Brush jewel beetle	2	0.001776	0.001776199	-6.33328	-0.01125
Burrowing Ground Beetle	1	0.000888	0.000888099	-7.02643	-0.00624
Comma toktokkie	2	0.001776	0.001776199	-6.33328	-0.01125
Dawitsirab ant	116	0.10302	0.103019538	-2.27284	-0.23415
Dune Dung Beetle	55	0.048845	0.048845471	-3.01909	-0.14747
Flat toktokkie	96	0.085258	0.085257549	-2.46208	-0.20991
Havester ant	8	0.007105	0.007104796	-4.94699	-0.03515
Miniature dung chafers	14	0.012433	0.012433393	-4.38737	-0.05455
Moth	2	0.001776	0.001776199	-6.33328	-0.01125
Mouldy toktokkie	6	0.005329	0.005328597	-5.23467	-0.02789
Namib Dune ant	2	0.001776	0.001776199	-6.33328	-0.01125
Nara cricket	10	0.008881	0.008880995	-4.72384	-0.04195
Orange flightless wasp	2	0.001776	0.001776199	-6.33328	-0.01125
Racing striped toktokie	5	0.00444	0.004440497	-5.41699	-0.02405
Red-banded Blister Beetle	1	0.000888	0.000888099	-7.02643	-0.00624
Wooly shaffer	2	0.001776	0.001776199	-6.33328	-0.01125
Side striped toktokkie	11	0.009769	0.009769094	-4.62853	-0.04522
Silverfish	96	0.085258	0.085257549	-2.46208	-0.20991
Sugar ants	153	0.135879	0.135879218	-1.99599	-0.27121
Tree Locust	6	0.005329	0.005328597	-5.23467	-0.02789
Vinegar Beetle	1	0.000888	0.000888099	-7.02643	-0.00624
Waxy toktokkie	95	0.084369	0.084369449	-2.47255	-0.20861
Genet	4	0.003552	0.003552398	-5.64013	-0.02004
Oryx	27	0.023979	0.023978686	-3.73059	-0.08945
Cape fox	2	0.001776	0.001776199	-6.33328	-0.01125
Cape Hare	1	0.000888	0.000888099	-7.02643	-0.00624
Hairy-footed gerbil	4	0.003552	0.003552398	-5.64013	-0.02004
Devil's thorn	8	0.007105	0.007104796	-4.94699	-0.03515
Wedge snout-lizard	1	0.000888	0.000888099	-7.02643	-0.00624
Cape cobra	1	0.000888	0.000888099	-7.02643	-0.00624
Namib Sand Snake	1	0.000888	0.000888099	-7.02643	-0.00624
Western Three-striped skink	7	0.006217	0.006216696	-5.08052	-0.03158
Kalahari tree skink	41	0.036412	0.036412078	-3.31285	-0.12063
Roundworm	2	0.001776	0.001776199	-6.33328	-0.01125
					-2.92902
Total	1126			H=	**2.929023**

Standing		n/N	pi	lnpi	pi ln pi
Granulated thick-tailed s	2	0.002123	0.002123142	-6.15486	-0.01307
Small round-running spid	16	0.016985	0.016985138	-4.07542	-0.06922
Sun spider	1	0.001062	0.001061571	-6.84801	-0.00727
Yellow burrowing Scorpi	10	0.010616	0.010615711	-4.54542	-0.04825
Cape Vulture	2	0.002123	0.002123142	-6.15486	-0.01307
Southern Pale Chanting (	2	0.002123	0.002123142	-6.15486	-0.01307
Sociable weavers	28	0.029724	0.029723992	-3.5158	-0.1045
Scaly fearthered finch	3	0.003185	0.003184713	-5.74939	-0.01831
Gha grass	9	0.009554	0.009554140	-4.65078	-0.04443
Tall bushman grass	57	0.06051	0.060509554	-2.80495	-0.16973
Amoured toktokkie	37	0.039278	0.039278132	-3.23709	-0.12715
Blotched long-horned Ar	72	0.076433	0.076433121	-2.57134	-0.19654
Brush jewel beetle	1	0.001062	0.001061571	-6.84801	-0.00727
Comma toktokkie	8	0.008493	0.008492569	-4.76856	-0.0405
Dawitsirab ant	148	0.157113	0.157112527	-1.85079	-0.29078
Dune Cricket	2	0.002123	0.002123142	-6.15486	-0.01307
Dune Dung Beetle	28	0.029724	0.029723992	-3.5158	-0.1045
Flat toktokkie	21	0.022293	0.022292994	-3.80348	-0.08479
Orangeflightless wasp	1	0.001062	0.001061571	-6.84801	-0.00727
Fly	1	0.001062	0.001061571	-6.84801	-0.00727
Havester ant	14	0.014862	0.014861996	-4.20895	-0.06255
Lunate Ladybird	1	0.001062	0.001061571	-6.84801	-0.00727
Miniature dung chafers	2	0.002123	0.002123142	-6.15486	-0.01307
Mouldy toktokkie	10	0.010616	0.010615711	-4.54542	-0.04825
Namib dune ant	3	0.003185	0.003184713	-5.74939	-0.01831
Racing striped toktokie	1	0.001062	0.001061571	-6.84801	-0.00727
Red-banded Blister Beet	1	0.001062	0.001061571	-6.84801	-0.00727
Side striped toktokkie	28	0.029724	0.029723992	-3.5158	-0.1045
Silverfish	95	0.100849	0.100849257	-2.29413	-0.23136
Sugar ants	170	0.180467	0.180467091	-1.71221	-0.309
Waxy toktokkie	30	0.031847	0.031847134	-3.44681	-0.10977
Tree Locust	1	0.001062	0.001061571	-6.84801	-0.00727
Vinegar Beetle	1	0.001062	0.001061571	-6.84801	-0.00727
Waxy toktokkie	53	0.056263	0.056263270	-2.87771	-0.16191
Yellow and Black stripes	1	0.001062	0.001061571	-6.84801	-0.00727
Cape Hare	1	0.001062	0.001061571	-6.84801	-0.00727
Cape Porcupine	2	0.002123	0.002123142	-6.15486	-0.01307
Genet	1	0.001062	0.001061571	-6.84801	-0.00727
Oryx	24	0.025478	0.025477707	-3.66995	-0.0935
Devil's thorn	2	0.002123	0.002123142	-6.15486	-0.01307
Hermannia	1	0.001062	0.001061571	-6.84801	-0.00727
Tsamma melon	1	0.001062	0.001061571	-6.84801	-0.00727
Wedge snout-lizard	1	0.001062	0.001061571	-6.84801	-0.00727
Common Barking Gecko	2	0.002123	0.002123142	-6.15486	-0.01307
Kalahari tree skink	44	0.046709	0.046709130	-3.06382	-0.14311
Northern Harvester term	3	0.003185	0.003184713	-5.74939	-0.01831
					-2.81287
Total	**942**			H =	**2.812871**