The detrimental effects of anthropogenic waste on the chacma baboons *(Papio ursinus)*, and potential human-baboon interactions in the Alldays area South Africa

A REVIEW OF A PILOT STUDY FOR LONG-TERM RESEARCH TO PROTECT THE SURROUNDING WILDLIFE AND THE DECREASE OF HUMAN-WILDLIFE CONFLICTS

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AWCRC
Alldays Wildlife and Communities Research Centre

PRIMATE & PREDATOR PROJECT

University of Applied Sciences

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A REVIEW OF A PILOT STUDY FOR LONG-TERM RESEARCH TO PROTECTING THE SURROUNDING WILDLIFE AND THE DECREASE OF HUMAN-WILDLIFE CONFLICTS

An undergraduate thesis for the degree
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Abstract

While the consumption of plastic by marine wildlife is well-studied, it is less so for terrestrial species. Anthropogenic pollution is an ever-increasing threat to the natural environment, and this is also the case in South Africa.

This research was conducted on 17th February; 20th March 2020 in the Alldays area, Limpopo province, South Africa. This research focusses on three different aspects; impact on society, ecology and ethology. This study aims to gain a greater understanding of the current situation of anthropogenic waste in the surrounding, and what effects these anthropogenic wastes have on the baboons around the Alldays dumpsite.

To gather all the information that was needed, two major methods have been used; line transects and behavioural research. A total of 129 line-transects were conducted around the dumpsite, each with a length of 30 meters into the environment. The line transects were divided in three interval groups (0-10m & 10-20m & 20-30m) to assess the spatial distribution of waste and to investigate the vegetation types. The 129 transects were two lots of 65 transects, conducted 24th February & 19th March. Besides, examine the current situation of anthropogenic wastes, a habituated group of 23 baboons were followed for a total of 13 days, consisting of 91,33 observations hours.

Overall, the results showed a number of 9.472 anthropogenic waste items found in the environment. Most of these items were recyclable. Densities of waste were calculated and resulted in 58,9 items/m^2 in the first interval, 8,25 items/m^2 in the second interval and 5,9 items/m^2 in the third interval. Anthropogenic wastes were found mostly in grasslands, with also a further spreading of waste into the environment. Denser vegetation consisted of significantly less amount of anthropogenic wastes. The dumpsite is located approximately 500 meters away from the community. However, the baboon sleeping site is located next to the community. It resulted in baboons are being used to live in surroundings in a human-modified environment. Baboons were present daily at the dumpsite for 00:57h per day. Data is collected on their food behaviour and resulted in a total of 97 human-derived food items, consumed inside the dump, and 577 natural food items in their natural environment. Human-derived foods constituted 15% of the total diet. Behavioural data is also used to determine their daily routine. The three most prominent groups in duration resulted in grooming, feeding and the category others (mating, resting and sleeping). A pattern of aggression did not differ between both environments. In comparison, feeding, foraging and grooming differ in percentages between the two environments. Feeding and foraging is done the most in the dump in the period 09:00h till 12:00h, while grooming is done the most in their natural habitat in the period 15:00h till 18:00h. Grooming is mostly done by adult females in the group. This indicates a strong social bond within the group. In the end, baboons are used to humans as they are often seen close to the houses, looking for anthropogenic waste.

In conclusion, Anthropogenic wastes outside the main dumpsite were not causing potential risks towards the baboons. On the other hand, anthropogenic food wastes in the main dump itself are affecting and attracting the surrounding wildlife and the baboons. In foraging food waste, animals are at risk of consuming plastic and other non-digestible waste. Anthropogenic wastes are far too high in caloric, fat and carbohydrates. It results in unhealthy food and unhealthy baboons. In addition to changes in dietary preferences, the distribution and quantity of food waste are likely to influence the behaviour and habitat use. Their home-range is very limited, and overlapping niches were causing an increased- negative-human-baboon interaction. Human-baboon interactions facilitate the spread of disease and pathogens due to the availability of anthropogenic (organic) waste.

To apply these findings, it is recommended to start an education programme in the local community about proper waste disposal. Creating awareness and management strategies to decline the availability of organic food wastes could lead to a decrease in human-wildlife conflicts between baboons and the community.

Keywords: Human-wildlife conflicts, Human-baboon conflict, Chacma Baboons, Anthropogenic waste, dumpsite, Home range, Alldays area

Abbreviations

AWCRC	Alldays Wildlife and Communities Research Centre
HWC	Human-wildlife conflict
MMBM	Multilevel multinomial behaviour model
PPP	Primate and Predator Project
SDB	Self-detected behaviours

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1 Introduction

South Africa is known as one of the most diverse and exciting countries in the world. It has immensely varied terrain, supporting a rich diversity of animals and plant-life, and offers an incomparable range of experiences (SA-Venues, 2020). Unfortunately, South Africa is under a significant threat. Anthropogenic pollution is a global and ever-increasing threat to the natural environment. It is estimated that 60%, from a total of 8.3 billion tons of plastic per year, ends up in either a landfill or the natural environment (UN environment Programme, 2019).

Not only plastics have a detrimental effect on the environment. Every year, 1.3 billion tonnes of food is produced for human consumption, from which a third is either lost or wasted (Newsome, 2017). The availability of food waste to wildlife can have dramatic effects on ecological communities and humans (Newsome, 2017). The loss of preferred habitat, coupled with expanding numbers of humans and a preference for high caloric food items, results in wildlife entering residential areas daily. Raccoons, wild opossums, bears, monkeys, rats and seagulls are the most common animals which are attracted to human waste (Gaines, 2018). The conflict between humans and wildlife on the urban edge is a global phenomenon and baboons are one of the most challenging animals for people to share space with. In South Africa, problems with baboons started when people started to build houses and created agricultural land for growing crops (iCWild, 2020). A combination of factors, including overlapping habitat and baboon predisposition to utilize and adapt to a variety of circumstances, contributes to why humans clash with baboons (DeSilva, 2016).

In southern Africa, there are two main baboon species; the chacma baboon *(Papio ursinus)* of southern Africa and the Yellow baboon (*Papio cynocephalus)* of East Africa. These baboons are often present at dumpsites and are known to raid dustbins (garbage containers), enter homes and attack humans in an effort to secure human-derived food (Drewe, 2012). This is also the case in the Alldays area with the chacma baboon. Alldays is located in Limpopo province, northeast in South Africa and is famous for its remarkable floral diversity and endemic species. A local and open dumpsite is located near the township of Alldays. The dumpsite attracts surrounding wildlife, including baboons. Baboons have learned to associate humans with food, and by foraging on human-derived foods they are able to spend much less time foraging to obtain the nutrition they require (Tenikwa, 2018).

This study is designed to investigate current human-baboon interactions around the Alldays dumpsite, using behavioural observation techniques and environmental measurements. This research will give an insight into the life of a single, habituated group of baboons which is attracted to the dump. An insight into the unnatural and natural behaviour of these baboons will give a clear view of the attractiveness of the dumpsite and the current situation of human-baboon interactions. To determine what implications primate conservation has for people, particularly those living in rural primate-range countries, the ecological, economic, scientific, and moral values of primates must be considered (Hill C. M., 2002).

The setup of this report starts with an overview of the problem analysis, including the objectives and aims of this study. The main question and a set of sub-questions are then formulated. The subsequent chapter describes two of the main definitions of this study, leading to stakeholder involvement. This is followed by the methodology, results, discussion and conclusion. Eventually, the recommendation chapter will discuss the following aspect: ''how to reduce negative human-baboon interactions'.

2 Problem analysis

Plastic and anthropogenic wastes have several impacts on the health of ecosystems and humans (European Commission, 2011). While South Africa accounts for less than 0.5% of global plastics production; this still amounts to 1.5 million tonnes of plastics consumed in South Africa annually (Plastics SA, 2019). Disposing of such an amount of solid waste can fill an entire football field 10 meters deep, every day (Award, 2019). Added to this, 1.3 billion tonnes of food are produced annually for human consumption, a third of which is lost or wasted into the environment (Newsome, 2017). A third of the South African population does not have access to regular waste removal services; so, this waste often ends up in open dumpsites (SAPRO, 2019). Open dumpsites are the preferred method of disposing of waste in these areas, which cannot be fully contained and as a result often spread into the surrounding environment. This makes it at risk of leakage and transport trough the natural environment by wind (Ritchie, 2018). The lightweight nature of plastic material means that, in terrestrial systems, particles are more easily transported by wind and weather events further into the environment (Windsor, 2019). This results in areas with lower terrain elevations and open structure, being more affected by landfill sites.

A typical open dumpsite consists of waste from many sources, many waste types e.g. hazardous waste and solid waste, and many compositions. Such variation depends mainly on the lifestyle, economic situation, waste management regulations and industrial structure of the surrounding human populations. (ISWA, 2015-2016). Open dumpsites are neither hygienic nor safe. They increase diseases, health effects such as birth defects, cancer and respiratory illnesses have been linked to exposure to landfill sites (Lisk, 1991). However, African countries have very little choice but to hang on to this method. Local governments think that uncontrolled waste disposal in open dumpsites is the best option, because of financial and institutional constraint (Remigios, 2010).

Human encroachment on natural habitat has resulted in worldwide resource competition, between people and wildlife. Competition over food and space is a primary driver of human–wildlife conflict (Kaplan, 2011). Conflicts between humans and wildlife is one of the most widespread issues, facing conservation biologists today (Dickman, 2010). While humans and wildlife have a long history of coexistence, the changing needs of humans have endangered their ability to live alongside wildlife (Findlay, 2016). In Africa, increasing human encroachment on previously wild and uninhabited areas has led to these conflicts, becoming more frequent (Lamarque, 2009). Where a species has a large niche overlap with humans, this conflict can be frequent, as is often found with conflicts involving nonhuman primates, hereafter referred to as primates (Kaplan, 2011).

Primates that live in human-influenced habitats face many ecological constraints including restricted home ranges, reduced food availability and increased inter and intra species competition. To overcome these constraints many primates, display remarkable dietary flexibility in response to habitat variation and seasonally fluctuating food resources, including the capability to incorporate human-derived foods into their diet. They also have become habituated to living in close contact with humans (Rahman, 2020). This is particularly relevant with baboons. South Africans have a love-hate relationship with chacma baboons. The people of southern Africa associate these infamous primates with home, even though they are seen as pests (Stone, 2016). From kitchens to fields, baboons are enemy number one for many local communities. Stealing crops and sugar, they are notoriously challenging to repel and frequently known to show highly aggressive behaviour (Migné, 2017). In South Africa, human–baboon conflict levels remain high despite substantial investment by conservation authorities in a variety of mitigation measures (Hoffman, 2012).

Baboons are often found at open dumpsites, which have negative effects on these animals. Research shows that baboons with access to human food show signs of tooth decay, become overweight and have increased cholesterol (Living with baboons, 2019). Ingesting plastic also causes harm to wildlife, the level of harm dependent on their digestive system and the amount and type of plastic ingested. One major effect is reduced appetite, as ingested plastic causes the stomach to feel full, which can then lead to starvation (European Commission, 2011). Baboons can also pick up human diseases and parasites through contact with waste, such as zoonoses (from baboons to humans) and tuberculosis (Drewe, 2012). They are also possible carriers of diseases and parasites which can be transmitted to humans (Living with baboons, 2019). Several issues continue to be challenges for effective waste management. These include ineffective data collection systems and lack of compliance and enforcement capacity, lack of education and awareness amongst stakeholders within the waste sector (Environmental affairs, 2019).

2.1 Aim and objectives of the research

This research focusses on three different aspects; impact on society, ecology and ethology. The aim is to gain a greater understanding of the current situation of anthropogenic wastes in and around the dumpsite, and what effects these anthropogenic wastes has, on the baboons around the Alldays dumpsite and possible negative human-baboon interactions.

The problem:
Current human waste disposal methods result in a spatial distribution of anthropogenic waste outside the dump, into the environment. The availability and amount of anthropogenic organic waste attract and negatively affects surrounding wildlife, particularly chacma baboons. This could lead to increased risks of negative human-baboon interactions in and around the community.

The objectives of this research are:

I. To assess the spatial distribution of anthropogenic wastes outside the dumpsite and assess if the natural surrounding affects the further spreading into the environment;
II. To get a better overview of to what extent baboons are making use of the dumpsite and how they influence the spatial distribution of anthropogenic wastes;
III. To use this information to make recommendations for further research on how to deter chacma baboons from the Alldays dumpsite, in order to decrease negative human-baboon interactions within the community.

2.2 Research question

The setup of this thesis can roughly be divided into two parts. First, the current situation towards anthropogenic wastes are examined. Secondly, the behaviour of the baboons in response to these anthropogenic wastes are researched by looking at the following research questions.

The main research question:
The main question of this research is: ***'How is anthropogenic waste, in and around the dumpsite, affecting the baboons and the potential human-baboon interactions in Alldays, South Africa?***

This can be answered by looking at the following sub-questions:

1. **To what extent does anthropogenic waste occur in the natural environment and its spatial distribution in relation to the baboons?**
   A. What kind of anthropogenic waste is mostly found in the environment?
   B. Is there a relationship between abundance of waste and distance to the main dump?
   C. Do vegetation structures affect the total amount of wastes outside the main dump?

D. To what extent are baboons contributing to the spatial distribution of anthropogenic waste into the environment?

2. **To what extent is unnatural behaviour present in the chacma baboons in and around the dumpsite, and can this lead to unnatural group behaviour and interaction with people?**
   E. How and where do the group of baboons access the dumpsite?
   F. How much time do the group of baboons spend at the dumpsite?
   G. What kind of unnatural food do the baboons consume at the dumpsite, compared with their natural food behaviour?
   H. Is there a difference in behaviour of the baboons in the dump compared with their natural behaviour outside the dump?
   I. How do baboons react to the presence of humans in their home range?

2.3 Hypothesis

The overall hypothesis of this research is described and divided over the two sub-questions of this research. To examine what could be realistic causes, some hypothesises are made. This hypothesis will be tested in Chapter 6.

The first sub-question is as follows: *"To what extent does anthropogenic waste occur in the natural environment and its spatial distribution in relation to the baboons?*

1. It is mostly plastic wastes, which will be found outside the main dump, in the surrounding environment;
2. Baboons do influence the spatial distribution of anthropogenic wastes by taking waste from the dump into the environment;
3. Vegetation structure affects the amount of waste. Which will result in open vegetation structures leading to a higher amount of anthropogenic waste and further spreading into the environment;
4. Areas in a surrounding of ten meters around the dump, will consist more wastes in numbers, in contrast to areas further than ten meters away from the dump.

The second sub-question is as follows: *'To what extend is unnatural behaviour present in the Chacma baboons in and around the dumpsite, and can this lead to unnatural group behaviour and interaction with people?"*

1. Access to human-derived foods increases diet variety of baboons;
2. Aggression is more presented in the dumpsite due to higher densities relative to each other and closer interaction with humans;
3. Foraging behaviour will decrease in time and differ in location;
4. The availability of extra (food) sources is causing a decrease in home range size;
5. Human-baboon interaction will increase due to overlapping niches due to the habituation of humans.

Overall hypothesis: The availability and level of anthropogenic wastes in and around the dumpsite, impacts and change the behaviour of the baboons, and will increase the potential negative human-baboon conflicts, in and around the community.

3 Background information

This chapter elaborates on several subjects concerning this research. These subjects are explained to give a better understanding and in-depth information of this research.

3.1 Anthropogenic waste in rural areas

Waste management in rural areas has become a major challenge for governments of developing countries (Han, 2018). Techniques used in more developed countries are not always applicable to developing countries, due to social, economic and cultural differences (Greben, 2009). Most rural and semi-urban areas in South Africa face challenges when it comes to implementing waste management and recycling strategies (The Peace Foundation, 2020).
The South African Department of Water Affairs and Forestry report that only 10% of landfills in South Africa are managed in accordance with the prescribed minimum requirements (Greben, 2009). The challenges that occur in rural villages are: (The Peace Foundation, 2020):

- Too much waste generated to sustain recycling initiatives
- A lack of accessible markets for rural areas to sell their waste
- Poor municipal service delivery leading to waste not being collected
- A lack of commercially viable and environmentally sustainable recycling projects to address environmental problems
- Pollution through waste burning, dumping and litter

Poorly managed domestic waste, including the lack of sanitation services, and inadequate waste management facilities has resulted in serious problems. Environmental pollution and landscape damage have a negative influence on local people's health (Han, 2018).

3.2 Agricultural land and the presence of wildlife

Agricultural land covers 79.83% of the country (Trading Economics, 2020) and is mostly owned by rural households. Rural households often face difficult trade-offs in decision-making about natural resources, as they seek to balance the conflicting demands of managing the surrounding environment with the economic survival of the family. Anthropogenic waste and agricultural lands attract a variety of wildlife. While some wildlife populations benefit from intensive agriculture, others are often reduced or eliminated (Hurst, 2014). Species like mongooses, rats, vervet monkeys, genets, foxes, aardwolves and baboons are often present in rural communities and agricultural landscapes (Seoraj-Pillai, 2016). The presence of these animals in human areas leads to human-wildlife interactions, which can often be negative for both people and wildlife. The presence of these animals, and overlapping habitat causes potential human-wildlife interactions.

3.3 Main study species

Chacma baboons *(Papio ursinus)* range all over southern Africa. Chacma baboons are the largest members of the old world monkey family *(Cercopithecidae)* and are a highly social species that live in groups of four to 200 individuals (South African National Biodiversity Institute, 2019). The baboons live in social groups in which affiliative bonds exist between individuals. These bonds need to be maintained through social interactions (grooming in most primates), sociality will be limited by time constraints. It has previously been shown that the time primates invest in grooming increases with group size (Lehmann, 2007). A number of different functions of grooming in social interactions have been proposed, including building and maintaining social bonds and group cohesion, reducing tension, and restoring relationships after aggressive encounters. (Barton, 1985) Within the group, adult males form a dominance hierarchy that is established by fighting and aggression, **see figure 1** (South African National Biodiversity Institute, 2019). Recent studies of specific subpopulations indicate that, despite their wide distribution because of their dietary and behavioural flexibility, chacma baboons use the landscape selectivity (Hoffman, 2016). Reported home range sizes vary from 1.5–37.7 km2, with these extreme values coming from a single subpopulation in the Cape Peninsula (Hoffman, 2012). Home range densities vary from 0.95 baboons/km^2 (Henzi, 1991) to 16.8 baboons/km^2 (Cheney, 2004). Reflecting their wide ecological range, they are omnivores with generalist diets (Hoffman, 2016). Their diet is dominated by fruits and leaves, while flowers (Lamarque, 2009) and animal parts constitute a much smaller proportion of the diet (Hoffman, 2016). The species is not threatened and is listed as least concern. The increasing overlap between baboon home ranges and human settlements has resulted in conflict (South African National Biodiversity Institute, 2019). This often results in baboons being killed, both legally as damage-causing animals, and illegally, by indiscriminate trapping and poisoning (Hoffman, 2016).

Figure 1. Dominant male yawning, (Bolwing, 1995)

3.3.1 Habituating baboons, process and techniques

The baboon troop followed for this research is a habituated group of 23 individuals. This group has been followed for approximately 6 months for other behavioural studies. For this research, habituation is very important. Habituation enables the observer to approach closely, allowing them to become familiar with individuals, and to observe fine level behaviours. Frequent contact with the same individuals is necessary to achieve habituation, so locating a known group or individual daily is important. Habituation can only be achieved when the animal is seeing the observer. How contact is established is one of the most important elements of habituation. When the primates are habituated, they are aware of the presence of the observers. Habituation is an ongoing process (Setchell, 2011), and normally takes 2-5 months.

4 Involvement of stakeholders

A wide range of stakeholders play an important role in this research. From the tourists that visit South Africa to the private landowners and the local government. For each group there is an explanation on why and how they are involved in this research.

4.1 Tourists and national /private parks

In terms of international tourist arrivals to African countries, South Africa ranks second (Statista, 2019). It is a destination that offers such an extensive variety of breath-taking holidays and experiences throughout the year. This is combined with its first-world infrastructure, that continuously brings more and more visitors to a variety of areas (SA specialist, 2020). The total number of tourists is estimated at 16.65 million per year and could be as high as 19.6 million by 2023 (Statista, 2019). This makes the tourism industry one of the key industries in South Africa (Statista, 2019). South Africa has 20 national parks and many private game reserves. Tourists visit national parks to spot the ''big five" (lion, buffalo, elephant, leopard and rhinoceros) and enjoy the once in a lifetime experience South Africa has to offer. National parks and their guides play an important role in the awareness and education of the waste problem and protection of the environment. In 2010, three authorities were involved in baboon management –the national parks (SANParks), CapeNature and the City of Cape Town. Together with the Baboon Research Unit (BRU) they came up with a protocol entitled: 'PROTOCOL for reducing the frequency and severity of raiding behaviour by chacma baboons on the Cape Peninsula, South Africa'. There are also more and more attempts to create a greater awareness about human-baboon conflicts amongst the general public (Koutstaal, 2013).

4.2 Private landowners/community and farmers

Private land in South Africa covers 96,550,791 ha, 79% of the total land area (Pretorius, 2019). As such, private landowners are very important decision-makers for many of South Africa's natural resources (McDowell, 1986). At present, private land is covered for 70% of the total land and is mostly covered by agriculture. Agricultural crops and waste provide valuable resources for some wildlife. Farmers often react to wildlife depredating these resources by shooting and killing (Benjamin-Fink, 2019). To ensure management strategies for protecting the environment, monitoring of these areas is very important. South African agriculture is of a dual nature, with a well-developed commercial sector and smaller scale communal farming. The commercial sector compromises of approximately 46,000 commercial farmers. Those farmers occupy 86% of the agricultural land. Small-scale communal farmers occupy the remaining 14% of farmland (Ortmann, 2007). It is important to understand the local communities and farmers in the Alldays area to know how they think about wildlife around their farmlands. The farmer-baboon relationship is complicated and filled with ambiguity. Farmers are happy to see baboons in the wild, but on the farm itself, baboons are not welcome. High population numbers and the inability to control baboons are particular concerns for commercial farmers (Findlay., 2016).

4.3 Local government

The local government for Alldays is also a very important decision-maker. A growing population and increasing rates of urbanization in South Africa have resulted in increased waste generation, which requires establishing and implementing effective waste management policies and programmes. Local government can play an important role in the lack of education, creating awareness, ineffective data and compliance/enforcement capacity of these policies. With effective management of the waste problem, the local government can also play also a very important role in reducing conflicts between humans and wildlife caused by anthropogenic waste.

5 Methodology

This dissertation consists of fieldwork, literature review and data discussion. Before any field research was attempted, a proper literary study was done in order to provide sufficient background information, to base the study upon and find the proper methodology to carry out the field study. To gather all the information that was needed to answer the research questions, two major methods have been used; line transects and behavioural research. The specific methods used, are described in the following chapters: 5.2 Spatial distribution of anthropogenic waste and 5.3 behavioural study of the chacma baboon.

5.1 Study area

The Limpopo Province shares international borders with provinces and districts of three countries: Botswana's Central and Kgatleng Provinces, Zimbabwe's Matabeleland and Masvingo provinces, and Mozambique's Gaza Province. Polokwane, formerly known as Pietersburg, is the capital of the province (Conference Venues, 2020). Limpopo's climate, and particularly Alldays as shown in **table 1**, is a local steppe climate. The temperature averages 27.3°C with an average of 15 mm rainfall per year (Climate data, 2020). Alldays is located in the Capricorn region (Limpopo info, 2020).

Table 1. Climate table of Alldays, South Africa. With the average temperature in degrees Celsius and the average rainfall (Holiday-weather, 2020)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temp (°C)	30	30	29	27	25	22	22	25	28	30	30	30
Precipitation(mm)	40	23	22	7	3	2	1	0	3	11	31	40

The Alldays Wildlife and Communities Research Centre (AWCRC) is located in the Alldays area on Campfornis Game Farm, S 022.68207°, E 029.01692° (**figure 2**). Campfornis game farm started as a crocodile breeding farm, for the sale of crocodile skins. As an attempt to become more sustainable, the farmers began breeding goats as a source of income, whilst leaving the remainder of the farm available for game hunting. AWCRC is now a research station for students and staff. AWCRC covers an area of 16km^2, but the research area extends far beyond this farm. The study area itself is within a transition zone between Mopane bushveld and Sweet and mixed bushveld. Due to the heavy overgrazing of cattle, all plant communities reflect some form of human related impact within the area. These are mostly historical and agriculturally related influences. The overarching biome is the Savannah biome. Alldays also serves as a hunting destination for trophy and foreign hunters (Limpopo info, 2020). The Primate and Predator Project (PPP) is based at AWCRC and is run by Professor Russell Hill, from Durham University, United Kingdom, who specializes in evolutionary anthropology. In 2011, the PPP was established at Lajuma Research Centre in the Soutpansberg Mountains, and in 2017 expanded to Alldays, where the AWCRC was established. (AWCRC, 2019) This research was conducted from 17th February to 20th March 2020.

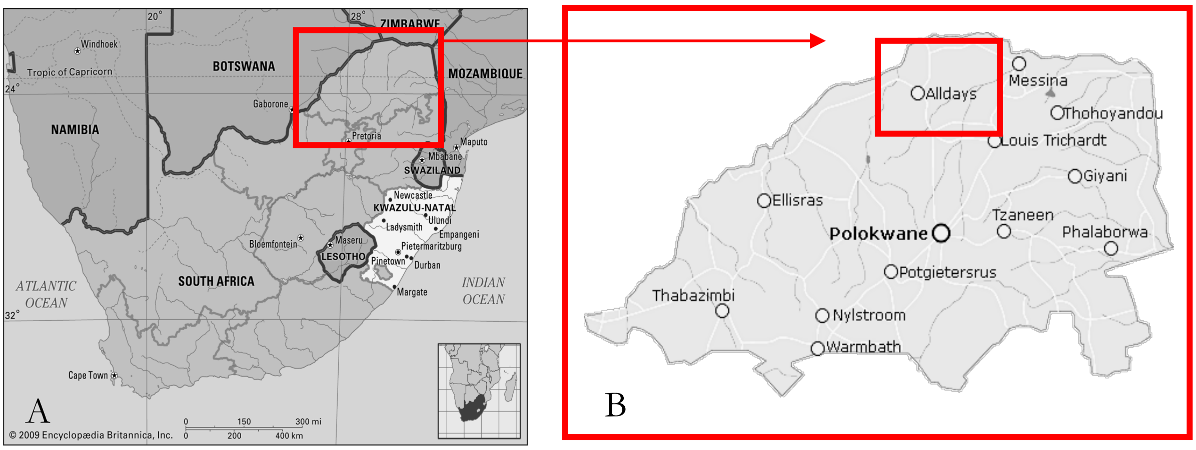

Figure 2. Map of the Limpopo province in South Africa (A), (B) showing the Limpopo province and location of the study area (red) (AfricaTourism, 2019) (Encyclopaedia britannica, 2020)

5.2 Spatial distribution of anthropogenic wastes

One of the main objectives of this research is to gain a better understanding of the amount of human waste disposal around the Alldays dumpsite. This will provide information on the attractiveness of the dumpsite to wildlife, the spatial distribution of waste in the environment, and to what extent baboons influence this distribution. This was done by describing the vegetation types, classifying different types of anthropogenic waste, and creating maps.

5.2.1 Line transects

Line transects were used to assess the distribution and amount of waste in the environment. Transect sampling provides a convenient method of estimating the number of objects in a study area (Buckland., 1985). Buckland (2001) recommend at least 10-20 lines. The perimeter of the open dumpsite in Alldays is 845 meters and is bordered by steel railing. Sixty-five transects were spaced 13 m apart around the dumpsite (**see figure 3**), starting at the steel railing and radiating out 30 meters into the environment. Two sets of 65 transects were conducted. Each individual transect was split into three 10-meter intervals (0-10m & 10-20m and 20-30m), and in each interval, vegetation structure, waste group composition and amount of total waste were recorded. See section '5.4.2 Classification of anthropogenic waste' for the different types of wastes.

Figure 3. Schematic view of the line transects around the dump. A) The total periphery of the dump in meters, B) the numbers of the total transects around the dump with B1 and B2 as overlap, C) the total length of the line transect and the interval ratio between transects D)The total length of the plot in every individual transect, created with GIS 2020.

For each transect, GPS coordinates of the start and end points were taken (the transect example sheet can be found in **appendix I**). Whilst walking transects, waste was classified into the four categories and the amount of each was recorded. A GPS coordinate was taken for each waste item. Where there was more than one waste type in a single location, each waste category was recorded but only one GPS point was taken. The perpendicular distance from the observer point on the transect to the waste item was used to calculate a probability density function (Plumptre, 2000).

5.2.2 Classification of anthropogenic waste

Waste was categorized into four classes based on whether it can be recycled in South Africa: organic waste (O), recyclable (R), non-recyclable (NR) and ecobrick materials (EB). All food waste, garden waste, manure and rotten meat were classified as organic waste. Recyclable waste includes hard plastics like drink bottles and butter tubs, glass, tins, paper, magazines, milk bottles and juice bottles shown in table 2. Also included in this category were wastes that could have been recycled before they were dumped into the environment e.g. rusted metal tins. Non-recyclable waste includes single-use plastic, containers and (polythene) take away bags, chip packets, sweet wrappers, fruit wrappers. See table 1 for more in-depth information about recyclable and non-recyclable wastes. An ecobrick is a plastic bottle stuffed tightly with clean and dry non-recyclable materials. These bottle bricks have been used as an insulative building brick and a powerful tool to connect people with their waste. This includes plastic bags, plastic pieces, plastic leftovers.

Table 2. Examples of recyclable and non-recyclable products in South Africa (Treevolution, 2018)

Waste Classes	Metal	Paper	Glass	Plastic	Batteries	Other
Solid waste Recyclable	Coldrinks, beer cans, metal lids, glass jars, packaging, paint,	White office paper, magazines, books, newspaper	Beverages bottles, food jars, wine bottles,	Cleaning product bottles, cool drinks, water bottles, plastic bags,	Large batteries e.g. gate motors	CDs, wool, cotton, electrical equipment
Solid waste non-recyclable	-	Plasticized paper, photographs, tissues and serviettes	Cups, oven ware, mirror glass, fluorescent tubes	Plastic contaminate d with oil, Polystyrene trays, PET trays,	Domestic batteries	Rubber, wooden items, cassette and video tapes

5.2.3 Classification of vegetation structure

The structure and species composition of vegetation reflects the total of all the abiotic environmental factors within a given environment, thereby acting as a living summary of the surrounding environmental factors (Mostert, 2006). The three intervals within each line transects will give a clear view of the sequence of vegetation types. Vegetation structure was recorded to investigate whether there is a change in the spatial distribution of the anthropogenic waste in relation to surrounding vegetation. Vegetation structures were categorized based on the Braun Blanquet method: 0=0-2,5 % dense vegetation structure, 1=2,5-5%, 2=5-25%, 3= 25-50%, 4=50-75%, till 5=75-100% complete open structure. Vegetation components were classified as: thorny bushes, bushes, grassland with occasional thorny bushes, open grassland and "road". The road (**see figure 3 (B)**) was taken into account because it is part of the surroundings.

5.2.4 Spatial distribution of waste caused by baboons

The spatial distribution of anthropogenic waste around the dump was investigated to identify the current situation of human waste disposal behaviour and to understand how much waste is disposed outside the dumpsite. To identify to what extent baboons, influence the spreading of waste around the dump, opportunistic behavioural observations were used. Where each instance of baboons seen spreading waste into the environment was recorded. This was done during baboon follows (**see section 5.3.1**) It is crucial to get a clear overview of the current spread of waste in order to make recommendations to decrease the attractiveness of the dump to baboons and thus decrease human-baboon interactions.

5.3 Behavioural study of the Chacma baboon

Behavioural data on chacma baboons were collected to assess if there is a difference in behaviour at the dumpsite compared with their natural environment. Behavioural data were also collected to assess whether anthropogenic waste affects their daily life and diet, behaviour towards humans or the community and behaviour towards other baboon troops. Due to the ''unnatural'' situation of the baboons, a literature study was used **(chapter 6.2.5.1)** to compare the behaviour of different habituated baboon troops in order to get a better idea about the behaviour of habituated baboons around in a human modified area.

5.3.1 Focal and scan sampling

The study troop consisted of 23 individuals, including ten adults (two males, one sub-adult male, seven females), nine juveniles and four infants. Data for this study derived exclusively from behavioural observations (example sheet can be found in **appendix II**), and no physical contact with the study subjects occurred. The troop was followed from an average distance of five to ten meter, from sleeping site to sleeping site, on foot for 12 hours. This is divided into four timeslots of 06:00 till 09:00 (1), 09:00 till 12:00 (2), 12:00 till 15:00 (3) and 15:00 till 18:00 (4). Successful follow days were defined as days on which the animals were followed from sleeping site to sleeping site, without losing audio-visual contact for a continuous period of more than one hour.

Two types of behavioural sampling were used. Focal sampling is the continuous recording of behaviours from a random selection of one or a few animals from the population and is the most accurate method for measuring primate activities (Gilby, 2010). This data is intended to represent the behaviours of the entire group (Mitlöhner, 2001). Focal sampling started before sunrise (5:57 am GMT+2) and each focal lasted at least 10 minutes. Every adult was sampled (once per timeslot) in a random order. Focal sampling was used to determine their daily life behaviour, natural and unnatural behaviour with a focus on the stress-level (due to human presence) and social interaction of the baboons, according to the following behaviours; affiliation, aggression, feeding, grooming, interspecies interactions, playing, self-detected behaviour (SDB's), vigilance and others. The category others consisted of resting, mating and sleeping. If the focal could not be finished within 10 minutes, the observation was not included in the analysis due to a not representative image of the behaviour of the baboon. Behaviours were recorded, of all visible adult individuals with a special focus on aggression, grooming and feeding behaviour. Analyses were restricted to these activities since previous studies have shown them to account for over 95% of a baboon's daily activity (Hill ,2003). (See **appendix III** for the full behaviour measures). Foraging behaviour was recorded, and food items were classified as natural (e.g. leaves, flowers, fruits, stem, roots) or unnatural (human-derived, e.g. cooked, animal matters, dried items etc.). Data were collected over an average of three days per week for one month. The data was collected by active monitoring, with the use of binoculars, and recorded using Cybertracker (**see chapter 5.5.1.1**). Scan sampling was used to collect data on the major behavioural activities of the whole group. The scan will be conducted at 30 min intervals, and each scan lasted up to maximum 5 minutes. In scan sampling, the behaviour of all the individuals in a group of animals was recorded at predetermined time intervals. As with instantaneous sampling, states were recorded instead of events (Haynes, 1996). The behaviours in the scan sampling were labelled as sub-behaviours and were more in-depth behaviours compared with the main behaviour.

5.3.2 Spatial distribution of baboons around the dumpsite

During full day follows, GPS coordinates were taken to record baboon spatial positions around the dumpsite. When the whole group rested for longer than one minute in the surrounding of the dumpsite, a GPS point was taken of the location. GPS coordinates were also taken of the location of the group, where they access the dumpsite over the steel railing.

5.3.3 Cybertracker

CyberTracker was used to record data on electronic devices such as an Apple iPad. CyberTracker is the most efficient way to gather large quantities of geo-referenced data for field observations. The application developer makes it possible for users to design their own electronic field guides with species identification keys (Filters). The species identification keys consist of a sequence of screens, each with a checklist of characteristic features of a species. For each subsequent screen, the filter gives an indication of the number of possible species. The electronic field guide makes it possible to imbed definitions, descriptions and images into the data capture screen sequence, providing an immediate reference for easy validation of field observations (CyberTracker, 2020).

5.4 Materials

A Global Position System (GPS) type GPSMAP® 64s and datasheets were used to record coordinates of baboons and anthropogenic waste around the dumpsite. A measuring tape of 30 meters was used for line transects with a compass to get a straight line from the dumpsite into the environment. A smaller management tape of 5M is used to get the plot accurate within the line transect. Tablets with the app Cybertracker were used to collect behavioural data on the baboons.

5.5 Data processing and statistical analysis

After fieldwork was completed, and all data were recorded on the tablets (focal, scan and transects), these data were prepared for analysis. To this end, the data were copied onto Microsoft Excel datasheets. Collection date, start/end time, duration of behaviour, focal ID, age-sex ratio, activity, sub behaviour, types of food, ID plant part, human-derived food, partner and observer were recorded (+scan sampling: habitat and weather were recorded). The datasheet of the transect forms included: ID transect number, interval group, vegetation type, GPS ID, GPS coordinates and waste categories. The data sheets used can been seen in **appendix I & II.**

To analyse the results, a one-way ANOVA and linear regression (+adjusted R-squared) were used. The one-way ANOVA test was chosen by looking at the normality and homogeneity. One of these assumptions was that the sampling distribution of the data is normal. The assumption of homogeneity of variance is that the variance within each of the populations is equal. In this way, the one-way ANOVA test was used. The one-way ANOVA test was used to compare the mean of more than two groups with the standard error included. If the one-way ANOVA test appears to be significant, the Tukey post hoc test was used. This is used to find means that were significantly different from each other. Besides the statistical tests, personal observations were used to describe the qualitative results and GIS is used to create maps. These statistical analyses have been done in R (R Core Team, 2013).

The one-way ANOVA test is used for the following variables:

I. The total amount of wastes per side (north, east, south, west) around the dumpsite;
II. What type of waste is found most frequently in the environment;
III. Differences in vegetation structure and the total amount of waste found in this vegetation structure;
IV. Differences of baboon behaviour in the dumpsite and outside the dump;
V. Differences in baboon foraging behaviour inside and outside the dump.

Linear regression attempts to model the relationship between two variables by fitting a linear equation to observed data and is used to:

I. Identify if the amount of waste decreases as it gets further from the dump into the environment;
II. Identify the relationship between vegetation structure and amount of waste;

Personal observations were used to assess:

I. The extent of baboons contributing to the spatial distribution of anthropogenic waste into the environment;
II. The duration of baboon visits to the dumpsite;
III. The behaviour of baboons towards the presence of humans/dogs/other baboon troops.

Geographic information system (GIS) was used to:

I. Identify the spatial distribution of baboons entering the dumpsite;
II. Identify the spatial distribution of anthropogenic waste in the environment;
III. Identify the location of baboons around the dumpsite.

6. Results

The results are presented per research question. This chapter will provide results from the field work period in order to answer the sub- research questions. The results of this project are split into two parts: 6.1 the current situation of anthropogenic wastes and 6.2 behavioural research.

6.1 To what extent does anthropogenic waste occur in the natural environment and its spatial distribution in relation to the baboons?

Results are based on a total of 129 line-transects, which were conducted around the dumpsite, each with a length of 30 meters. The 129 transects were two lots of 65 transects, conducted on the 24th of February & 19th of March. In the analysis, transect 18 is not included in the data analysis because of the incomplete data (the transect could not be conducted due to difficult accessibly). Between the two sets of transects, there was 40,4 mm of rainfall. The wind speed had an average of 12.6 kmph between the two sets of transects.

6.1.1 Anthropogenic wastes found in the environment

An average of 9.472 anthropogenic waste items was recorded outside the dump. Most of these items were recyclable (N=7455). Glass was the most common item found in this category (N=5500). Non-recyclable waste consisted of N=1252 items, ecobricks consisted of N=767 items, and organic waste consisted of N=5 items. The second set of the transects resulted in a total increase of 196 anthropogenic waste items found around the dumpsite, with an increase of 41 recyclable items, 28 non-recyclable items, five organic waste items and 120 ecobricks items.

6.1.2 Abundance of waste and distance to the main dump

Densities of waste were calculated and resulted in 58,9 items/m^2 in the first interval, 8,25 items/m^2 in the second interval and 5,9 items/m^2 in the third interval. A map of the spatial distribution of anthropogenic waste in the environment can be found in **appendix V**. **Figure 4** shows the total amount and type of anthropogenic waste per interval group. Along the transects, a total of 7657 waste items were found in the first 0-10 meters, 1050 items were found from 10-20 meters, and 765 items were found at 20-30 meters. To test if there was a significant difference in number of wastes per interval group, a one-way ANOVA test was used. It resulted in a significant difference in the total amount of waste between each interval group ($P=5.28^{-3}$, **figure 5**). The Tukey HSD resulted a significant difference between the interval 0-10m & 10-20m ($P=1.14^{-2}$), as well as between 0-10m & 20-30m ($P=1.07^{-2}$). There is no significant difference between interval group 10-20m & 20-30m.

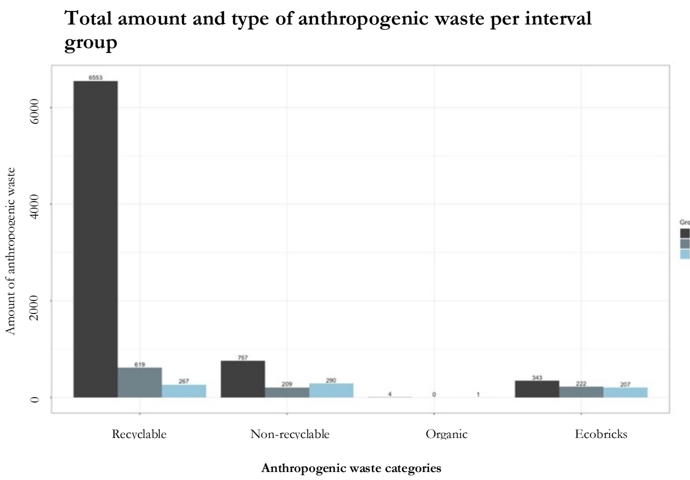

Figure 4. Average amount of waste per segment group. Recyclable waste consisted of 7439 items, non-recyclable of 1256 items, organic of 5 items and ecobricks of 772 items.

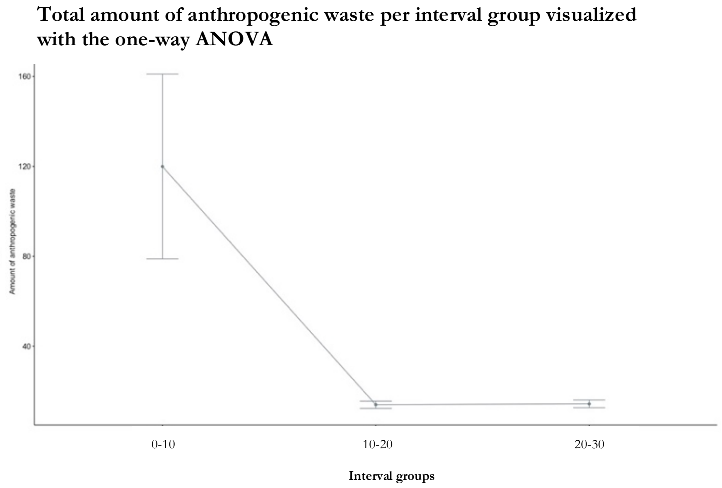

Figure 5. Total amount of waste per segment group visualized with the one-way ANOVA test. It shows a significant difference of ($P=5.28^{-3}$). The Tukey HSD shows a significant difference between the groups of 0-10m & 10-20m ($P=1.14^{-2}$) and of the group 0-10m & 20-30m ($P=1.07^{-2}$).

The linear regression in **figure 6** shows a negative correlation between the total amount of anthropogenic wastes found per interval group. This resulted in a significant correlation of P=2.1^{-3} with the formula Y =155.01-52.80X. This means that 4.3% of the data can be predicted following the linear formula with a 99.9% certainty. Comparisons with **figure 4** and **figure 5** strongly suggest decreases in amount of anthropogenic waste. In contrast, this is not presented **figure 6** due to no difference in interval group 10-20m and 20-30m. Upon further investigation, outliners of the observations, in the first interval were excluded. Upon removal, the correlation resulted in no difference in the regression line when the outliners were excluded. These outliners were in the end included, due to showing a representative image of the first interval around the dumpsite. Transects were grouped (**figure 7**) due to showing a representative image of the location of anthropogenic wastes around the dumpsite, per side. Accordingly: group 1 = transects 1-11; group 2 = transects 12-30; group 3 = transects 31-46; group 4 = transects 47-65. Group 1 was located at the west of the dumpsite and was covered by thorny bushes and grassland with occasional bushes. Group 2, located north of the dump, was mostly covered by grassland. Group 3 to the east was covered mostly by dense bushes and group 4 to the south was mostly covered by the road and grassland with occasional bushes. The one-way ANOVA test showed no significant result between transect groups (P= 0.0824).

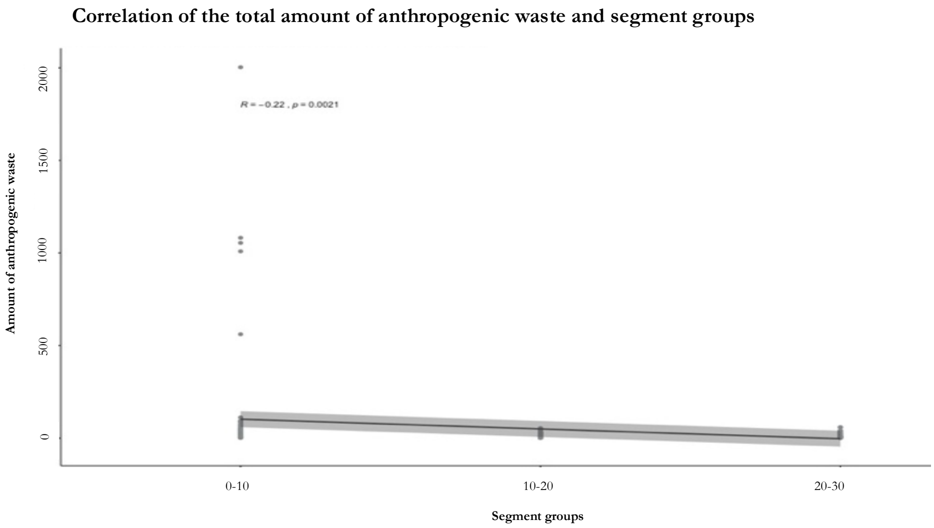

Figure 5. Correlation of the total amount of anthropogenic wastes and segment groups. The correlation resulted in a significant difference of P=2.1^{-3} and R=-0.22

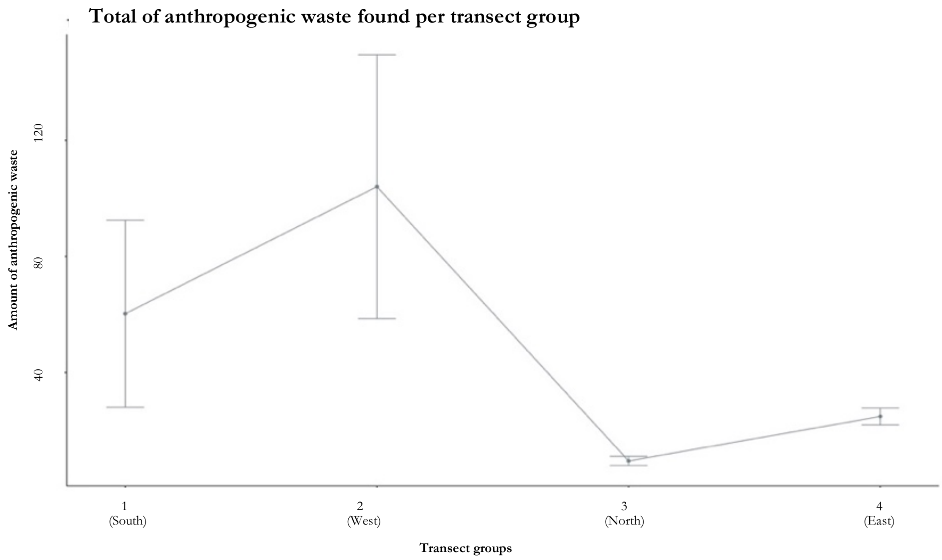

Figure 5. Total amount of anthropogenic wastes per transects groups. The one-way ANOVA resulted in no significant difference (P= 0.0824). Group 1 includes transect 1-11, group 2 includes 12 -30, group 3 includes 31-46 and group 4 includes 47-65.

6.1.3 Vegetation structures and the total amount of wastes

The vegetation structure is recorded per interval group, within each transect. **Figure 8** shows an overview in the amount of anthropogenic wastes, found per vegetation type, in each interval (a zoomed-in graph of 10 transects per vegetation type can be found in **appendix IV**). This figure is split up per interval group for determine the vegetation structure. This is due to the sequence of vegetation types; this differs on a transect of 0 till 30 meters and has several consequences on the further spreading and spatial distribution of anthropogenic wastes. It resulted that open vegetation provides a broader distribution of wastes into the environment. Grassland consisted overall the most amount of waste items. The second interval functions as a natural boundary to stop further spreading of wastes. This is resulted by structures like bushland and thorny vegetation in the second interval. Bushland in interval two holds 2.4 times more waste and thorny structures holds 1.7 times as much waste than the third interval. This indicates that more dense vegetation may function as a natural border to stop further spreading of wastes into the environment.

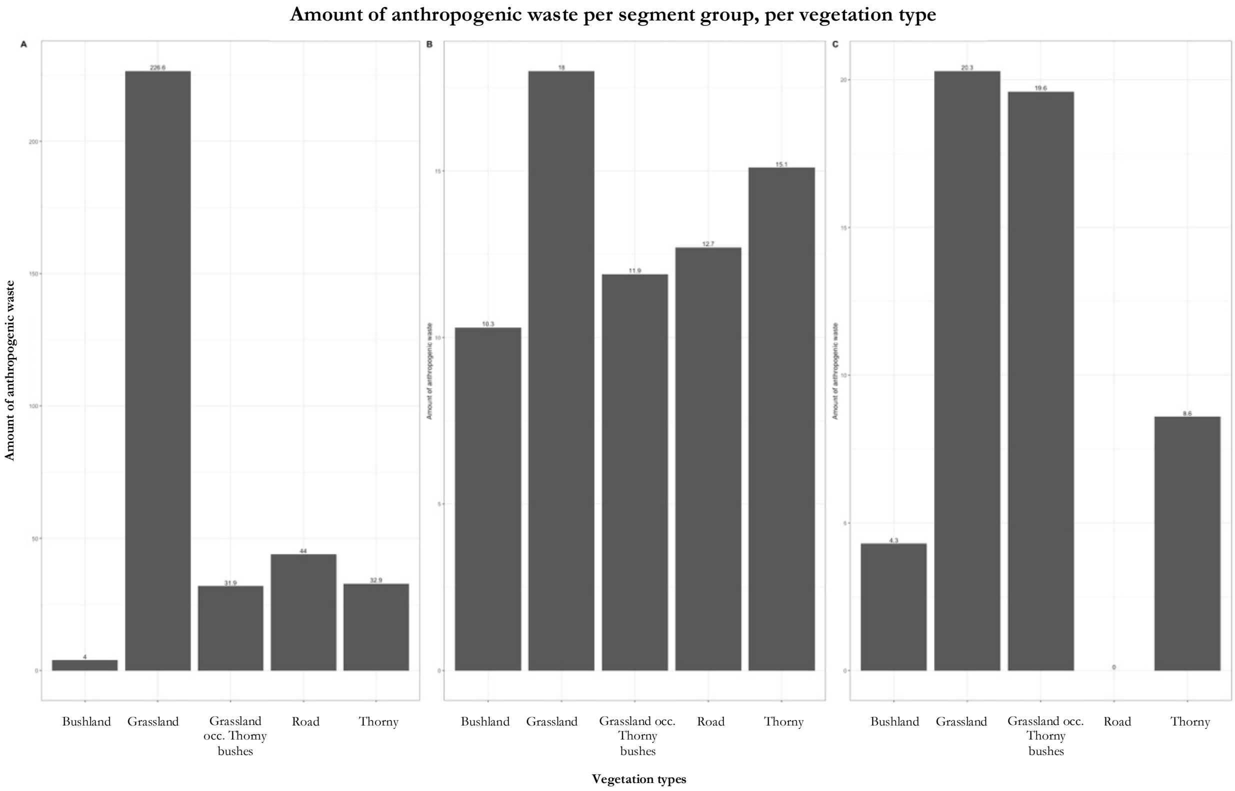

Figure 6. The total amount of anthropogenic wastes of the segment groups, per vegetation type. Categorized as A= interval 0-10 meters, B= interval 10-20 meters and C=interval 20-30 meters

Figure 9 shows the correlation between the total amount of waste per vegetation type, displayed per interval group. The correlations were done with all the observations included to maintain the consequent use of the data set. The linear regression shows a significant relationship between vegetation type and amount of waste of $P=3.9^{-2}$ with the formula Y=0.0015+ 3.81X. This resulted in a positive correlation with the strength of the relationship presents, (A) no to weak relationship (B) presents no to weak relationship with no correlation and (C) presents a moderate relationship. Category C shows a significant relationship between the interval group of 20-30m and the type of vegetation ($P=6.85^{-3}$). This means that 15.1% of the data can be predicted following the linear formula with a 99.9% certainty. The linear regression resulted in no relationship between the interval groups A (P=0.234) and B (P=0.8).

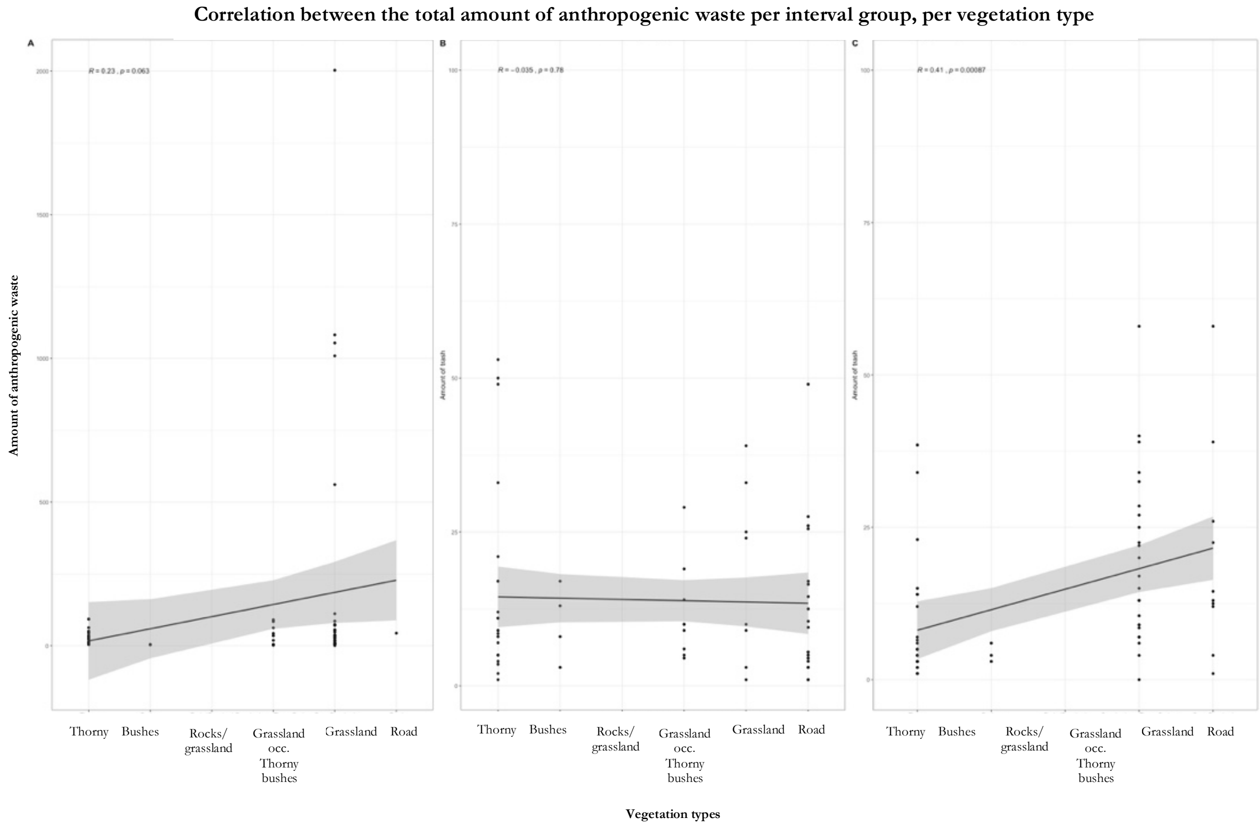

Figure 9. Correlation between the total amount of anthropogenic wastes and vegetation type, per segment. Categorised in A= 0-10, B= 10-20 and C= 20-30. The linear regression shows no correlation in A (P=0.234 and R=0.23) & B (P=0.8 and R=-0.035). C is shown a correlation of P=6.85^{-3} and R=0.41.

6.1.4 The extent of baboons contributing to the spatial distribution of anthropogenic waste

Information gathered through personal communication with dump security guards, and personal observations suggests that the spread of anthropogenic waste outside the dumpsite was mostly caused by human disposal methods. Even though usage of the dump is free, people still dumped their waste outside the dumpsite. This included larger items such as washing machines. On two occasions, waste was recorded being thrown out of vehicles, as they passed by on the road. Despite there being a 1000 South African Rand fine (€=48,55) for dumping in the environment. The extent and quantity of baboons spreading anthropogenic waste into the environment was almost nothing compared with humans. There were 10 recorded occasions when anthropogenic waste items were moved from the dump into the environment by baboons. Four out of ten of these occasions, the items were a piece of bread, on another four occasions the item was a plastic bottle, and on two occasions the item was a plastic ring. There were 15 recorded occasions of people dumping outside the dump. The distribution of waste, which already located outside the dump into another area, was noted 11 times. This consist of seven times moving a plastic bottle, three times a paper bag and one-time single use plastic. A GIS map (**appendix VI**) was created to visualize the spread of anthropogenic waste caused by humans compared with the location of the baboons.

6.2 To what extent is unnatural behaviour present in the chacma baboons in and around the dumpsite, and can this lead to unnatural group behaviour and interaction with people?

Baboons were followed for a total of 13 days, consisting of 91,33 observations hours. During these observation hours, a total of 399 focal samples, with a total of 66,5 hours were conducted. Scan sampling resulted in 298 scans, with a total 24,83 hours.

6.2.1 Baboons entering the dumpsite

Baboons tended to follow one another and accessed the dump at approximately the same spot/location as the baboon before them. Juveniles would often pass through the steel railing. Accessing the dumpsite was mostly done by the nearest location from their sleeping site (see **appendix VII** for the visualized map of baboons entering the dumpsite and **appendix VIII** for their home range). This resulted in baboons were accessing the dump, mostly from the west. Compared with **figure 7,** the westside of the dump resulted in highest amount of anthropogenic waste. The focal troop of baboons, urbanised and habituated to human presence, visited the dumpsite more often than other baboon troops (recorded by surrounding farmers and due to personal observations).

6.2.2 Time of baboons spending in the dumpsite

The average duration of the baboons visiting the dumpsite is 00:57h (±0,019) per day, for one month (**see table 3**). The time of day that the baboons first entered the dump ranged from (earliest time) to (latest time) resulted in 11:07 am, (timeslot 2).

Table 3. Average duration of baboons visiting the dumpsite

Day	Month	Time in	Time out	Overall time (H)
Tuesday	February	10:00	11:40	01:40
	February	12:55	13:05	00:10
Thursday	February	08:20	08:50	00:30
	February	09:10	09:30	00:20
Friday	February	11:25	12:35	01:10
Tuesday	February	09:15	10:40	01:25
	February	12:45	13:25	00:40
	February	16:15	16:35	00:20
Friday	February	10:15	11:10	00:55
Monday	March	10:03	11:18	01:15
	March	13:04	14:06	01:02
Wednesday	March	08:15	09:52	01:37
Thursday	March	10:10	11:20	01:10
Sunday	March	10:40	11:45	01:05
Thursday	March	08:01	09:02	01:01
Wednesday	March	10:45	09:40	01:05
Average				**00:57**

6.2.3 Unnatural food intake compared with their natural food intake

The number of all food categories of the baboon dump diets are presented in **figure 10**. The number of food categories of the baboon natural habitat diet is presented in **figure 11**. Specific parts eaten of the naturally derived foods are presented in **figure 12**. The combined data of food items of the dump and their natural habitat resulted in a total of 674 food items. Food items consumed in their natural habitat resulted in a number of 577 items. A total of 97 human-derived food items were consumed inside the dump. Human-derived foods constituted 15% of the total diet. Human-derived food items consisted of bread, leftover vegetables, leftover fruits and milk/juice products and cooked food. In addition to these unnatural foods, their natural diet was composed mostly of plants. This included all types of plant species (unid plants), which were not identified to species level. Tree species such as Murula (*Sclerocarya birrea)* and Common corkwood (*Commiphora pyracanthoides*) were high in abundance in their diet. From these trees, fruits were eaten the most (**figure. 12**).

Number of anthropogenic food types eaten in the dumpsite as a total of the whole baboon group

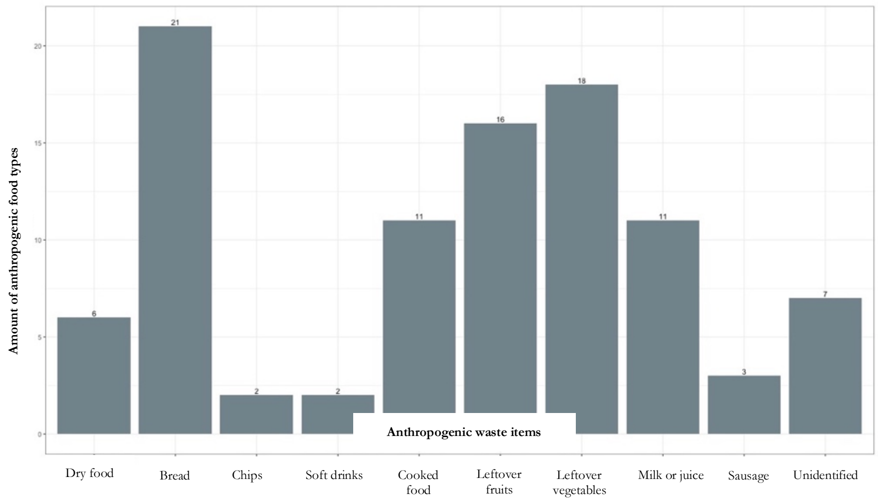

Figure 10. Number of anthropogenic food types eaten in human-modified environment. Biscuit or other dry foods: 6, Bread: 21, Chips: 2, Coca cola or other drinks: 2, Cooked food: 11, Leftover fruits: 16, Leftover veg.:18, Milk or juice: 11, Sausage:3 and unidentified 7

Amount of natural species eaten in the natural environment

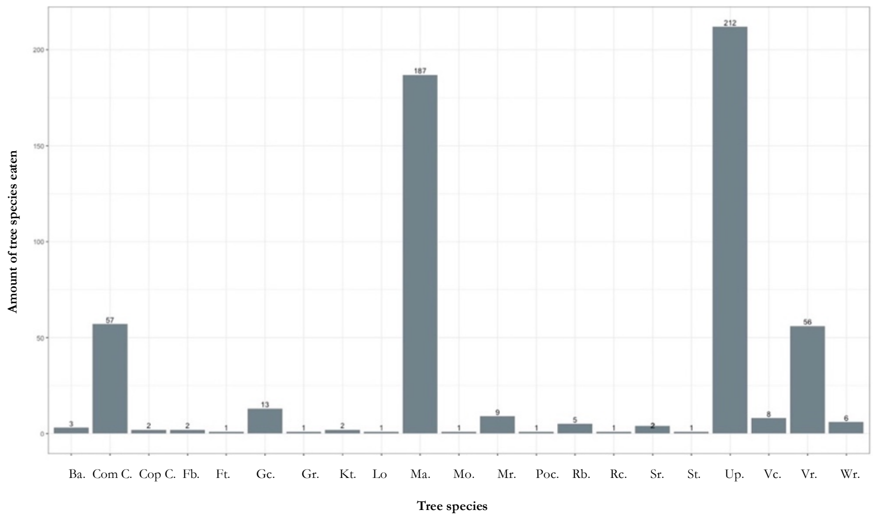

Figure 11. Tree species eaten in the natural environment, (Ba) Baobab, (Com C) Common corkwood, (Cop C) Copperstem corkwood, (FB) Four-leaved Bushwillow, (Ft) Flame thorn, (Gc) Glossy-leaved corkwood, (Gr) Grasshopper, (Kt) Knob thorn, (Ma) Marula, (Mo) Moth, (Mr) Mallow raisin, (Pc) Purple pod clusterleaf, (Poc) Poison-grub corkwood, (Ps) Prey species, (Rb) Red bushwillow, (Rc) Rough-leaved corkwood, (Sb) Sicklebush, (Sr) Sandpaper raisin, (St) Sweet thorn, (Up) Unid plant, (Vc) Vervet-leaved corkwood, (Vr) Velvet raisin, (Wr)White raisin

Number of specific parts eaten in the natural environment

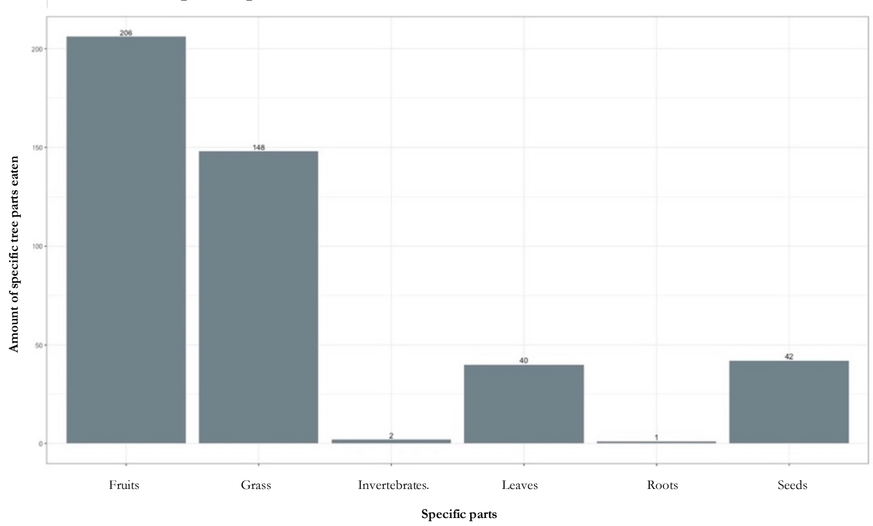

Figure 12. Number of specific parts eaten in natural environment, where fruits is highest as natural food source (N=206). Secondly, grass (N=148), seeds (N=42), leaves (40), invertebrates (n=2) and roots (N=1)

6.2.4 Behaviour at the dumpsite and in their natural home-range

For each activity state, **figure 13** displays the duration of behaviours in seconds, from both environments combined (dump+ natural environment). The data represent the time of behaviours of all the individual baboons combined. The one-way Anova test is used to see if there is a significant difference in time. It resulted in a significant difference between the behaviours ($P=2^{-16}$). The three most prominent groups present by the Tukey HSD were grooming, feeding and the category others (mating, resting and sleeping).

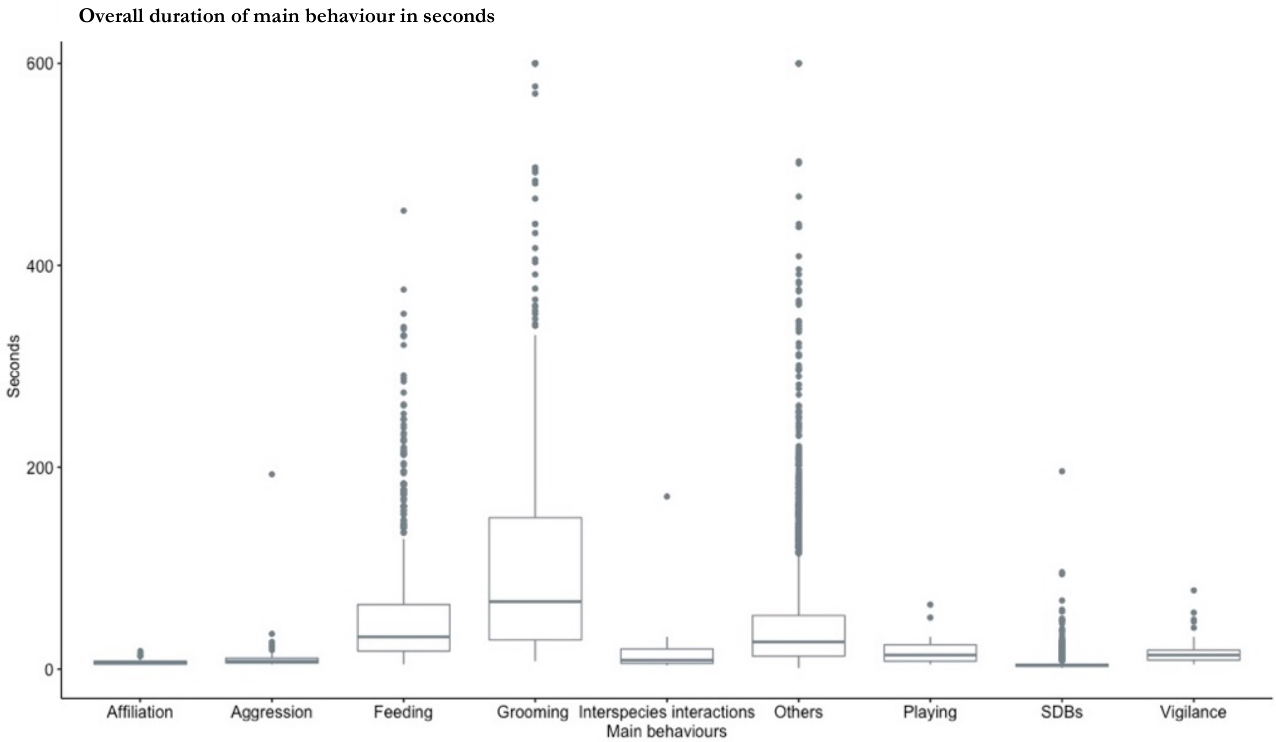

Figure 13. Overall duration of main behaviours in seconds. Behaviour times in second with the SE. Feeding time: 53.32 (± 2.15), Foraging time 42.50 (± 3.44), Others 45.55 (± 1.08), SDBs 5.69 (± 0.26), Affiliation 7.83 (± 0.56), Aggression 13.92 (± 3.76), Interspecies 31.63 (± 20.17), Playing 18.59 (± 3.22), Vigilance 17.08 (± 1.34), Grooming 118.27 (±6.41), Grooming given 126.12 (± 8.22), Grooming received 126.12 (± 10.19) The one-way ANOVA visualised a significant difference between the main behaviours ($P=2^{-16}$). There is also a significant difference in Feeding-Affiliation (P=0.0003629), Grooming-Affiliation (P=<0.05), Feeding-Aggression(P=0.0002840), Grooming-Aggression (P=<0.05), SDBs-Feeding (P=<0.05), Vigilance-Feeding (P=<0.05), Playing-Grooming (P=<0.05) and SDBs-Grooming (P=<0.05).

Figure 14 presents the total number of the sub-behaviours performed in the dumpsite compared with their natural habitat in percentages. These percentages were calculated from the total amount of behaviours per environment. A pattern of aggression did not differ between both environments. The troop had similar overall rates of aggressive interactions in both environments. In comparison with **figure 13**, the prominent patterns like feeding, foraging and grooming differ in percentages between the two environments. Feeding and foraging is done the most in the dump, while grooming is done the most in their natural habitat. **Figure 15** shows the behaviours presented per timeslot. Calculated the total behaviours of the whole group, with the two environments combined. It appears that timeslot 2 (09:00-12:00) has the highest number of feeding and aggressive behaviour, this is also the time were baboons were visiting the dumpsite. Grooming appears to be highest in timeslot 4 (15:00-18:00). Resting is done the most in timeslot 3 (12:00-15:00), which resulted in the hottest period of the day. **Figure 16** shows the behaviour per age-sex ratio in % of both environments combined. It resulted in adult males and sub adult males differed in the frequency of acting aggressively to another individual. Grooming is done the most by adult females and indicates that social interaction is done mostly by females.

Sub-behaviour of natural environment compared with dumpsite behaviour in %

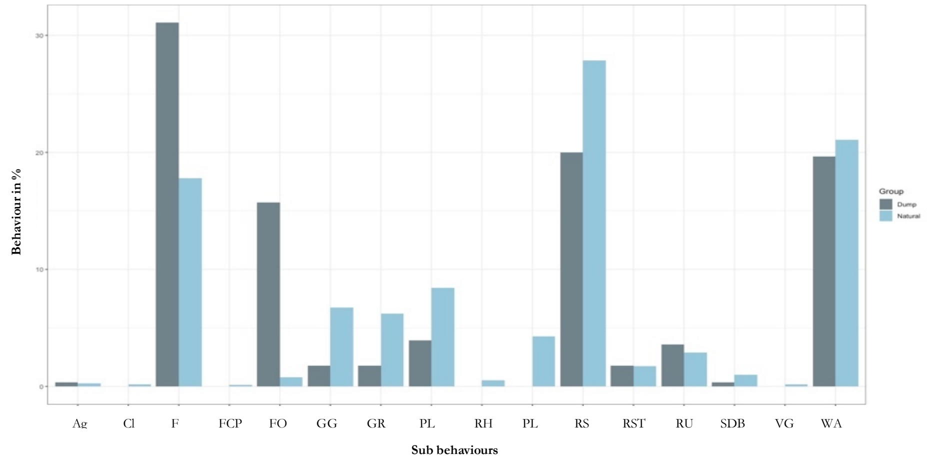

Figure 14. Behaviour of natural environment compared with the human-modified environment in %, AG (agression), CL (climing), F (feeding), FCP (feeding cheek pouch), FO (foraging), GG (grooming given), GR (grooming receiving), PL (playing), RH (resting huddle), RL (resting laying), RS (resting), RST (resting standing), RU (running), SDB (self detected behaviour), VG (vigilance), WA (walking).

Sub-behaviours of both environments per timeslot

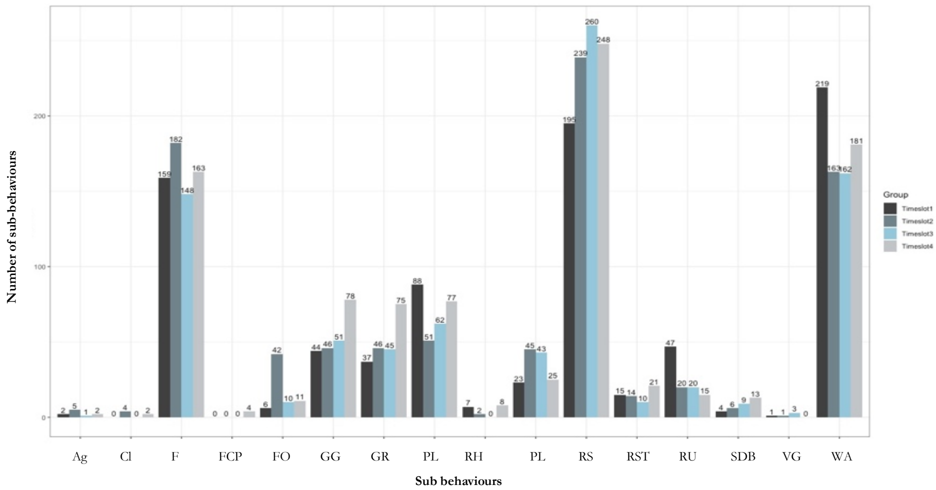

Figure 15. Overall number of sub-behaviours per timeslot of natural and human-modified environment added together. AG (agression), CL (climing), F (feeding), FCP (feeding cheek pouch), FO (foraging), GG (grooming given), GR (grooming receiving), PL (playing), RH (resting huddle), RL (resting laying), RS (resting), RST (resting standing), RU (running), SDB (self detected behaviour), VG (vigilance), WA (walking). Timeslot 1=06:00/09:00, timeslot 2=09:00/12:00, timeslot 3=12:00/15:00 and timeslot 4=15:00/18:00

Sub-behaviours per age-sex ratio in %

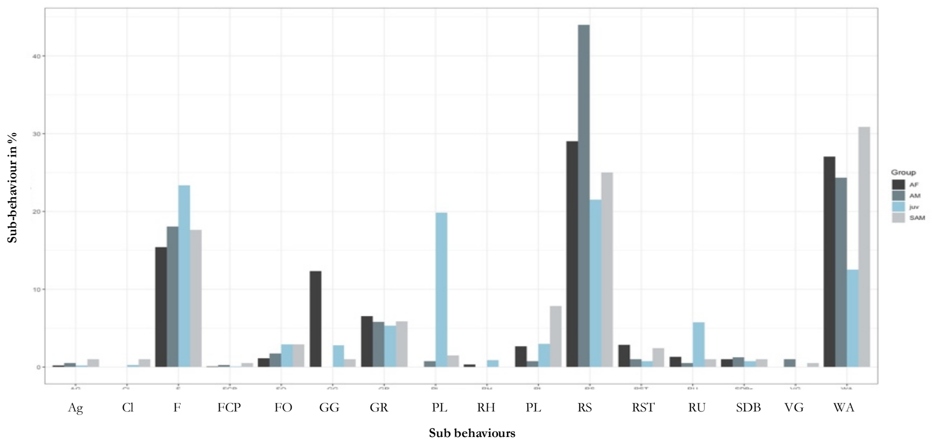

Figure 16. Sub-behaviour per age-sex ratio in %, AF (adult female), AM (adult male), JUV (juvenile), SAM (sub adult male). AG (agression), CL (climing), F (feeding), FCP (feeding cheek pouch), FO (foraging), GG (grooming given), GR (grooming receiving), PL (playing), RH (resting huddle), RL (resting laying), RS (resting), RST (resting standing), RU (running), SDB (self detected behaviour), VG (vigilance), WA (walking).

The average time of the observed grooming behaviour is in total is 118.27 seconds (±6.41). In total, a number of 405 observations were recorded of the grooming behaviour, as shown in **figure 17**. In time slot one, there were 117 grooming observations, in timeslot 2 there were 91 observations, timeslot three consists of 84 observation and timeslot four has 113 observations. There is no significant difference in duration of the grooming per time slots (P=0.436). The boxplot was done with all the outliners included to maintain the consequent use of the data set. Grooming is divided into three subjects: overall grooming, grooming receiving (126.12 sec.± 10.19), and grooming given (126.12 sec. ± 8.22).

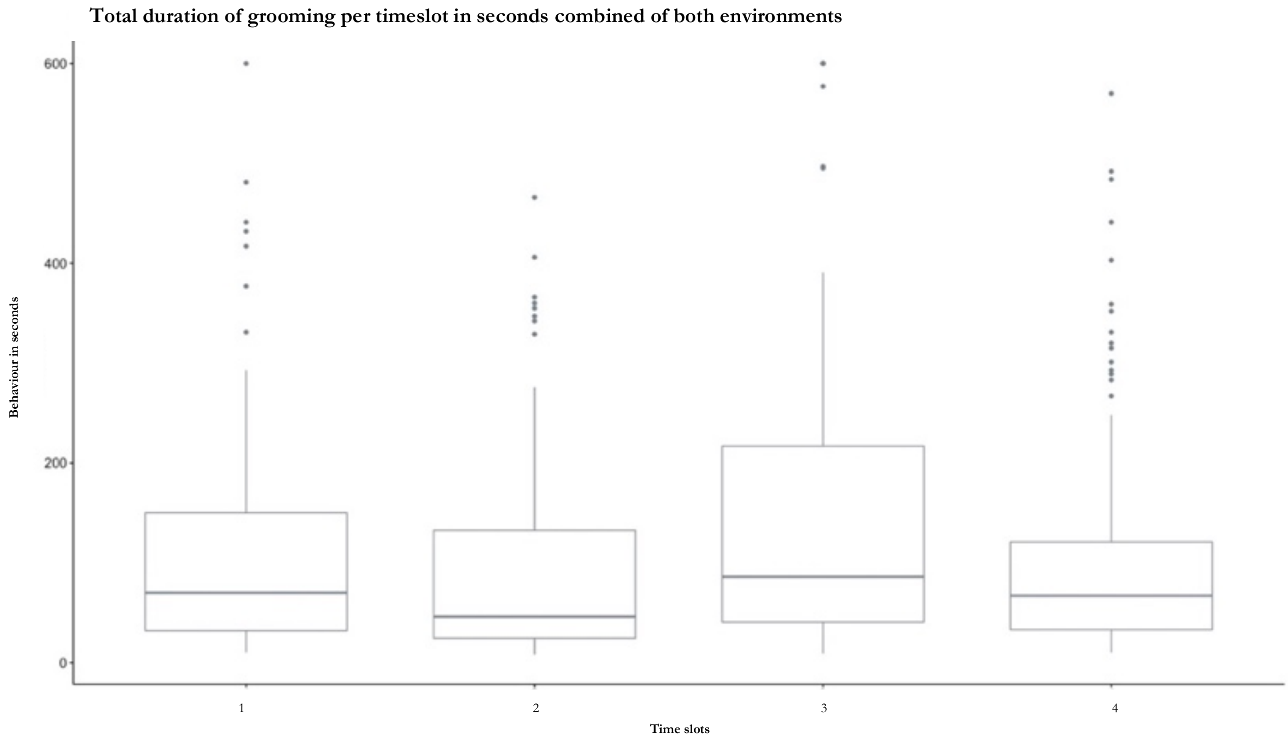

Figure 17. Total duration of the social interaction grooming in the study group in seconds. With an average time of 118.27 (±6.41) seconds of grooming. Grooming partner with the amount of grooming is Adult female-adult female 187, adult female-adult male 33, adult female-infant 54, adult female- juvenile 76, adult female-sub adult male 12, adult male-adult female 28, adult male-infant 1, adult male-sub adult male 1 and sub adult male-adult female 12.

6.2.5 Baboons reacting to the presence of humans and other baboon troops

The troop is used to live in surroundings in a human-modified environment. **Appendix VIII** shows a more in-depth visualized map of their home range, included their sleeping site with the coordinates -22.654769, 29.119067 and the dumpsite with coordinates -22.6498072, 29.1193283. Their sleeping site is next to the township. Baboons are used to humans as they are often seen close to the houses. When unknown humans are in eyesight, it causes flight behaviour. In addition to this, when the presence of dogs occurs, baboons flee into the bush. **Table 4** shows the amount of flight behaviour of the habituated troop noted during this study during personal observations. These flight behaviours were not counted in the main behaviours due to the short duration time and the coincidence of the behaviour.

Table 4. Reasons of flight behaviour of baboons during full day follows (personal observations)

Problem type	**Examples**	**Frequency**
Encounter farmers	Encounter with an angry farmer with a gun	1
Children	Children are scared and throwing rocks	2
Working villagers	Working villagers on land	3
Walking villagers	Villagers walking in the home range of baboons	6
Different baboon troop	Encounter with different baboon troop	3
Presence of dogs from the local village	Presence of dogs, chasing/fighting with the baboons and annoyance of noise created from barking	8

6.2.5.1 Compared literature study on human-baboon interaction

A lot of research has already been conducted on the human-baboon conflicts in South Africa. Kansky, (2016) Investigated the understanding of human-wildlife conflicts. They surveyed five of seven communities on the Cape Peninsula with a history of human-baboon conflict. These communities were the majority in the baboon home ranges. Most respondents (78.6%) had some problems with baboons (**see table 5**). Of these 34.7% had small problems, 24.1% had moderate problems and 20% had a serious baboon problem. Overall the mean extent of baboon problem was 3.9 ± 1.98 (scale 1 = not a problem at all and 7 = a crisis") (Kansky, 2016).

Table 5. Types of problems residents have when living with baboons and the possible unmet needs associated with each problem type. Frequency is the number of times a problem category was reported by a respondent. Mean extent of problem is the mean score of the extent of problem scale where 1 was not a problem at all and 7 a crisis. See Appendix D for additional discussion on un-met universal human needs (Kansky, 2016).

Problem type	**Definition and examples**	**Frequency**	**Mean**
Tangible costs Damage	Monetary losses to property and food	149	4.27
Intangible costs Self	Worry about personal safety, fear and stress of baboons	17	5.53
Opportunity costs	Relating to the loss of ability to undertake certain activities such as having a vegetable garden, fruit trees or eating in garden	22	5.14
Children	Worry about welfare of dependents and inconvenience at having to manage them	55	5.09
Prison	A feeling of confinement indoors due to the necessity to keep the house locked up and windows closed	60	5.07
Baboons	Relating to baboon aggressive behaviour	19	5.06
General	A non-specific description such as raiding, trying to get into house	16	4.25
Mess	A feeling of resentment or stress at having to clean up after baboons have made a house untidy or pulled rubbish out of bins	57	4.09
Mitigation measures	Frustration or difficulty implementing mitigation measures	36	4.2

7. Discussion

During the data collection, several influencing factors were found. Nevertheless, the results are still contributing to answering the main research question. These factors influence the results that were found and were potentially responsible for the statistically insignificant results. The discussion is built up by discussing the sub-research questions and limitations during the research.

7.1 Anthropogenic wastes found in the environment

An average of the two transects resulted in N=9.472 anthropogenic waste items. Recyclable waste was found most in the surrounding with a number of N=7.455 items. There is only rudimentary understanding of the distribution and effects of plastics in other ecosystems. The massive production op plastics in terrestrial systems, limited land area and range of distribution processes may result in a higher environmental concentration within these ecosystems, compared to marine environments recorded by Windsor (2019).

7.2 Abundance of waste and distance to the main dump

It was suspected to see a decline in the amount of waste further into the environment from the main dump. This expectation was confirmed with a correlation of $P=2.1^{-3}$. It resulted in a higher density closer to the dump, compared with the second and third interval group, further from the main dump. This correlation is also shown an increase in segment 20-30. The increase at 20-30 meters could be due to the location of the transects next to the road. The lightweight nature of plastic material means that, in terrestrial systems, particles are more easily transported by wind and weather events further into the environment (Windsor, 2019). Human waste disposal behaviour (dumping waste from the car) is also a strong factor in the spatial distribution of anthropogenic wastes. The anthropogenic wastes around the dumpsite are caused mostly by human waste disposal methods. This can be due that littering is embedded in the culture of some people. For example, most of those living in townships would never stop littering even if they are told that it is not suitable for their health, wildlife interactions and the environment (Etengeneng, 2012).

7.3 Vegetation structures and the total amount of wastes

The results of this research indicate that dense vegetation contains less anthropogenic wastes compared with more open vegetation structures. Grassland structures consisted of two times more wastes compared with denser vegetation. The sequence of vegetation types per interval group, within in one single transect, makes a major difference in the total abundance of vegetation because plants often have a very patchy distribution, the ability to cover a large area of ground with modest resources is an important advantage. The research of Shaker (2010) showed results where areas with lower terrain elevations and open structure, are more affected by the landfill site by the increase of wastes. The research of NEPA (1995) suggests buffer areas of existing (dense) vegetation are providing a visual screen. This could indicate why there is a further spreading of waste in more open structures than in dense vegetation.

7.4 The extent of baboons contributing to the spatial distribution of anthropogenic waste

It resulted that baboons are not the main factor in the spatial distribution of anthropogenic wastes into the environment. The research of Shimada (2006) indicated that social play, using portable object(s), has been observed among the juveniles in a group. Object playing is one of the categories in play behaviour; activities using objects, including pushing, pulling, or breaking an object. This is also the case with e.g. plastic bottles. Wastes are taken into the environment and will be spread elsewhere.

7.5 Baboons entering the dumpsite

The baboons were entering the dump mostly on the west side of the dumpsite. Baboons tended to follow one another and accessed the dump at approximately same spot/location as the baboon before them. Juveniles would often pass through between the steel railing. The research of Howlett (2017) suggests where fences are employed, their height (most often between 1– 1.5 m) may be sufficient to exclude small animals but are not always useful in excluding primates which can climb and larger ungulates that can jump over the fence. Habituated baboons made significantly more attempts per visit to manipulate the structure to gain access to the site (Howlett, 2017).

7.6 Time of baboons spending in the dumpsite

The baboons in this study were spending an average of 00:57h of their day at the dumpsite. They went to the dumpsite at an average time of 11:00 am. In the research of Sapolsky (2004) they were following a troop of Olive baboons *(Papio anubis)*. During his research, an open dumpsite was available, and the troop went to the garbage pit at dawn for food (Sapolsky, 2004). Baboons are attracted to places they think might provide food and will return if they have been successful in finding food there. This will be part of their daily routine. Howlett (2017) researched that a habituated baboon group spent significantly more time at the fence, than non-habituated baboons (habituated group: 85.3 ±56.7 min; non-habituated groups: 31.3 ±15.6 min (Howlett, 2017).

7.7 Unnatural food intake compared with their natural food intake

Foraging profiles of baboons will be described as remarkable variations across different habitats. The baboons of this study spent 15% of their time on feeding of human derived food items, and 85% of natural food sources. Their natural food consisted mostly of fruits, grasses, leaves and seeds. This is also research by Whiten (1991). It resulted in that the natural diet of baboons consisted of ranges of 3-74 % of fruits, 1-53 % subterranean items and 8-53 % leaves. The availability of the dumpsite resulted in that organic food is one of the main attractors for baboons visiting the dumpsite. The nutritional contrast between naturally derived food items and high caloric urban food, which is higher in protein, fat, and carbohydrates, greatly increases the foraging behaviour of human derived food items (Kaplan, 2011). The research of Johnson (2013) resulted in that human derived foods are 7% of their daily diet. Food provisioning in natural environments could potentially provide this change in diet and increase human derived food items (Kaplan, 2011), this may indicate changes in percentages of the intake of food items in human modified areas. The availability and amount of specific natural derived food items can indicate a bigger food range (Johnson, 2013). This may indicate the difference in natural diet, and the baboons will find trees to meet their nutrient intakes (SA National biodiversity institute, 2020). At this level of analysis, baboons' foraging strategy can be characterized as highly flexible and adaptable (Whiten, 1991).

7.8 Behaviour at the dumpsite and in their natural home-range

The study troop of this research consisted only of 23 individuals, including ten adults (seven females and three adult males), nine juveniles and four infants. The group sizes investigated by Henzi (1999) resulted in an average of 45 adult females and 22 adult males over 23 different groups of baboons. The research of Henzi (1999) resulted in that the mean group size within chacma populations is smaller than in other baboon subspecies. Sex ratio in chacma baboon troops (males/females) are more female biased, the same in this study group (Henzi S. P., 1999). The smaller groups sizes and the number of females are likely due the environmental conditions below the tropic (Henzi S. P., 1999). The daily life of this baboon troop consisted mostly of feeding, foraging, grooming and moving. Feeding is done for approximately 25% of their time, foraging 10%, grooming 16% and resting for approximately 23% and moving for 20%. Feeding and foraging are mostly done in the human-modified area while grooming, resting and playing is done the most in their natural home-range. The results of the research of Post (1981) indicates that baboons spend approximately three-quarters of their time on feeding or moving. The difference in activity patterns of this baboon group and the baboon group researched by Post (1981) may be influenced and varies to any characterization of their lifestyles and lays a foundation for interrelating their ecology and behaviour (Post, 1981). The lifestyle of baboons living next to a local dumpsite, were spending 20% of their time feeding and 50% of their time resting (McCleery, 2014). Supplemented with the easy access to human food, primates exhibit increased growth rates and are able to allocate more time to rest and social behaviour (Kaplan, 2011).

Behaviours in their home-range are mostly grooming, playing, resting and walking. This significant result indicates where primates are putting more time in and can be named as main behaviours. It does not indicate that the baboons ‘‘playing” as long as ‘‘showing aggression”. There is a trend visible that shows that grooming and resting increases with increasing temperatures while feeding and moving declines with increasing temperatures. The baboon’s peak moment for resting and playing is between 12:00 and 15:00, the hottest part of the day. Moving and feeding is usually done between 06:00 and 09:00 & 09:00 and 12:00, the cooler part of the day. Grooming is consistent during the day (Hill, 2006). The thermal environment is an important factor of the behaviour schedule of the baboons and activity through its influence on habitat selection and day-journey routes (Hill, 2006). Seyfarth, (1978) hypothesized that grooming is exchanged for also other commodities, including support in alliances, tolerance at feeding sites, or access to infants.

Grooming behaviour mostly done by the adult females in the group to each other and resulted in one of the main behaviours in duration. Grooming is widely considered to provide meaningful measures of social relationships among nonhuman primates. The research of Silk (2006) suggests that social bonds play a vital role in females’ lives, and the ability to establish and maintain strong social bonds may have important fitness consequences for females. The adult males compared with the adult females almost rarely groom. The study of Seyfarth, (1978) suggest that males grooming females only rarely outside the sexual partnership. When males did groom females, they groomed the same individuals with whom they shared most frequent proximity and by whom they were themselves groomed most often.

7.9 Baboons reacting to the presence of humans and other baboon troops

This baboon troop in this study is habituated for a period of approximately six months. Because baboons are highly terrestrial primates, this makes them easy to observe when compared to arboreal primates (Maurice, 2018). While numerous studies demonstrate that negative responses to humans decrease over time, the fact that an animal does not flee from or behave aggressively towards observers cannot be taken as evidence that it is not altering its behaviour, because remotely monitoring the behaviour of wild animals is difficult (Crofoot, 2010). Only a handful of studies have considered to some degree the long-term consequences of habituation on wild primates. This is researched by Shutt (2014). It resulted in the three main effects of habituation: 1) increased vulnerability to poachers, 2) changes in ecology and behaviour, and 3) the introduction and transmission of disease (Shutt, 2014). The human-baboon interaction may be influenced by their overlapping niche. They are living in a home range of approximately 615 m^2. Compared with the study of Hoffman (2011), it resulted that the troop of 115 individuals living in a home range of 9.50 km^2. This indicates a very small home range compared with other baboon troops. Their small home range can be influenced by the availability of the dumpsite. The open dumpsite functions as an extra source of food source and may cause a decrease in travel costs of the baboons (Milton, 1976). Competition over food and space is a primary driver of human–wildlife conflict (Kaplan, 2011).

7.10 Limitations during the research

Outside influencing factors were found during the research. It was not counted on the dense vegetation on the dumpsite, that limited the length of the transects. The disadvantage of the relatively short duration of the present study is that it is hard to assess the potential impact of anthropogenic waste on baboons and the potential human-baboon interactions in and near the community. During this research, there was a plan to conduct stakeholder interviews in order to get in-depth information about dumping anthropogenic wastes and the potential human-baboon interactions in the community. The lack of knowledge in primatology is also a limitation. Time-wise it takes much time, to conduct the pilot study, adapting the methods and applying the method again. Knowing the primate, behaviours, and the habituation process is also time consuming. A limitation in this research was that the group of baboons had been lost for a few days.

8. Conclusion and recommendation

After analysing and discussing all the data that has been collected, a conclusion is drawn to answer the research question. This is done by drawing a conclusion per sub research question, followed by recommendations for future research and implementations.

8.1 Conclusion

I. To what extent does anthropogenic waste occur in the natural environment and its spatial distribution in relation to the baboons?

Recyclable waste is the most common waste what is found in the environment. Glass is the most common item in this category. It can be concluded that how closer to the dump; more wastes were found in significant numbers. Further away from the dump, concluded in less anthropogenic wastes. This also resulted in higher densities closer to the dump compared with further away from the dump. The natural environment plays a significant role in the spatial distribution of anthropogenic wastes. More open vegetation structures lead to further spreading of anthropogenic waste and consisted more wastes in comparison with dense vegetation. Dense vegetation, functions as a natural border. Anthropogenic wastes in the surrounding were caused by human waste disposal methods and were not caused by the extent of baboons.

This is not confirming the hypothesis of 'plastics are the most common items found in the environment and the extent of baboons influences the spatial distribution'. In contrast, it confirmed the hypothesis of 'vegetation structures affecting the spatial distribution of waste and the sequence of waste from the dump into the natural surrounding'.

II. To what extend is unnatural behaviour present of the Chacma baboons in and around the dumpsite, and can this lead to unnatural group behaviour and interaction with people?

It can be concluded that a steel railing with points on edge is not enough to keep the baboons outside the dumpsite. The availability of organic (food) waste in the dump is causing an additional food source in the daily life of the baboons. Visiting the dumpsite is part of their new routine. The food intake of baboons has changed to anthropogenic food sources like bread, leftover fruits and vegetables and soft drinks. Their natural food intakes were mostly fruits and grasses. In addition to changes in dietary preferences, the distribution and quantity of food waste are likely to influence the carrying capacity, behaviour, and habitat use. At the dumpsite, the foraging and feeding behaviour is highly present due to the availability of new sources of organic food. It can be concluded that behaviours like grooming, resting and playing are done mostly in their natural habitat. The troop is spending significant time grooming, and this concludes in strong interactions and bonding in the baboon troop. The confidence to be around humans (in the community and the dumpsite) is causing a higher potential of human-baboon interactions. Humans (except the observers) usually cause flight behaviour of the baboons when they are in eyesight. Even the baboons will normally flight form human presence; there are confident enough to be very close in the surrounding of humans. Farmers saw every baboon troop as 1 group; this could lead to the increasing of baboons being killed because of their adapted behaviour towards humans.

This is not confirming the hypothesis of "increased aggressive behaviour due to extra food sources in the dumpsite in contrast to their natural home-range" In contrast, it confirmed the hypothesis that the access to human-derived foods increases the diet variety of baboons and the decrease in foraging behaviour in their natural home-range. It is also confirmed that the home-range of this baboon troop is very small and the increases potentials in human-baboon interaction due to overlapping habitats.

III. **Overall conclusion**

The overall conclusion to answer the main research question: **'*How is anthropogenic waste, in and around the dumpsite, affecting the baboons and the potential human-baboon interactions in Alldays, South Africa?***

Anthropogenic wastes outside the main dumpsite were not causing potential risks towards the baboons. On the other hand, anthropogenic food wastes in the main dump itself are affecting and attracting the surrounding wildlife and the baboons. In foraging food waste, animals are at risk of consuming plastic and other non-digestible waste. Anthropogenic wastes are far too high in caloric, fat and carbohydrates. This results in unhealthy food and unhealthy baboons. In addition to changes in dietary preferences, the distribution and quantity of food waste are likely to influence the behaviour and habitat use. Their home-range is very limited, and overlapping niches were causing an increased- negative-human-baboon interaction. Human-baboon interactions facilitate the spread of disease and pathogens due to the availability of anthropogenic (organic) waste.

8.2 Recommendations

While the consumption of plastic by marine wildlife is well-studied it is less so for terrestrial species. Risks of intake of plastics need to be more researched to conduct management strategies for protecting the species.

It is recommended to start an education programme in the local community about proper waste disposal. In this way, the number of wastes outside the dump can be decreased. By planting more thorny bushes in the surrounding of the dumpsite, it can function as a natural border to stop further spreading of wastes into the environment. Acknowledged baboon-proof electrified perimeter fencing is the best defence. Electrified barriers under the eaves prevent baboons from climbing onto the roof. This is an expensive, maintenance-heavy option. However, not available to many subsistence farmers living in rural locations. Additionally, it is recommended to create baboon-proof containers, which are hard to open, where organic waste can be stored in the dumpsite. In this way, the attraction and availability of organic food wastes may be declined. Management and awareness can help by creating solutions to storing waste in the houses. Management strategies may be applied:

- Double lockable bins what is secured, so that baboons cannot knock it over;
- Padlock bins, in order to deter baboons from entering local villages;
- Storing bins in a garage, a locked cage or secured to a pole or wall;
- Not leaving any food, especially fruits, in plain sight of the baboons;
- Never dump any organic matter into the garden as this will attract baboons.

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10. Appendix

I. Transect example sheet

#Transect	Segment	Braun blanquet	Vegetation	GPS ID	GPS coordinates		1st transect #Recyclable	#Non-recyclable	#Organic	#Ecobricks	Distance in meters from the transect
1	0-10	5	Grassland	73	S22 39.023	E29 07.046		1			1.7
1	0-10			74	S22 39.024	E29 07.047		1			1
1	0-10			75	S22 39.025	E29 07.046	1				3.9
1	0-10			76	S22 39.027	E29 07.048	3	2			6
1	0-10			77	S22 39.028	E29 07.050		1			1
1	0-10			78	S22 39.028	E29 07.046	1				0
1	0-10			79	S22 39.029	E29 07.046					0
1	0-10			80	S22 39.030	E29 07.045					0
1	10-20.	1+	Grassland occ. Thorny bushes	81	S22 39.032	E29 07.049		1			1

II. Focal and scan sample sheets

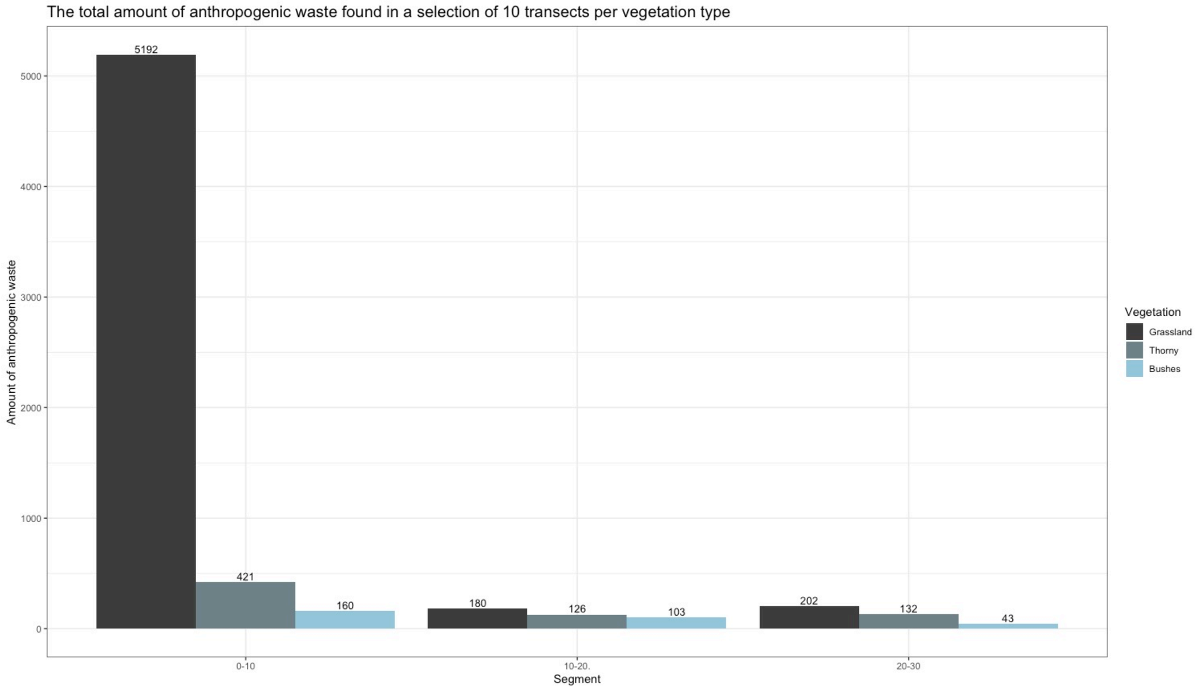
Date	start time	End time	Duration of behaviour	Focal ID number	Age-sex of focal animal	Activity	Sub behaviour	Types of food	Name of food plants	Name of parts eaten	Anthropogenic food types	Partner
20/02/2020	06:19:39	06:19:55	00:00:16	1	AM	Others						
20/02/2020	06:19:55	06:20:29	00:00:34	1	AM-.	Feeding	Feeding	Natural vegetation	Unid plant	Grass		
20/02/2020	06:20:29	06:21:21	00:00:52	1	AM-.	Others						
20/02/2020	06:21:21	06:21:40	00:00:19	1	AM-.	Feeding	Feeding	Natural vegetation	Glossy-leaved corkwood	Leaves		
20/02/2020	06:21:40	06:22:34	00:00:54	1	AM-.	Others						
20/02/2020	06:22:34	06:22:47	00:00:13	1	AM-.	Feeding	Feeding	Natural vegetation	Unid plant	Grass		
20/02/2020	06:22:47	06:22:58	00:00:11	1	AM-.	Vigilance						
20/02/2020	06:22:58	06:23:22	00:00:24	1	AM-.	Feeding	Feeding	Natural vegetation	Unid plant	Leaves		
20/02/2020	06:23:22	06:24:45	00:01:23	1	AM-.	Others						
20/02/2020	06:24:45	06:25:34	00:00:49	1	AM-.	Feeding	Feeding	Natural vegetation	Velvet raisin	Seeds		
20/02/2020	06:25:34	06:26:14	00:00:40	1	AM-.	Others						
20/02/2020	06:26:14	06:26:57	00:00:43	1	AM-.	Others						
20/02/2020	06:26:57	06:27:13	00:00:16	1	AM-.	Feeding	Feeding	Natural vegetation	Velvet raisin	Seeds		

Date (dd/mm/yy)	Time of the scan	Weather	Habitat	Age-Sex class	Sub behaviour	Food types	Plant species	Food items	Partner
20/02/2020	06:00	Mosty clear	Natural	AM-.	F	Natural	Unid plant	Gr	
20/02/2020	06:00		Natural	AF-.	RST				
20/02/2020	06:00		Natural	AF-.	WA				
20/02/2020	06:00		Natural	Juv	PL				Juv
20/02/2020	06:00		Natural	Juv	PL				Juv
20/02/2020	06:00		Natural	Juv	F	Natural	Unid plant	Gr	
20/02/2020	06:30	Clear sky	Natural	AM-.	GR				AF-.
20/02/2020	06:30		Natural	AF-.	GG				AM-.
20/02/2020	06:30		Natural	Juv	F	Natural	Velvet raisin	Se	
20/02/2020	06:30		Natural	AF-.	WA				
20/02/2020	06:30		Natural	AF-.	WA				
20/02/2020	06:30		Natural	Juv	F	Natural	Unid plant	Gr	
20/02/2020	06:30		Natural	Juv	F	Natural	Unid plant	Gr	
20/02/2020	06:30		Natural	Juv	F	Natural	Unid plant	Gr	

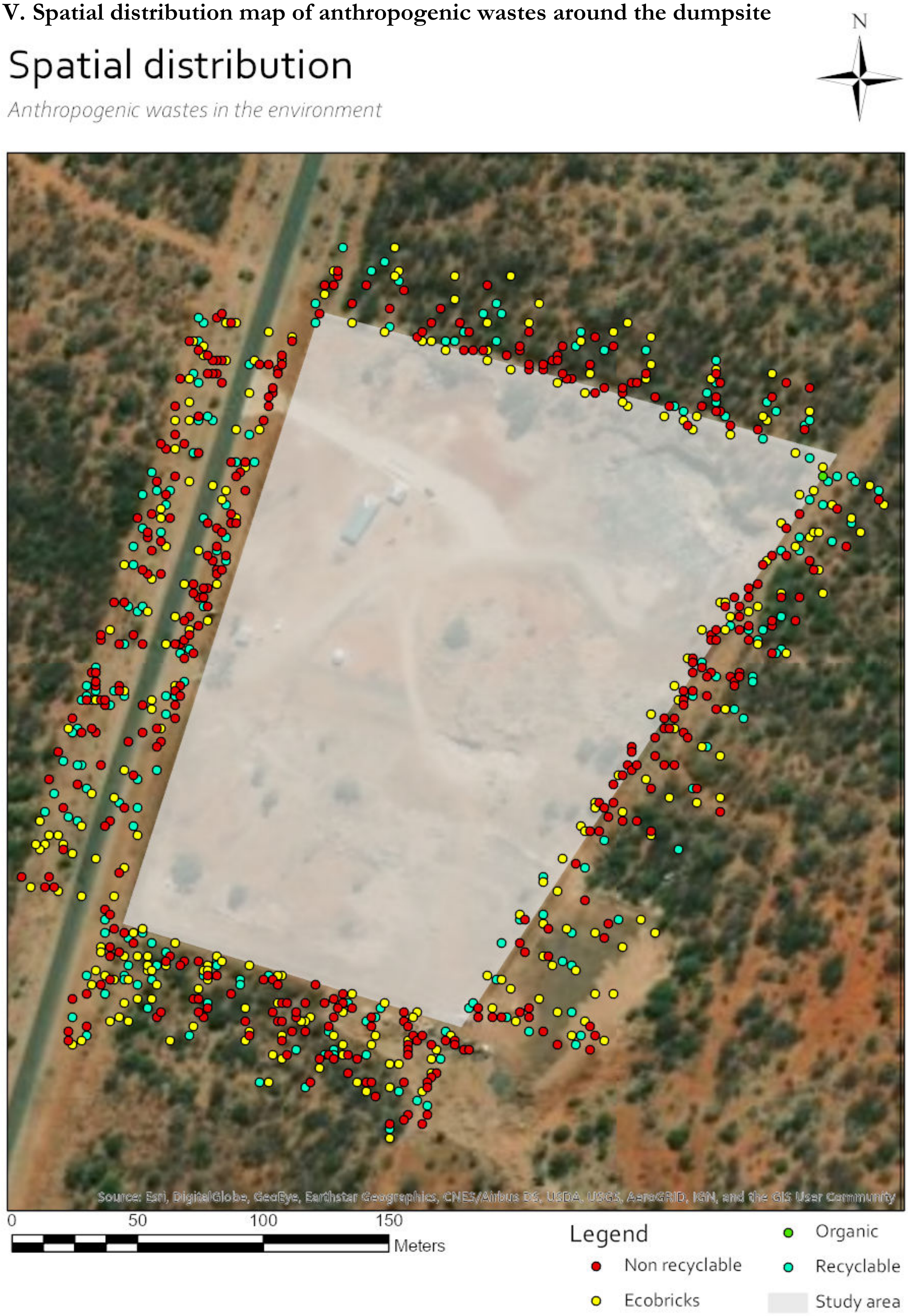
III. Abbreviation list of behaviour and plant species

Abbreviation	Description				
Behaviour		**Food**		**Trees**	
AM	Adult male	**Le**	Leaves	**Vr**	Velvet raisin
AF	Adult female	**Fr**	Fruits	**Ma**	Marula
SAM	Sub adult male	**Se**	Seeds	**Wr**	White raisin
SAF	Sub adult female	**Fl**	Flower	**Com C**	Common corkwood
Juv	Juvenile	**Ro**	Root	**Sb**	Sicklebush
F	Feeding	**Bud**	Bud	**Sr**	Sandpaper raisin
M	Moving	**Bark**	Bark	**Vc**	Vervet-leaved corkwood
R	Resting	**Gr**	grass	**Ft**	Flame thorn
A	Agression	**Gum**	Gum	**Ba**	Baobab
V	Vigilance	**He**	Herbs	**Kt**	Knob thorn
RST	Resting standing	**Ani.der food**	Animal derived food	**FB**	Four-leaved bushwhillow
WA	Walking	**Inv**	Invertrabate	**Rc**	Rough-leaved corkwood
PL	Playing	**Fun**	Fungus	**Mr**	Mallow raisin
GR	Grooming received	**Cp**	Cheec pouches	**St**	Sweet thorn
GG	Grooming given	**OT**	Others	**Rb**	Red bushwillow
Others	Behaviour not noted in this list	**Fcp**	Feeding cheek pouth	**Ps**	Prey species
RS	Resting sitting	**L veg**	Leftover vegetables	**Gr**	Grasshopper
RL	Resting laying	**L Fruit**	Leftover fruit	**Mo**	Moth
SDB	Self detected behaviours (selfgroomig, yawing, body shaking, scratching)			**Up**	Unid plant
RU	Running			**Poc**	Poison-grub corkwood
FO	Foraging			**Cop C**	Copperstem corkwood
Vigilance	The action or state of keeping careful watch for possible danger or difficulties			**Gc**	Glossy-leaved corkwood
Affiliation	Tendency to approach, interact with, and remain near another individual in the social group			**Pc**	Purple pod clusterleaf
RH	Resting huddle				
IU	Unidentified				
MA	Mating				
II	Interspecies interactions				
CL	Climbing				

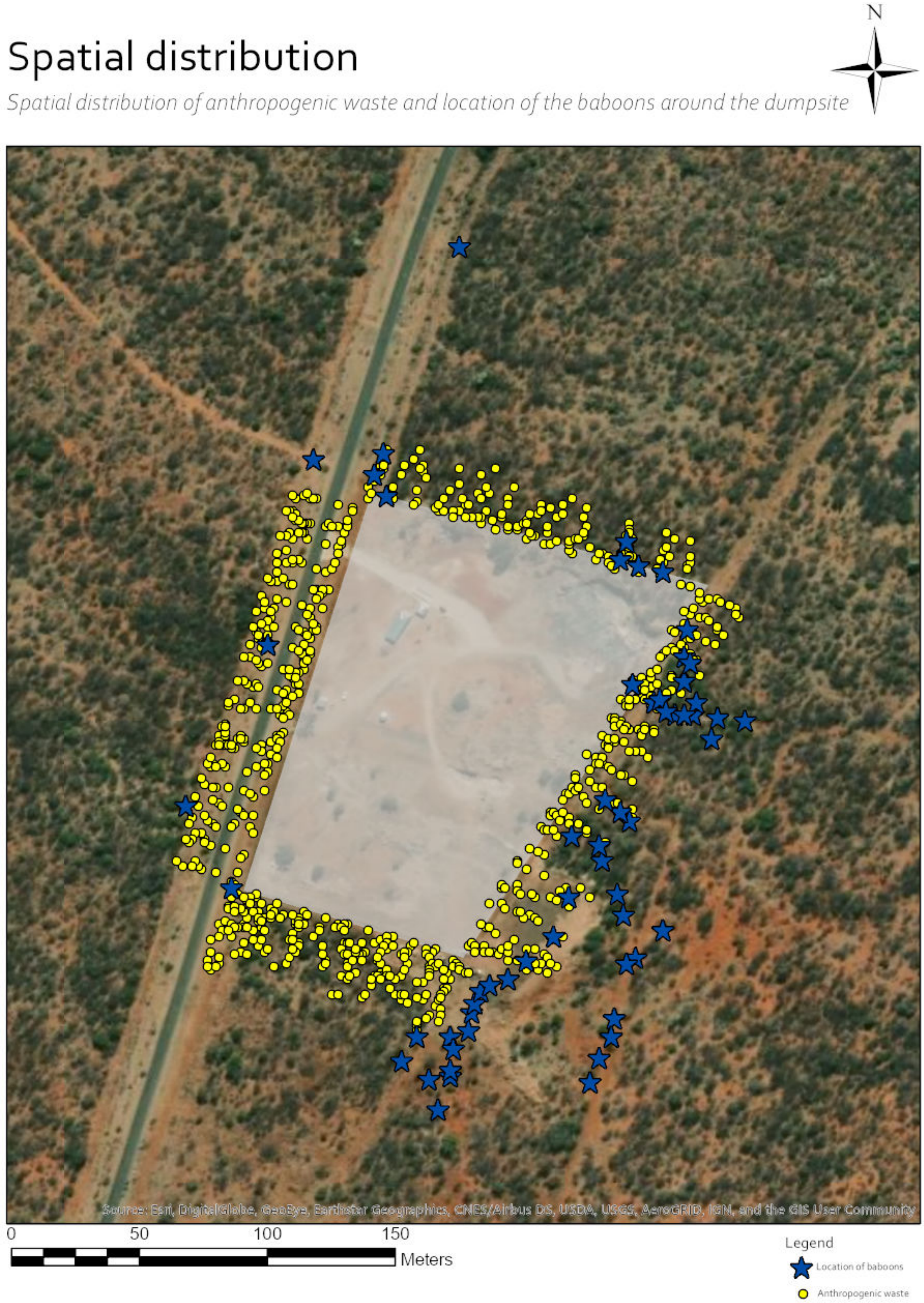
IV. Zoomed-in graph of a selection of 10 transects per vegetation type



V. Spatial distribution map of anthropogenic wastes around the dumpsite



VI. Spatial distribution map of anthropogenic wastes and location of the baboons



VII. Map of baboons entering the dumpsite

VIII. Home range of the baboons