INCORPORATING COMMUNITY CONSERVATION WITH WASTE MANAGEMENT IN THE WOLFGAT AND WITZANDS AQUIFER NATURE RESERVE, CAPE TOWN, SOUTH AFRICA.

by

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DECLARATION

I, Xolisiwe Sinalo Grangxabe, declare that the contents of this dissertation represent my own unaided work, and that the dissertation has not previously been submitted for academic examination towards any qualification. Furthermore, it represents my own opinions and not necessarily those of the Cape Peninsula University of Technology.

Signature:

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Date:

16 November 2021

ABSTRACT

Nature Reserves have played a pivotal role in conserving biodiversity for many decades. Nonetheless, migration and rapid population increase in metropolitan areas have resulted in the creation of residential areas adjacent to protected areas leading to a growing volume of solid waste in nature reserves as a result of littering and unlawful dumping. The purpose of the study was to investigate neighbouring communities' socioeconomic impact on the nature reserves and how the relationship between the study sites and their communities can facilitate effective waste management. The research was conducted at two of the City of Cape Town's nature reserves in Western Cape; South Africa, using a mixed method approach; Qualitative and Quantitative. A total of 40 and 45 households were randomly selected in Wolfgat Nature Reserve and Witzands Aquifer Nature Reserve, respectively. Structured questionnaires were used to collect field surveys from selected households, which were then analysed using statistical package software.

The study's findings were consistent with prior studies which revealed that ignoring local communities often leads to people disregarding the appropriate regulations in place. Nonetheless, the survey discovered a lack of community practical participation, and the reserve managements were more reactive than proactive. In this study, the level of education, which in some studies is always associated with knowledge, was contradicted; those with post-secondary education knew little about these protected areas, and the vast majority of participants did not know the protected areas located just a few kilometres from their communities.

The study revealed that in order to address illegal dumping and littering, nature reserves must take a people-centred approach and gain public support by involving the public in critical decision-making and management plans.

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DEDICATIONS

This dissertation is dedicated to my late brother Yandisa Grangxabe, for being a role model, for instilling the passion of learning, teaching me to be disciplined at all times, and for making me understand the value of life.

GLOSSARY

Community-Based Conservation (CBC) - The way/manner of empowering local people in the management process and simultaneously achieving development and conservation goals (Berkes, 2007)

Protected area- It is defined as a geographical space, recognized, dedicated, and managed through legal or other effective means to achieve the long term conservation of nature with associated ecosystem services and cultural values (Dudley, 2008).

Community participation- Involvement of people in community projects to solve their problems, but people cannot be forced to participate in projects which affect their lives but should be given the opportunity where possible (Harvey *et.al*, 2002)

Ecological function- It represents the potential of an ecosystem to deliver a service that is itself dependent on ecological processes and structures (De Groot *et.al,* 2010).

Collaborative management- This can be defined as a collection of various management techniques that enlighten a sense of unity and teamwork among the interested and affected parties to accomplish a common goal (Winter *et al*., 2021)

Protected area outreach- It is a management strategy where a community is allocated ownership or appropriate authority for the management of natural resources which have local value (Berkes, 2009).

Community-Based Natural Resource Management (CBNRM) - Refers to the collective use and management of natural resources in rural areas by a group of people with a self-defined, distinct destiny, using communally owned facilities (Fabricius, 2007).

Integrated Waste Management (IWM) - It is defined as comprehensive waste prevention, recycling, composting, and disposal program, simply incorporate the

waste hierarchy and may attempt to engage with stakeholders (Marshall & Farahbakhsh, 2013)

LIST OF ACRONYMS

CBC- Community-Based Conservation
CBNRM- Community Based Natural Resource Management
CoCT- City of Cape Town
CFN-Cape Flats Nature
ECA- Environmental Conservation Act 73 of 1989
NEMA- National Environmental Management Act 107 of 1998
NEMBA- National Environmental Management Biodiversity Act 10 of 2004
SANParks- South African National Parks
EPWP- Expanded Publics Work Programme
NEMPAA- National Environmental Management Protected Areas Act 57 of 2003
QFLT- Quarterly Force Labour Survey
KNP- Kruger National Park
PI- Principle Investigator
SPSS- Statistical Package for the Social Sciences
POPIA- Protection of Personal Information Act
WNR- Wolfgat Nature Reserve

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CHAPTER ONE: INTRODUCTION

1.1 Introduction and background to the study

Globally, South Africa is recognised for its rich biodiversity, ethnic and cultural diversity (Cocks *et al*., 2018). Cape Town has the most diverse biodiversity and most threatened of any urban area in the world (CoCT, 2008). Due to increased demand for human settlement land, Cape Town is one of the rapidly urbanising cities in South Africa (Du Toit & Neves, 2009). The migration of people from rural areas to urban areas plays a huge role in the rapid human settlement demand, which is motivated by historical migrant labour patterns that have been exacerbated by lack of rural development (Seekings & Nattrass, 2005). The urban population growth and economic development leads to generation of waste. Furthermore, challenging socio-economic conditions contributes to ineffective waste management practices.

According to Hackel (1999) and Brockington (2004), people settle and cultivate new areas as one of their primary responses to population growth and the need for land. This leads to cities increasingly extending into areas of ecological importance hence most protected areas are faced with new sets of complexities such as illegal dumping, rapid global urban growth. Proclaimed protected areas such as the Wolfgat Nature Reserve and Witzands Aquifer Nature Reserves provide multiple environmental services such as erosion control, nutrient cycling, and safe drinking water (Costanza & Folke, 1997; Kalemani & Chape, 2004). They also provide a high level of benefits such as employment and recreational activities. However, de los Angeles Somarriba-Chang (2012) has argued that opening protected areas to human engagement to garner conservation support may exacerbate existing constraints on the natural environment.

As the proximity between urban and protected areas increases so does the potential for human interactions which often results in a whole new set of negative effects such as improper waste disposal (Mcdonald *et al.*, 2009). Communities around the nature reserves tend to illegally dump their waste in

protected areas as these areas are often seen as open spaces that harbour criminals due to their overgrown vegetation (Mcdonald *et al.*, 2009; CoCT, 2019). This is most common in areas of informal settlements as they have no sustainable waste collection services. However, while some throw their waste at the open fields, strong winds and rains drive them straight into the protected areas leading to waste challenges. It has been established that thousands of protected areas are already negatively impacted by urban areas and many more will be impacted in the future (Mcdonald *et al.*, 2009).

Additionally, many other protected areas are suffering from growing visiting pressure and one of the most abundant and noticeable impacts of having humans in protected areas is littering which eventually poses hazardous consequences for biodiversity. For most protected areas, promoting recreational activities and protecting the natural environment tends to be a challenge since the interest of the public is often very different and can be influenced by the ever-changing demographics of urban areas. As a result, failing to engage the community in these areas on a proactive basis can result in massive waste generation, which is frequently linked to a lack of collaboration and unsuitable behavioural patterns. Indeed, the impact of littering on the natural and protected areas is concerning since it adversely affects the visual quality of the environment and can further harm flora and fauna. Furthermore, depending on the toxicity and the environment, littering can act as a major hazardous source of pollution to wildlife, soil, water, and humans (Brown *et al*., 2010; Buckley, 2003).

Different countries deal with the waste generated in their reserves differently. In Bavarian Forest National Park (Germany), guests are obliged to carry their generated waste (Przydatek, 2019), albeit still faced with challenges of illegally abandoned waste. Canada and the United State of America employ the same practice, which in some cases the waste, is collected in containers and then transported to landfill sites. Furthermore, there are no regulations to prohibit composting, incineration, and recycling in France but none of their parks uses these techniques. While, for instance, in African countries such as Uganda, Kenya, Tanzania, and Botswana, transportation distance for waste from parks to

areas of disposal is long and expensive. According to Sobczyk *et al* (2011), wastes are alternatively burnt and buried within the protected areas that are usually closer to the visitors or staff facility. According to Sobczyk *et al* (2011) and Gúčik & Marciš (2017), the waste in the parks is the responsibility of the municipality at which the park exists and also of the visitors.

1.2 Study area

The study was conducted in two different nature reserves, namely Wolfgat Nature Reserve and Witzands Aquifer Nature Reserve in South Africa. Both reserves are managed by the City of Cape Town and were chosen as study sites due to their distinctive size, waste management practices, and proximity to disadvantaged communities. The study areas are further explained in Figures 1 and 2.

Figure 1: Map of Wolfgat Nature Reserve (Source: Jacques van der Merwe)

Wolfgat Nature Reserve is a coastal nature reserve located in the communities of Mitchells Plain and Khayelitsha, between the Mnandi and Monwabisi recreation

resorts. These areas are located on the east side of the coast (-34.060008 S, 18.593046 E). Wolfgat is 248 hectares and was declared a nature reserve in 1986 by the City of Cape Town. It is home to endangered Cape Flats dune Strandveld vegetation and it conserves more than 150 different plant species (CoCT, 2008). For interest sake, a brown Hyena that lived in Cape Town around the 1840s was also found in the Wolfgat cliffs in 1962, which resulted in the reserve being called Wolfgat.

The reserve is known for its perfect destination for picnicking, fishing, and paragliding (CoCT, 2008). Disadvantaged communities board the reserve, which makes it prone to illegal activities. More than half of Cape Town's unemployed live in the notoriously high crime area of Khayelitsha that has a population of 391,749 (Stats SA, 2011), and a dominant population group of black Africans, Mitchell's Plain is a large, sprawling coloured township with a population size of 310,485 (Stats SA, 2011). Mitchells Plain is one of fifteen areas identified as a high priority for action against crime and drug abuse (Eksteen, 2012; Stats SA, 2011).

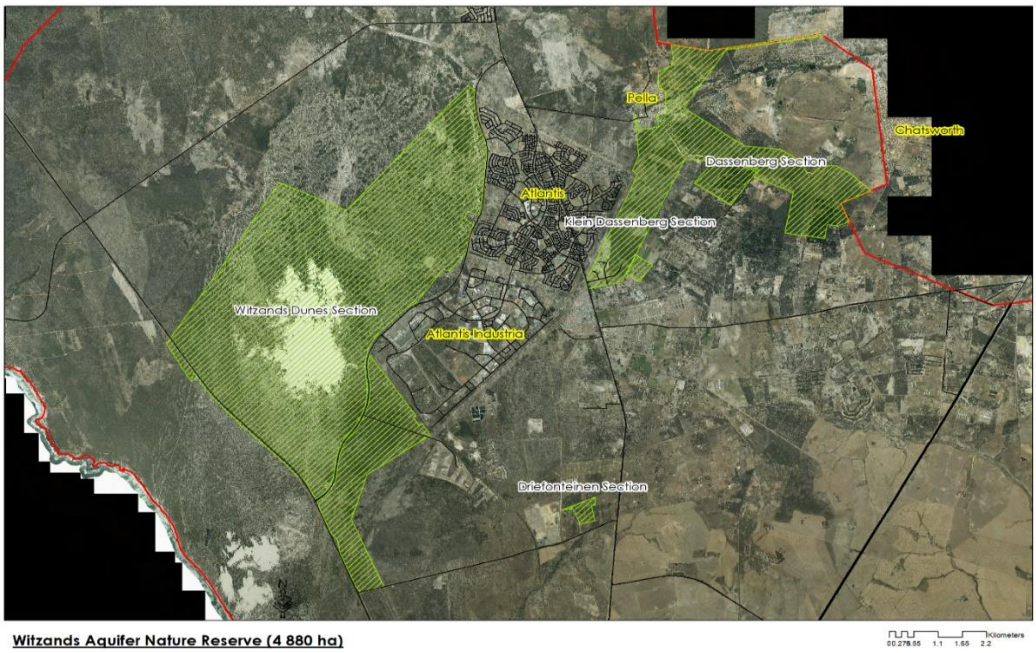


Figure 2: Aerial photograph of Witzands Aquifer Nature Reserves (Source: Jacques van der Merwe)

The Witzands Aquifer Nature Reserve consists of the Atlantis Dune field that makes up 1750 hectares. According to CoCT (2008), the reserve is home to two distinct vegetation types: the critically endangered Cape Flats dune Strandveld, which is the reserve's dominating vegetation, and the critically endangered Atlantis sand Fynbos. The non-vegetated mobile dunes and rocky outcrops are two outstanding features of the nature reserve (CoCT, 2008); the dunes are mostly used for leisure activities, and this increases the number of visitors to the area.

The reserve is close to residential communities and industries. Some of the communities include Atlantis, Mamre, Witzands informal settlement, and Pella. Except for Witzands informal community, these communities rely significantly on the reserve for water. The reserve has an underground natural aquifer, which is managed by the City's Bulk Water Branch. Water is extracted and purified to potable water from this aquifer (Eksteen, 2012). The residential communities are coloured dominated and characterized by a low to middle-income margin (Stats SA, 2011). Atlantis has a population of 67 491 with a 37% unemployment rate (CoCT, 2006; Stats SA, 2011). Mamre has a population of 9,048 while Pella has a population size of 1,681 (Stats SA, 2011).

1.3 Problem statement.

Globally, community-based conservation is utilised to engage local communities in the protection of nature and its wildlife. It is also used to further establish an interconnected relationship between members of the community, environment, and Nature Reserve management. However, it cannot be neglected that waste left in protected areas by some individual members from these communities has an unavoidable environmental impact (Buckley, 2003). Protected areas are specifically designed to conserve natural resources and restrict human impacts but with the population’s rapid increase in protected areas, according to De Witt & Van der Merwe (2015), this leads to an increasing number of environmental concerns such as waste pollution. For years, irresponsible waste dumping has been one of the most visible ways of degradation in protected areas since it affects the visual quality of the environment (de los Angeles Somarriba-Chang,

2012). Furthermore, improper waste management is gradually impacting key elements of the environment and human health. A study by Kadafa *et al.,* (2014) & Przydatek (2019) indicated that the growing amount of solid waste is a key challenge for many developing countries and therefore, protected areas are no exception. The fundamental question is whether an integrated strategy where community participation can be incorporated with waste management strategies can reduce illegal dumping as well as waste generation in protected areas.

1.4 Research question

- To what extent does community conservation occur at the nature reserves?
- How do nature reserves manage illegal dumping of waste?
- What is the effectiveness of a waste management plan in the Wolfgat and Witzands Aquifer Nature Reserve?
- How has history influenced community perceptions toward nature reserves?
- What are the possible socio-economic impacts of the nature reserves on the surrounding communities?

1.5 Aim

- The overall aim of the study was to determine how community conservation can be combined with waste management to reduce waste generated at the reserves, as well as to determine the socio-economic impacts of the nature reserves on the surrounding communities.

1.6 Objectives

- To assess the approach used by nature reserves in promoting community engagement.
- To assess the level of community participation in the management of Wolfgat Nature Reserve and Witzands Aquifer Nature Reserve.

- To investigate the effectiveness of a waste management plan in place.
- To assess the possible socio-economic influence the nature reserves from the surrounding communities.

1.7 Ethics (Ref: 214261867/06/2021)

Ethical considerations were strictly adhered to throughout the study, particularly concerning the selection of participants, and thus the survey was responded to anonymously and research activities were limited to those specified in the research proposal.

- All communications were in English.
- No participants under 18 years old were surveyed.
- No personal information was obtained, only information related to the study.
- The study complied with the Protection of Personal Information Act (POPIA)
- Consent forms for City of Cape Town key participants were used.
- Questionnaires were used to collect data from the neighbouring communities.

1.8 Delineation

The study is investigating improper waste management in protected areas/nature reserves, and how community conservation can be incorporated to solve waste management. The study uses the City of Cape Town Nature Reserves as study areas. These nature reserves are explicitly Wolfgat Nature Reserve and Witzands Aquifer Nature Reserve, which are based in the north and east of Cape Town, respectively. Furthermore, the study focusses on the communities around the nature reserves including community leaders and as well as reserve staff.

1.9 The rationale of the study

Very few studies on waste management have been carried out in protected areas situated near/close to communities in urban and rural areas. There is a great deal of literature on waste management in urban locations, but there is little literature on waste in urban protected areas. Although extensive research has been done on Community Based Natural Resource Management (CBNRM) and Community-Based Conservation (CBC) in rural areas and few in urban areas (Eksteen, 2012; Ramutsindela, 2004; Western & Wright, 1994). Additionally, little attention has been placed on how communities can be included as crucial stakeholders in waste reduction and in raising awareness to other members of the communities. Therefore, this study aims to investigate how community conservation can be used in protected areas to manage waste generation, in such a way that the community will be involved in waste management plans as they are the main waste generators. The study investigates how community conservation occurs in these protected areas; this will be framed around waste as an environmental challenge that requests both the community and nature reserve to manage sustainable.

CHAPTER TWO: LITERATURE REVIEW

2.1 Introduction

The population in developing countries is rapidly increasing and leading to high demand for space. As a consequence, residential areas are slowly being built close to protected areas which lead to physical interaction between the people and the natural environment. For years, protected areas have been seen as areas of ecological importance with minimum or no disturbance and these areas were once managed as a separate ecosystem that excluded people (Khan, 1994). It was later realised that the exclusion approach created tension between protected areas and the neighbouring communities. Although visitors and surrounding community members are allowed in certain protected areas, these areas often experience environmental challenges. Illegal dumping is a worldwide problem for natural protected areas (Jakiel *et al*., 2019) and so is ignorant behaviour or lack of awareness by visitors who continue to litter in these protected areas (Sewak *et al.*, 2021).

The waste problem is not only a challenge to South African nature reserves but is a global issue especially in developing countries where education and environmental awareness are insufficient. According to Pryzdatek (2019), countries manage protected areas differently. For example, waste management in South African nature reserves is guided by several laws such as the National Environmental Management Act 107 of 1998 and National Environmental Management: Protected Areas Act 57 of 2003. However, with these regulations in place, nature reserves are still faced with littering issues (see Appendix G). The conceptual framework of this study looks at literature that seeks to address illegal dumping of waste and explore community involvement strategies that can effectively tackle waste problems in protected areas.

2.2 Relationship between the local communities and the protected areas

Some communities reside around protected areas of South Africa and these communities can be categorised as neighbouring and distant communities (Simelane *et al*., 2006). Protected areas restore and preserve the state of

resources and natural environment, which are protected by different agencies such as national and provincial governments. These areas are very important as they play a vital role in protecting fauna and flora. Several studies have shown that people within these communities rate their relationship with their neighbouring protected areas as relatively poor (Kaltenborn *et al*., 2008; Netshakhuma, 2021). A good example would be Kruger National Park whereby the neighbouring communities continue to clash with the park management (Musavengane & Kloppers, 2020). Whilst there have been clashes between the local communities and the conservators. Andrade & Rhodes (2012) showed that, despite the poor relationship, most local communities are still willing to support conservation and management of biodiversity through engaging with the Nature Reserve Managements.

A number of studies have also shown that communities do have a limited understanding of resources occurring within their neighbouring protected areas (Andrade & Rhodes, 2012; Angwenyi *et al*., 2021; Western & Henry, 1979) and this is because many protected areas followed the conventional and exclusionary approach whereby people were denied access to the areas. This is a trend that was also observed and applied globally many years ago (Andrade & Rhodes, 2012). Furthermore, Simelane *et al* (2006) indicated that the limited understanding of natural resources in South Africa is understandable since most conservation areas have been privately fenced after communities were removed without any proper explanations. Furthermore, previous physical exclusions have restricted local communities from understanding the importance of natural resources in embracing the concept of human development through conservation (Western & Henry, 1979; Khan, 1994). On the other hand, many researchers have revealed that many protected areas have not succeeded in integrating social, cultural and political factors (Andrade & Rhodes, 2012).

In some cases, neglecting the local communities may trigger adverse social impacts on local communities. Therefore, such outcomes may result in hostile attitudes toward conservation strategies that may undermine the protection policies and reduce the effectiveness of protected areas for biodiversity.

According to Simelane *et al.* (2006), to avoid conflict between conservationists and local communities, a clear understanding of environmental concerns as well as the role of a community in that specific conservation area must be prioritised to enhance optimal participation of local communities. On the other hand, the lack of relationship between the local communities and the areas of ecological importance can threaten the future and sustainability of protected areas such as the Kruger National Park in South Africa (Simelane *et al.,* 2006). In other words, the management of conservation areas must always adapt and respond rapidly to conservation-related challenges by providing strategies that would also promote the support of the protected areas by the communities.

2.3 Local communities as crucial stakeholders in nature conservation

Biodiversity conservation is faced with novel sets of socio-economic complexities in the rapidly urbanizing areas of Cape Town (Andrade & Rhodes, 2012). Formal and informal areas are rapidly encroaching on areas of ecological importance such as nature reserves. Nevertheless, an increase in the population size around nature reserves is always associated with less compliance and eventual disregard of policies that govern these protected areas (Mutanga *et al*., 2015). As a result, conservation managers are now shifting attention towards implementing community-based conservation strategies. According to Brown *et al.* (2010), the shift to implementing Community-Based Conservation strategies may have possible consequences as some participants who do not value fauna and flora may now be empowered as crucial stakeholders in the management of the protected areas. Such consequences may be due to multiple factors particularly household history, education and gender.

Without the participation and consent of local communities, the protected areas are doomed and as a result, the policies may not be effective in minimizing illegal activities within those protected areas (Andrade & Rhodes, 2012). Particularly in disadvantaged areas, community participation initiative is increasingly important as it empowers members to become more proactive in their communities. Community-Based Conservation is to create a cooperation relationship with all stakeholders, building relationships based on voluntary compliance rather than

enforcement (Lane, 2001; Andrade & Rhodes, 2012). Furthermore, there is evidence suggesting that when scientific and traditional knowledge is combined to manage the protected areas, local communities are more willing to comply with the policies of protected areas because they feel they are part of the decision-making processes (Sewak *et al.,* 2021.). Local communities are more likely to comply and commit to long term conservation strategies when their knowledge and opinions are accepted and incorporated during the decision-making processes (Soliku & Schraml, 2018). It is evident that the inclusion of local communities in the activities of protected areas is extremely vital (De pourcq *et al*., 2017) as it also encourages law enforcement as the cornerstone for the success of conservation in protected areas.

Although waste in South African nature reserves is addressed by several regulations such as the National Environmental Management Protected Area Act of 2003 (NEMPAA) and National Waste Management Strategy of 1999 which fall under National Environmental Management Act (NEMA), literature shows that the bigger the protected area the lower the compliance with these regulations (Mutanga *et al*., 2015). However, if the local communities are treated as critical stakeholders, this can also motivate them to become local law enforcers thereby inhibiting and reducing illegal activities in the affected protected areas (Bruner *et al.,* 2001). According to Kaltenborn *et al.* (2008), collaborative management of protected areas improves biodiversity protection and has become critical for the long term success of protected areas. The partnership with local communities and protected areas staff/managers could promote a win-win outcome because local communities often argue that reserve managers served the interests of the nature reserves at the expense of their livelihood (Andrade & Rhodes, 2012). Therefore, incorporating locals in conservation efforts could indeed promote effective conservation. De pourcq *et al.* (2017) also noted that understanding and incorporating the views of local people in decision making and providing alternative livelihood solutions are important steps towards successful conservation.

2.4 The relationship between protected areas and local communities

Several studies have shown that the relationships between Nature Reserve management and local communities are not easily created and once they have been created they are hardly maintained (Angwenyi *et al*., 2021; Eksteen, 2012). Therefore, the depth of the relationship is not important as long as it is equally beneficial to communities and the Nature Reserve management (Eksteen, 2012). Balancing social needs with conservation needs is a struggle for Nature Reserve management but there are many successes in cases where this balance was realised. A positive community relationship enhances conservation. On the other hand, the attitudes and approaches of staff members that manage protected areas play a fundamental role in promoting and ensuring community participation and the maintenance of biodiversity, respectively. In other words, if the staff of the protected areas does not respect and value the traditional knowledge of the local communities the communities can directly or indirectly refuse to participate with authorities of the protected areas. According to Mutanga *et al* (2015), a relationship refers to the interaction between two or more people in which the participants are interdependent. Therefore, each stakeholder must be treated as important as the other and must be an active participant. The staffs of protected areas are an important component in the global conservation environment. Hence, understanding their views is important in ensuring balanced conservation from both the perspectives of protected areas and local communities (Mutanga *et al*., 2015).

According to Andrade & Rhodes (2012), the success of protected areas lies in the ability of managers to promote greater compliance of local communities with the conservation strategies of protected areas. The relationship between protected area management and adjacent communities is mostly dependent on the communities and staffs attitude but mostly on the managers. Some studies concluded that reserve managers should look at communities as active partners in the management of protected areas if sustainable conservation objectives are to be realised (Andrade & Rhodes, 2012; Angwenyi *et al*., 2021; Graham & Ernston, 2012). Meaning that if the staff of the protected areas work disjointedly

from their adjacent communities, nature conservation cannot be realised (Soliku & Schraml, 2018).

Based on a study by Angwenyi *et al.* (2021), it is shown that most local communities closer to the reserve disapprove of the managers that are in charge of the reserve if there is no form of interdependent relationship between them. Most locals often feel like the managers are forced onto them and according to Angwenyi *et al.* (2021), this can create mistrust between local communities and reserve management as they do not share common objectives and understanding. Soliku & Schraml (2018) noted that making decisions that affect the local community without involving them could result in retaliation and hostile decisions.

2.5 Waste management policies, by-laws and regulations

The South African government has formulated guidelines and regulations to address the inequality of the past by ensuring that conservation no longer requires certain people to be excluded from protected areas and nature be left separated from the people. However, addressing the inequality of the past was not a solution to the problems faced by Nature Reserve management in protected areas. Despite having by-laws, national and provincial regulations in place, the issue of people not following those rules seems to be a challenge in most protected areas. There have been growing concerns about illegal access to the protected areas and illegal dumping of waste (Rodriguez- Rodriguez, 2012) which impacts negatively on biodiversity.

Conservators often struggle to achieve conservation goals on a full scale even though conservational areas are guided and regulated by several waste management regulations which must prohibit littering and pollution in protected areas. In the case of nature reserves, they are proclaimed in terms of the National Environmental Management Protected Areas Act (NEMPAA) 57 of 2003. The 2002 by-law prohibits littering or the dumping of waste and its impact is minimised where littering or dumping of waste takes place. Therefore, the nature reserves by-laws are meant to enable the area to fulfil its obligation in

terms of the NEMPAA that provide protection and conservation of ecological viable areas. In terms of the waste collection in nature reserves, the City of Cape Town may, by written notice, direct the relevant persons to cease the dumping or littering, or to prevent the continuation of the dumping or littering, and to take whatever steps the municipality considers necessary to clean up or remove the waste (Jackson *et al*., 2008. One of the biggest challenges the nature reserves faces is illegal dumping because it damages the environment and it is harmful to the flora and fauna (Haider, 2008). Additionally, it is a time-consuming and costly procedure (see Appendix F). Cleaning up illegally dumped waste is approximately 20 times more expensive than collecting it, as it requires the use of specialized equipment, such as front-end loaders (CoCT, 2016).

The nature reserves by-laws are based on national regulations. However, with these laws in place, waste mismanagement is still a conservation issue. Therefore, it has been argued that conservation needs to combine law enforcement with the local community's support. According to Pekor *et al*. (2019) and Simelane *et al*. (2006), for local communities to be effective custodians of natural resources, it will require building trust between communities and reserve management. For effective conservation, therefore, conservationists must find ways to entice local communities to be interested in the management of the protected area (Pekor *et al*., 2019; Angwenyi *et al*., 2021).

Table 1 below shows regulations and by-laws that are applicable in nature reserves used in dealing with the waste problems faced by certain reserves. Although these regulations exist, waste mismanagement persists, which suggests that law enforcement tools alone cannot solve environmental problems.

Table 1 Summary of applicable regulations and by-laws

Regulations/ By-laws	Description
National Environmental Management Act, 107 of 1998 (NEMA)	Provides for cooperative environmental governance by establishing principles for decision making, institutions to promote

	cooperative governance, and procedures for coordinating environmental functions.
National Environmental Management: Protected Areas Act, Act 57 of 2003 **(NEMPAA)**	Aims to establish a national system of protected areas as part of a strategy to manage and conserve biodiversity and ecosystems.
National Environmental Management: Biodiversity Act, Act 10 of 2004 **(NEMBA)**	Provides for the management and conservation of biodiversity, and the components of such biological diversity, within the framework of NEMA. Provides for cooperative governance in biodiversity management and conservation.
Environmental Conservation Act, Act 73 of 1989 **(ECA)**	The Environmental Conservation Act is the other law that relates specifically to the environment. Although most of this Act has been replaced by NEMA, there are still some important parts in operation. These sections relate to protected natural environments (littering, special nature reserves and waste management.
National Environmental Management: Waste Act 59 of 2008 **(NEMWA)**	The act makes provision with respect to measures to improve waste management practices and most importantly it plays a vital role in the protection of health and the environment by providing reasonable

	measures.

2.6 Factors influencing community's perception, attitude and behaviour towards protected areas

Community attitudes towards protected areas and conservation are affected by several factors which include the history of the protected areas, socio-economic and demographic factors (Graham *et al.*, 2005). Furthermore, unemployment and poverty are major causes of illegal activities such as poaching, encroachment and illegal dumping. However, the history attached to the creation of the most protected areas can affect the way communities perceive/feel about the protected areas. In some instances, the past forceful removal of people from those protected areas could have created social, economic and political tension (Graham *et al*., 2005; Mutanga *et al*., 2015). In many cases, the communities (particularly elders) may harbour deep-rooted memories which their perception regarding protected areas may affect the way they relate to the protected areas (Dube, 2018), and this can result in resentment of protected areas.

In order to rectify mistakes of the past and the dark experiences, a broader array of issues and their root causes must be taken into account to improve nature conservation outcomes (Dube, 2018). The socio-economic status of community members significantly affects attitudes towards conservation and protected areas and this is often due to how protected areas were established and rural communities displaced from their traditional lands and denied access to resources (Barrett & Arcese, 1995; Khan, 1994). In the past, protected areas used to operate directly against the economic interest of local communities which eventually lead people especially in developing countries in Africa to react negatively towards conservation initiatives.

Local communities know and appreciate the importance of nature and natural resources in such a way that they visit protected areas and enjoy intangible values such as aesthetic and spiritual value (Angwenyi *et al*., 2021). Furthermore, several previous studies in developing countries indicate that community attitudes toward protected areas are related to education,

stewardship, participation and cost benefits (Brown *et al.*, 2010; Graham & Ernstson, 2012; Simelane *et al*., 2006). This is an indication that, if local communities are allowed to participate in the day-to-day running of reserves, they are likely to become effective partners.

2.7 Deterioration of the natural value by littering

The fast-growing public use of protected areas such as nature reserves often overwhelms the carrying capacities (Pryzdatek, 2019). The increase in visitation to protected areas has been growing and this is linked to population increase around these areas. Furthermore, it has been recorded that pressures from mass tourism and visitation have been identified as the main current threat to the conservation of protected areas (Rodriguez- Rodriguez, 2012). Mass tourism and visitation by locals are indirectly deteriorating the natural value of nature reserves due to illegal dumping of waste or waste that is pushed to the nature reserve by wind or rain. A baseline study to develop a waste management plan for Baviaanskloof Nature Reserve and adjacent areas by Haider (2008) showed that improper waste management can lead to negative environmental and health impacts. While a study by Przydatek (2019) shows that the negative impact of waste mismanagement on the natural environment is mainly noticeable as it affects the vegetation, aesthetic value and scars wildlife such as birds which may get entangled and also feed on the waste. In other studies, the waste problem is associated with the degradation of fragile ecosystems which causes the loss of vegetation coverage and depletion of soil erosion, habitat fragmentation, degradation and introduction of exotic species (Sasidharan *et al*., 2002). Nevertheless, it has been found that most visitors to the areas are usually from urban areas where litter collecting facilities are usually in place but are often less aware of the impact of littering in natural environments (Brown *et al*., 2010). According to Brown *et al.* (2010), reasonable waste management is a global requirement that can significantly contribute to the protection of the environment where the sustainable waste management can be achieved through the development of pro-environmental means.

One of the most significant threats in these protected areas is inappropriate waste management which is a serious threat to the environment. Efforts to reduce the littering problem in protected areas fall into two categories both of which involve communication and education aimed at visitors as well as other means of prompting behaviour (Brown *et al*., 2010). An extremely important and simple way to solve the waste problem is to increase environmental awareness, as well as develop planning solutions. An extensive body of research indicates that the provision of information and education to visitors can help to reduce certain types of littering behaviour in certain types of settings (Brown *et al.*, 2010; Sewak *et al.*, 2021; Esfandiar *et al*., 2021). Prior research by Brown *et al.* (2010) also suggests that anti-littering messages and persuasive communication remains vital.

2.8 Conclusion

There is sufficient evidence from previous and current studies that littering and illegal dumping is not a new phenomenon to protected areas. The local communities support towards protected areas is crucially for their existence and sustainability. Most studies are based on the relationship between the protected areas and the local communities. However, none explored the impact that adjacent communities have on illegal dumping in protected areas. Communities are often passive participants in the whole waste management chain as they are not involved in the environmental affairs and co-management of the protected areas. Our preliminary view is that, when the locals are considered in the day to day activities of the protected areas, they tend to comply with the rules and regulations of the area. This study must show the responsibilities of local communities as crucial stakeholders in the waste management of protected areas. This will eventually identify the socio-economic impacts of the nature reserves on the surrounding communities.

CHAPTER THREE: RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This chapter gives a detailed description of the materials and methods. The chapter presents the methods adopted in this research, research procedures and data collection techniques utilized, and the type of research practices used to answer the study's research objectives and data analysis method. It further breaks down how the sampling size was determined and how the data was collected. This chapter entails the boundaries of the study as well as how the data was stored and how it will be analysed.

3.2 Data collection method

3. 2.1 Research design and methodology

Qualitative and quantitative methodologies were used for this study. The qualitative approach was chosen because it reinforces the understanding and interpretation of meaning as well as the motives and attitudes of humans, while the quantitative approach is chosen because it is more measurable and can be tested, and results are more precise and accurate. A researcher's ontological and epistemological perspective, coupled with their research skills and practices, may influence their choice of research design.

3. 2.2 Sampling method

The research was conducted using both qualitative and quantitative research technique approaches which were in a form of questionnaires, semi-interviews as well as observational methods which were employed as an instrument for data collection. The questionnaire was used in communities around the reserve to gather information about waste generation in the protected areas. The questionnaires consisted of open-ended and closed-ended questions. Interviews with the reserve managers were in a form of open discussions relating to awareness as well as relationships with the surrounding communities.

Additionally, the observational assessment method was used to monitor people's behavioural patterns as well as their interaction with the natural environment.

This study made use of three different kinds of non-probability sampling techniques namely, purposive, snowball, and convenience sampling methods. These techniques were employed to collect data from all the participants (managers, community members, community partners, etc.). The purposive sampling method (non-probability) was used to interview participants that were assumed to have an understanding regarding the study and had the necessary answers. In this category, the managers and community partners were the key participants. The convenience sampling technique was targeted at public places near the nature reserve and where participants/residents were part of the study willingly.

3. 2.3 Sampling size

The researcher used probability-sampling techniques to select a representation of the population under investigation. Stratified sampling method was used which is a method of sampling that involve dividing a population into homogeneous subpopulations called strata based on specific characteristics (e.g., race, gender, location, etc.). In this sampling method, biasness was eliminated; each member of the population was given a precisely equal chance of being selected to take part in the study.

The sample size was calculated using Slovin's formula, where (n) is the sample size, (N) is the given population size, and (e) is the margin of error. The margin of error is defined as the "range of values below and above the sample statistic in a confidence interval".

The sample size for data collection was determined using Slovin's formula, which is used to calculate the sample size (n) given the population size (N) and a margin of error (e). It is computed as, $n = \frac{\mathrm{N}}{1+Ne^2}$ with a 95% confidence interval, therefore the margin of error is 0.05%.

Witzands Aquifer Nature Reserve

1. Atlantis

$$n = \frac{67491}{1 + (67491)(0{,}05)^2}$$

$$n = 397.64$$

Wolfgat Nature Reserve

2. Khayelitsha

$$n = \frac{310485}{1 + (310485)(0{,}05)^2}$$

$$n = 399.49$$

3. 2.4 Primary data

Primary data includes all the data collected first-hand through field observations, surveys in the form of questionnaires and interviews. This study gathered information through field observations that include observing the physical environment within the study area to note waste pollution and polluted water sources and that was done captured by taking pictures as well.

3. 2.5 Secondary Data

This is the type of data that was sourced from existing research to substantiate facts and solidify discussion that leads to a reasonable conclusion. This data was obtained from different sources such as government publications websites, books, peer-reviewed journal articles and internal records to help build up knowledge on the research.

3. 2.6 Observations

Observations were made during site visits targeting areas on the periphery of the nature reserve where illegal dumping was prevalent. Remote sections of the nature reserves were also included in our observation.

The following questions were part of the checklist that was used for the study area:

- What are the main types of solid waste being disposed of in your area?
- How long does the dumping site exist?
- Are there any other forms of pollution in the area?

The purpose of using observation approach was to gather more reliable data not based on human perceptions but based on the actions and behaviours of participants. Observations are also important in creating data for validating the information that is provided in questionnaires or face-to-face interviews (Hancock *et al*., 2009). This method gives important information about the environment where a research venture is taken.

3. 2.7 Questionnaire to Atlantis

As calculated above 397.64 questionnaires were supposed to be printed and distributed to the area, however, due to Covid-19 regulations and time pressures, the researcher had a limited number of 40 participants. During the data collection, all participants were asked to keep their masks on.

3. 2.8 Questionnaire to Khayelitsha

As calculated above 399.49 questionnaires were supposed to be printed and distributed to the area because of the nature of the environment such as socio-economic issues which include crime. We however managed to administer 45 questionnaires (see Appendix A) and made sure that all questions were answered correctly.

3.3 Data analysis

The administered questionnaires and the recordings of the interviews were transcribed to get a general sense of the whole data presented and the content analysed. Data from the questionnaires such as the demographic information was carried out using IBM Statistical Package for the Social Sciences (SPSS) version 26, which is software used for editing and analysing of data (Verma, 2012) which ensures meaningful and symbolic content of qualitative data (Creswell, 2007). The meaning of the important statements and phrases about the phenomenon being studied were then formulated into significant statements.

CHAPTER FOUR: RESULTS AND DISCUSSION

4.1 Introduction

This research looks at the impact of official and informal settlements on nearby nature reserves, with an emphasis on waste management in Wolfgat Nature Reserve and Witzands Aquifer Nature Reserve in the City of Cape Town. The information was gathered through open-ended and closed-ended questionnaires, as well as semi-structured interviews, with an emphasis on the conservators of the above-mentioned nature reserves and the residents who live near them. The goal of the study is to investigate how local people living near nature reserves impact the conservation effort with an emphasis on illegal dumping. According to de lo Angeles Somarriba-Chang & Gunnarsdotter (2012), community involvement is mostly dependent on management. As a result, bar graphs and pie charts were utilised to analyse the relationships between the local communities' and conservators.

4.2 Demographic profile of the participants in Atlantis and Khayelitsha community

4.2.1 Gender difference between the participants

Figure 3 shows gender division between females and males that were sampled in both study areas. Out of the 40 participants from Atlantis, female participants were dominant accounting for 55% of the overall sample size, while 18 male participants accounted for 45% of the entire sample size (Figure 3). Indeed, according to Stats SA (2011), Atlantis had more females than males, with 49% men and 51% women. Furthermore, the population of the Western Cape was estimated to be at 5 883 000 persons, with women accounting for more than half of the total (around 51%) (Stats SA, 2018).

Male participants made up 48.89% of the overall sample size in Khayelitsha, while female participants made up 51.11%. According to Statistics SA from 2011, there were around 200,187 females (51.10%) and 191,561 men (48.90%) in the

khayelitsha population. Furthermore, according to the Department of Social Development (2017), Cape Town has a 51.5% female population.

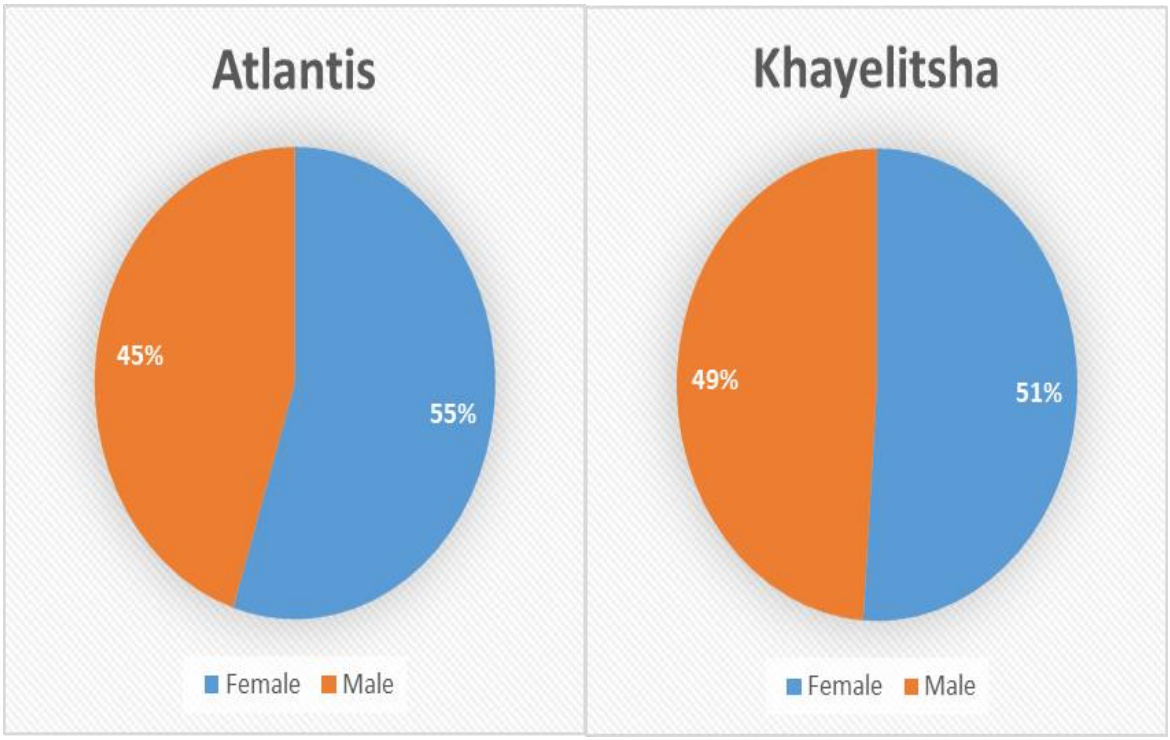


Figure 3: Illustration of gender dominance in the two study areas

4.2.2 Age range of the Respondents

Figure 4 is an illustration of age variation between Khayelitsha and Atlantis communities. The age demographics gave us a clear understanding of which age group was more dominant in both study areas. The findings reveal that both study areas had a majority of representative population of people between the age range of 25-34 and a domination of middle-aged people (35-44) (see figure 4) with less teenagers for both sites and few youth representatives (18-24). The age pyramid of Atlantis, on the other hand, contradicts the aforementioned findings, indicating that there are a greater number of young, both males and women, between the ages of 20 and 30 (Census, 2011). The 18-24 age groups in Khayelitha had 8.89%, followed by the 55+ age group with 4.44%. With a rate of 2.22 %, the age group 18 had the lowest proportion. Finally, the majority of the

participants were between the ages of 20 and 30. According to Business Trust & Department of Provincial and Local Government (2007) & Ngxiza (2012), nearly 70% of the Khayelitsha population is under 30 years.

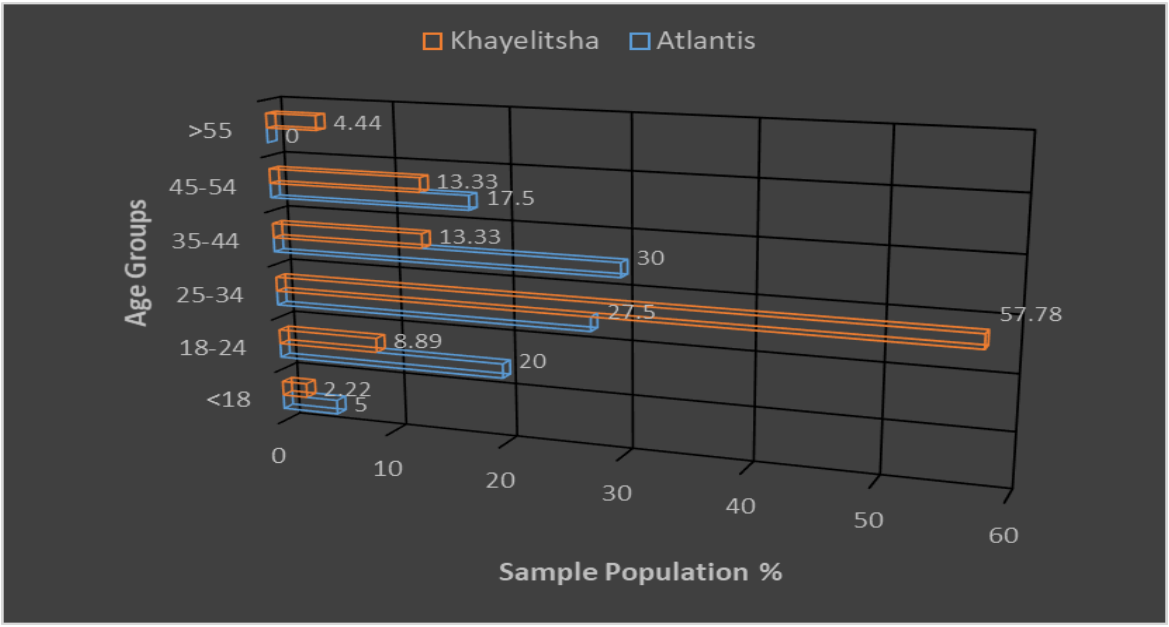


Figure 4: Participants' ages in Khayelitsha and Atlantis

4.2.3 Occupational status of participants

Figure 5 displays the employment status of the Atlantis and Khayelitsha communities based on the number of questionnaires distributed for each site. According to Stats SA (2019), the official unemployment rate grew in seven of the nine provinces, while the Western Cape and Free State had low unemployment rates. To compound these difficulties, the Covid-19 epidemic has altered people's lifestyles in the present era; caused extensive job losses and threatened the sustenance of millions of people; as businesses have shut down to control the spread of the virus. This has caused employment losses among populations that have historically been susceptible, such as the less educated, young, and people of colour (Saadat *et al*., 2002).

Based on the study it was discovered that the majority of Atlantis participants were unemployed, accounting for 47.50% of the sample size and employed

participants accounted for 32.50% whereas those who reside in Khayelitsha had a majority of employed participants (42.22%) and 31.11% of unemployed individuals. Stats SA (2011) supports the Atlantis unemployment results by stating that the Atlantis neighbourhood is characterized by a low-to-middle-income margin, with a 37% unemployment rate. Despite the job loss owing to Covid-19, the Khayelitsha sample group had a majority of employed individuals. However, according to research by Business Trust & Department of Provincial and Local Government (2007), the population is still impoverished, with many individuals jobless or underemployed, and the majority earning less than the household subsistence threshold. Stats SA (2021) recently released their latest Quarterly Force Labour Survey (QFLS), which shows that the Western Cape currently has the lowest unemployment rate in the country.

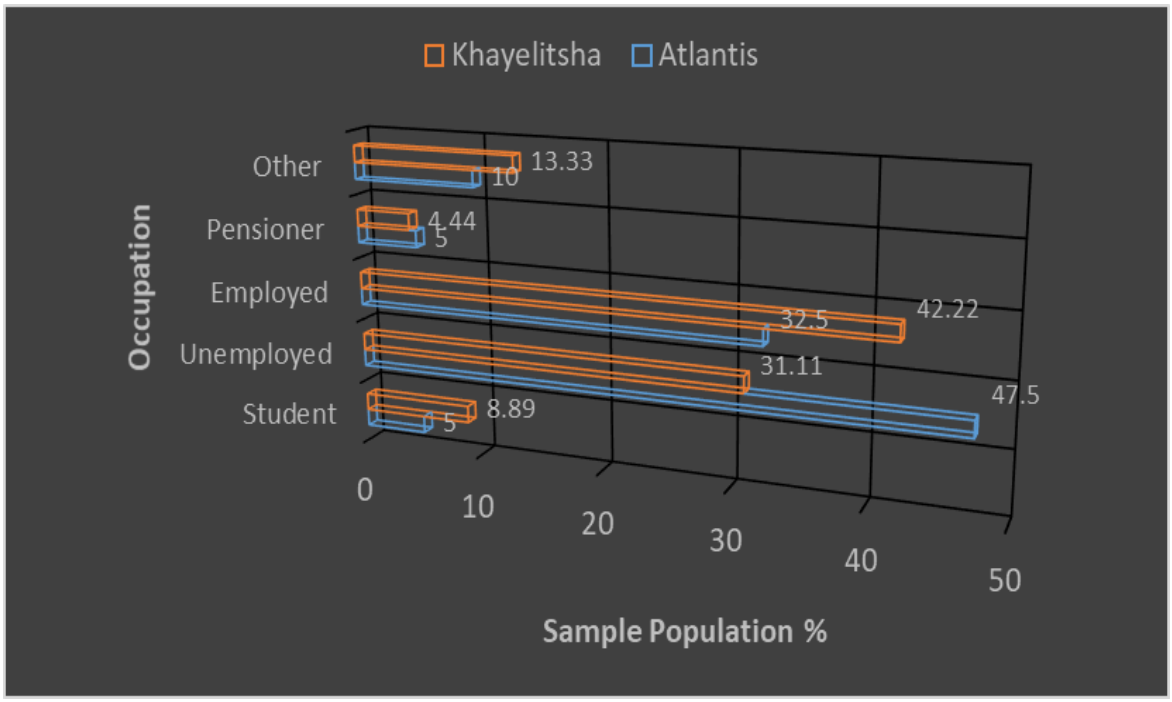


Figure 5: Employment statuses of Khayelitsha and Atlantis survey participants

4.2.4 Participants level of education in Atlantis

The figure 6 below illustrates the level of education at Atlantis. Out of the (40) questionnaires that were administered, 27 (67.50%) participants had primary education; 2 (5%) had no formal education with 8 (20%) with secondary

education followed by 3 (7.5%) participants with post-secondary education. Based on Figure 6, majority of people had formal education; however, they had little to no knowledge about the nature reserves. Furthermore, other studies contradict figure 6 by stating that a positive attitude towards the natural environment is tended to increase with respondents' level of education and knowledge about conservation issues (Bajracharya *et al.*, 2007; Brown *et al*., 2010). However, based on the majority of the results of people with formal education they have never been to a nature reserve before. Therefore, participant level of education cannot be used as indicator of knowledge regarding a specific area.

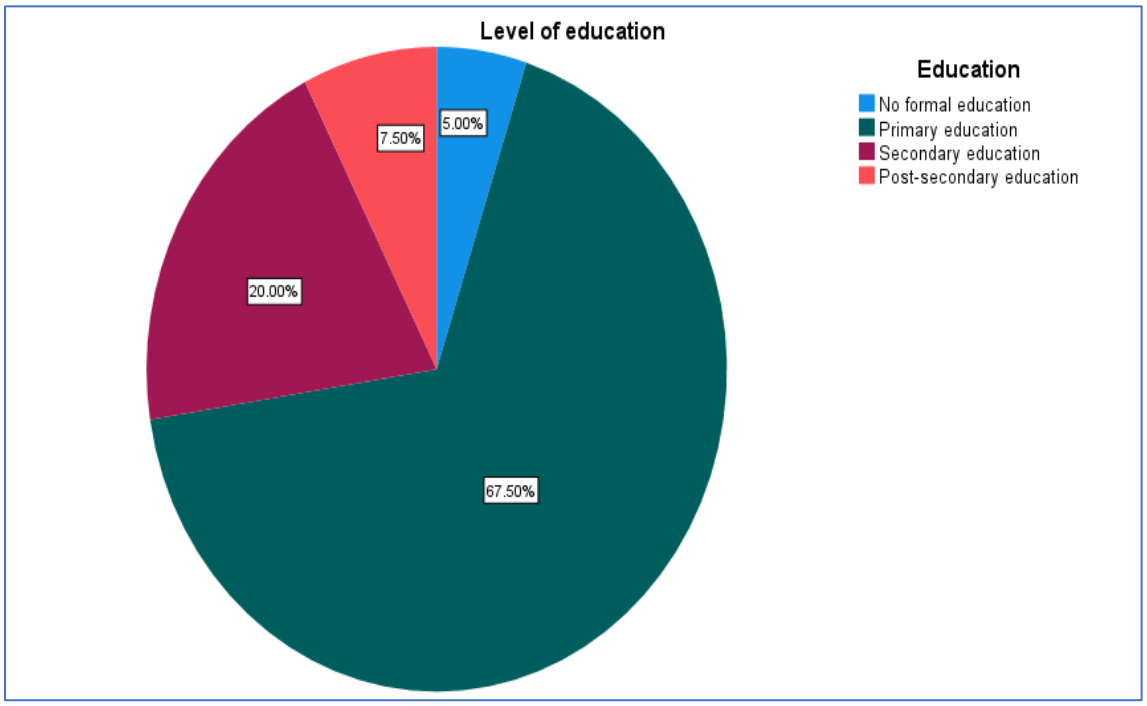


Figure 6: Illustration of education levels in Atlantis

4.2.5 Participants level of education in Khayelitsha

Figure 7 displays education level of participants based on the questionnaire. As indicated on the questionnaires, the level of education ranged from no form of formal education, primary education, secondary education and post-secondary education. According to the participants' educational levels, 6.66% had no formal education, 22.22% had primary education, 24.44% had post-secondary education, and the majority 46.66% had secondary education. Despite a

comparable level of attendance at tertiary institutions among young people, the proportion of Khayelitsha inhabitants with higher education is barely half that of the rest of South Africa. (Business Trust & Department of Provincial and Local Government, 2007).

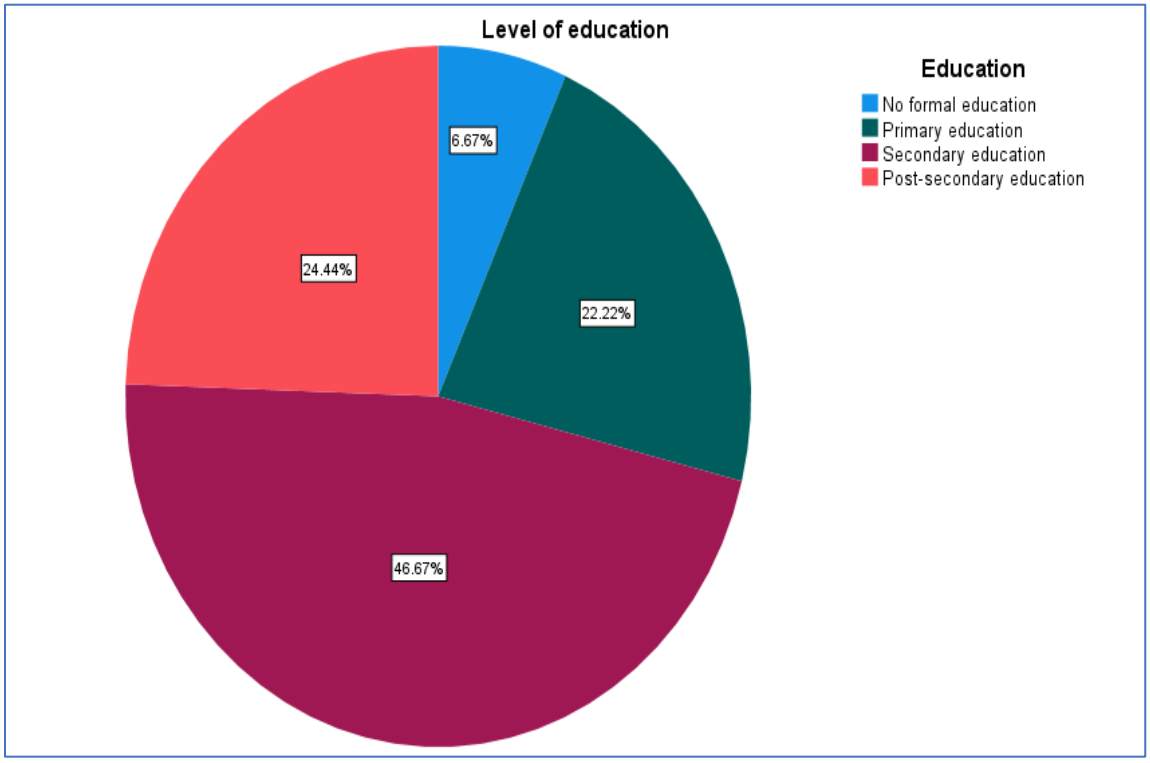


Figure 7: Level of education range

4.3 Perceptions on illegal dumping and conservation

4.3.1 Exploring how the level of education can be associated with the Wolfgat and Witzands Aquifer nature reserve visitations by local communities

Figure 8 assesses whether there is any direct relationship between education level visitations to the nature reserve in Atlantis and Khayelitsha residents. Figure 8A indicates that, in total, 65% participants in Atlantis have never been to a nature reserve while 35% have visited the area before, whereas Khayelitsha (see figure 8B) was represented by 20% (9 participants) of the respondents who have been to a nature reserve before. Those who have never been to a nature reserve were represented by 77.77%. The results reveal that a majority of the

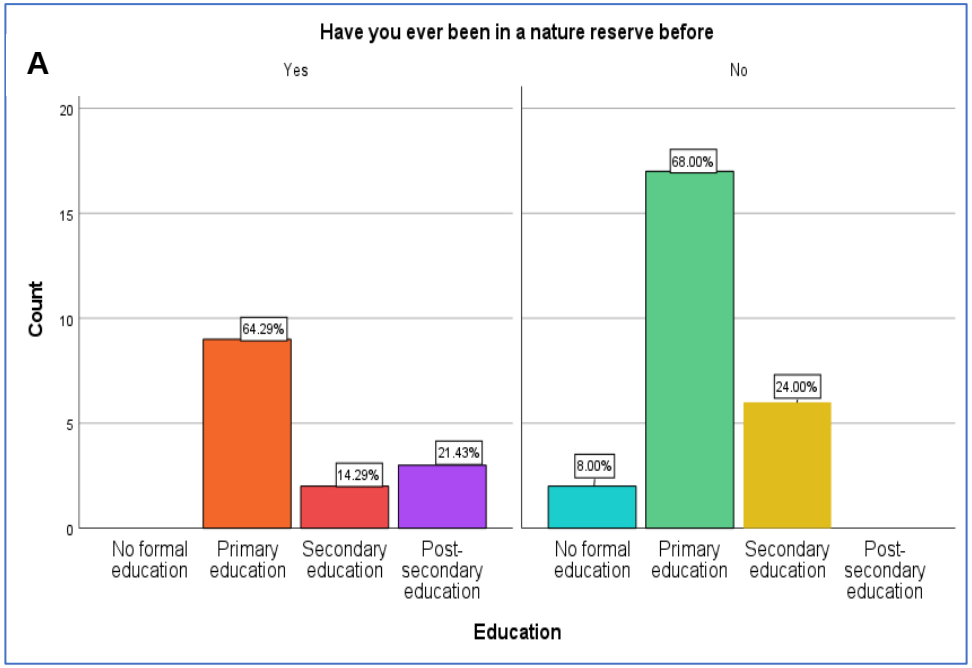
participant in both study areas have never been to their neighboring nature reserves.

Out of the 26 respondents from Atlantis that have never been to a nature reserve, it was noted that a majority of them had primary education (68%) followed by 24% of respondents with secondary education whereas those from Khayelitshasha were represented by 77.77% and based on their education level, majority of 45.71% was recorded for people with secondary education and 25. 71% had post-secondary education. The data revealed that the level of education does not influence individuals to visit nature reserves or natural areas.

For those who have been to a nature reserve, majority of the participants were those with primary education (64.29%) followed by those with post-secondary education valued at 21.43%. 9 participants (20%) from Khayelitsha indicated that they have been to a nature reserve before and out of that group a majority of respondents had secondary education with 55.56% followed by 33.33% of post-secondary education. This further indicates that participants' level of education cannot be used, as indicator of knowledge regarding a specific area and it does not guarantee conscience behaviour from residents. According to Eksteen (2012) people's relationships with the environment varies with individuals but not only does people level of education influences their perception but also their history and encounters with the environment. Therefore, how people interact with the natural environment is not entirely based on their level of education there are various influencing factors such as where they grow up.

Studies contradict the above result by stating that a positive attitude towards the natural environment tends to increase with the increase in the level of education and knowledge about conservation issues (Bajracharya *et al.*, 2007; Brown *et al*., 2010). However, based on the majority of the results of people with formal

education they have never been to a nature reserve before. Therefore, participant level of education cannot be used as way to understand the communities' perception and behavior regarding waste disposal in nature reserve. Educating the community about waste related issue can be effective in raising awareness which could eventually change behaviours (Brown *et al*., 2010)



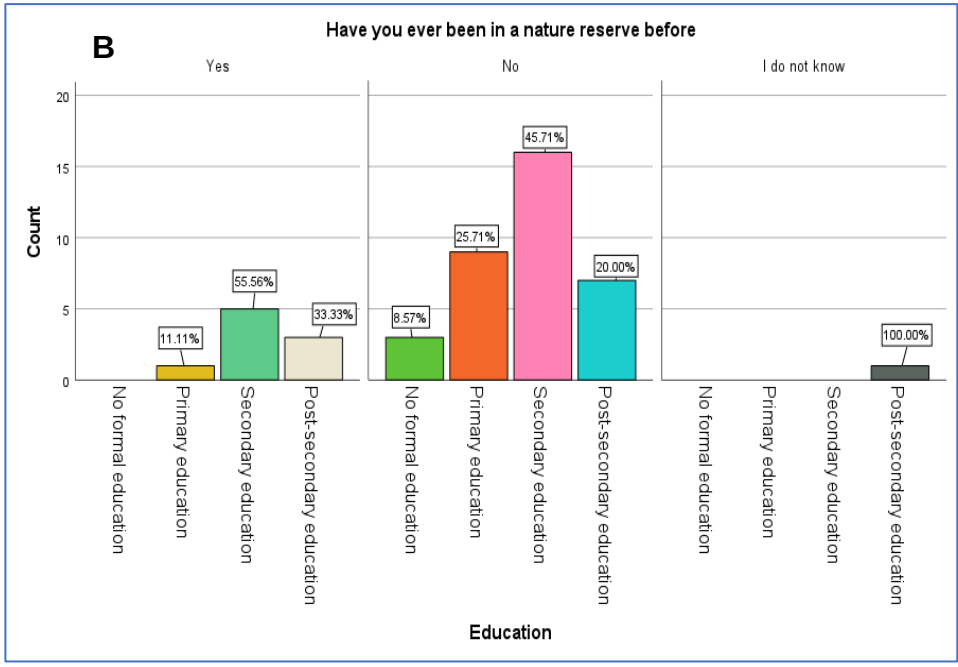


Figure 8: Data comparison between reserve visitation and education level in Atlantis (A) and Khayelitsha (B)

4.3.2 The relationship between illegal dumping and the function of communities in nature reserves in Atlantis.

Table 2 is the response of the participants when they were questioned if illegal dumping has an impact on the nature reserve. The table shows that, out of all the people that participated in the study in Atlantis, 62,50% (25 participants) agreed that illegal dumping has an impact on the nature reserve while 17,50% disagreed that illegal dumping has an effect and 20% did not have knowledge on the subject matter. Furthermore, figure 9 illustrate that respondent knew their role in dealing with illegal dumping, after they were questioned about the consequences of illegal dumping. Most responses were positive, however, majority of participants accounting for 25% did not know their role while 20% indicated that their role is to report it, stop dumping (15%) or clean it (15%).

According to Eksteen (2012), there has been a steady transition from living in rural regions with nature to living in metropolitan areas with built-up areas. Figure 9 demonstrates that impoverished people are aware of their influence on the environment, but they lack the time to care owing to a variety of negative social and economic repercussions. Furthermore, other research confirms the findings, indicating that some individuals are aware of their impact on the environment and want to act in a manner that minimizes that damage (Eksteen, 2012; Wells & McShane, 2004). This can be seen in figure 9, where a majority of the participants were aware of their duties in dealing with unlawful dumping. Therefore, according Agranal & Gibson (1999) engaging communities in conservation is critical especially when laws and regulations do not assure compliance.

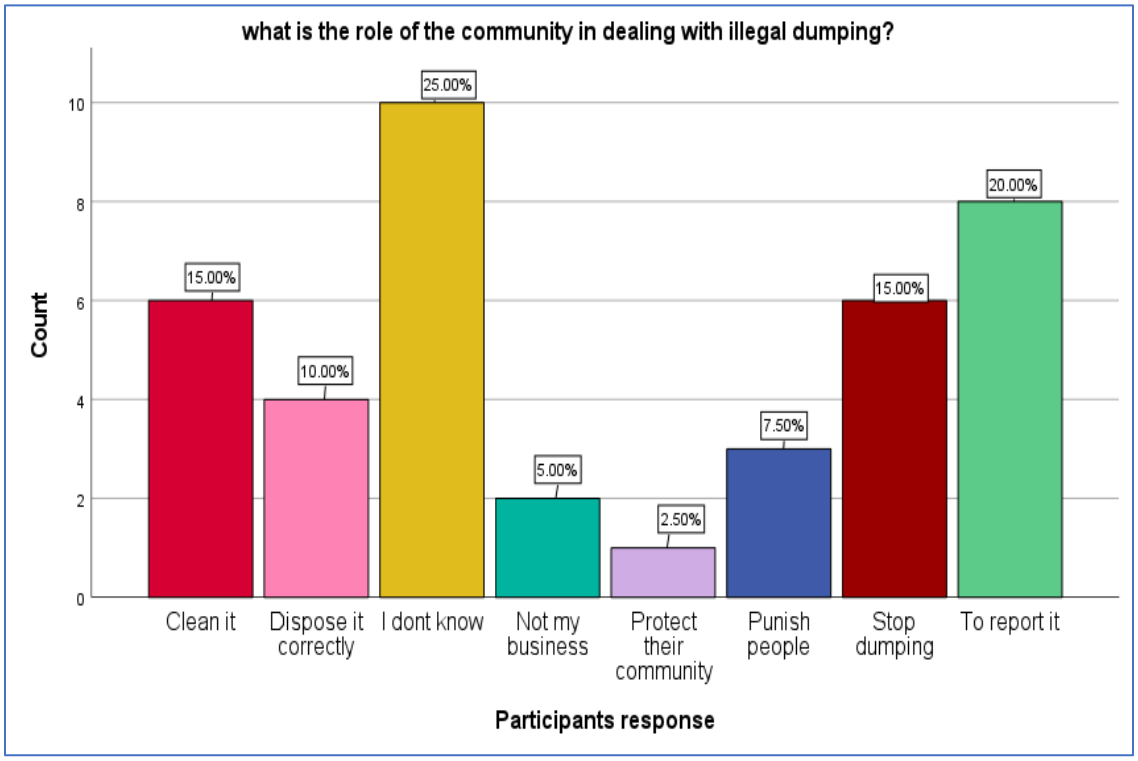


Figure 9: Responses of Atlantis residents on how to deal with illegal dumping

Table 2 Respondent opinion on whether illegal dumping has an impact in Witzands Aquifer Nature Reserve

Do you think illegal dumping has an impact on the nature reserve

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	25	62.5	62.5	62.5
	No	7	17.5	17.5	80.0
	I do not know	8	20.0	20.0	100.0
	Total	40	100.0	100.0	

4.3.3 The relationship between illegal dumping and the function of communities in nature reserves, Khayelitsha.

Table 3 is an illustration of respondents from Khayelitsha following a question on whether illegal dumping has an impact on the nature reserve and figure 10

illustrate their response on the role they could possibly play to minimise waste generation.

The results of table 3 and figure 10 were interpreted and the relationship was observed. Table 3 shows that out of all the people that participated in the study, 71.11% (32 participants) also agreed that illegal dumping has an impact on the nature reserve and approximately 8.88% (4) disagreed that illegal dumping has an effect whereas 9 participants did not know.
71.11% of the participants were aware of the litter impact on the nature reserve and based on figure 10 the majority of participant knew their role in dealing with illegal dumping, 20% stated that their role in dealing with dumping is to clean it while a minority of 13.33% suggested that those that litter should be punished. 37.78% of the participants indicated that as community members, they should report it and 28.89% advised that people should stop dumping.

Communities should not be regarded in isolation from the environment (Agrawal & Gibson, 1999). Environmental protection must be prioritized, and local people must be educated and empowered to monitor their environment and manage waste (Joseph, 2006). According to research (Joseph, 2006; Przydatek, 2019), communities and cultures may fight unlawful dumping by empowering themselves since individuals who engage in illegal dumping operations do so deliberately.

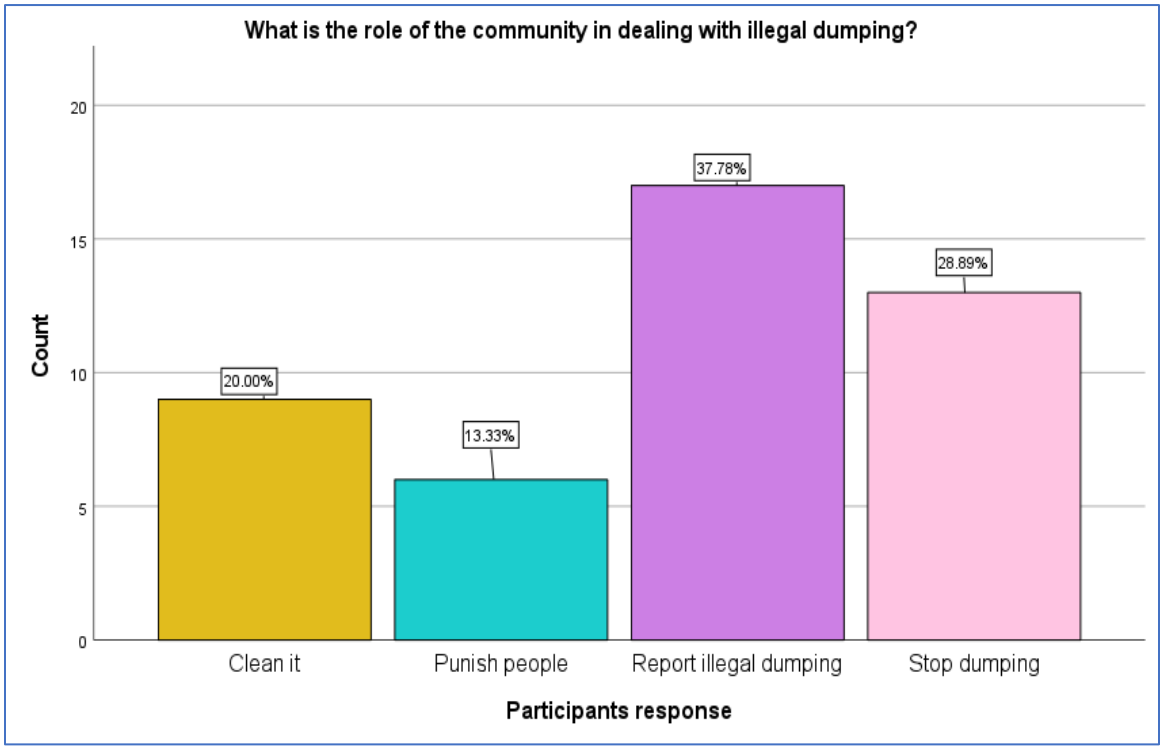


Figure 10: Role of community in tackling illegal dumping

Table 3 Respondent response on the impact of illegal dumping in Wolfgat Nature Reserve

Do you think illegal dumping has an impact on the nature reserve

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	32	71.1	71.1	71.1
	No	4	8.9	8.9	80.0
	I do not know	9	20.0	20.0	100.0
	Total	45	100.0	100.0	

4.3.4 A comparative exploratory analysis of community project involvement and residency duration in Atlantis and Khayelitsha.

During data collection, participants were questioned on how long they have been part of the community and whether they have ever been part of a nature reserve-based project. The results for Atlantis (A) and Khayelitsha (B) are shown in figure 11. Based on the data collected from the two study sites, it was noted that in a category of respondents living in Atlantis for 5-20 years, a majority have never been part of a community-based nature reserve project, accounting for 34 (85%) participant in Atlantis and 32 (71.11%) participant from Khayelitsha.

Respondents who have been living in Khayelitsha for 5-20 year who have also indicated that they have been part of a project, accounted for 15.55% and those who do not know, accounted for 13.33% while in Atlantis there were only 5 (12.50%) who have been involved in nature reserve-based project and 2.5% who did not know.

Without conservation effort, the natural protected areas will disappear from the city, taking with them the essential ecosystem services that are difficult and expensive to provide artificially (CoCT, 2018). However, everyone agrees that communities should be included in conservation through projects that build relationships with them. The benefits derived from community-based conservation are critical for gaining community participation (Dewu & Roskaft, 2017; Mutanga *et al.*, 2016). Therefore, conservation must provide tangible benefits that people understand. Benefits, where poverty exists, should typically be economic value for politicians and people to perceive it as tangible (Mutanga *et al.*, 2016).

Communities are thought to be a buffer against threats such as urban development, poaching, and land grabbing, and this is accomplished by empowering communities and instilling a sense of ownership of their conservation area through daily activities that promote engagement and through projects that occur. Poverty and inequality are having an increasingly negative influence on natural ecosystems (Ferreira & Freire, 2009

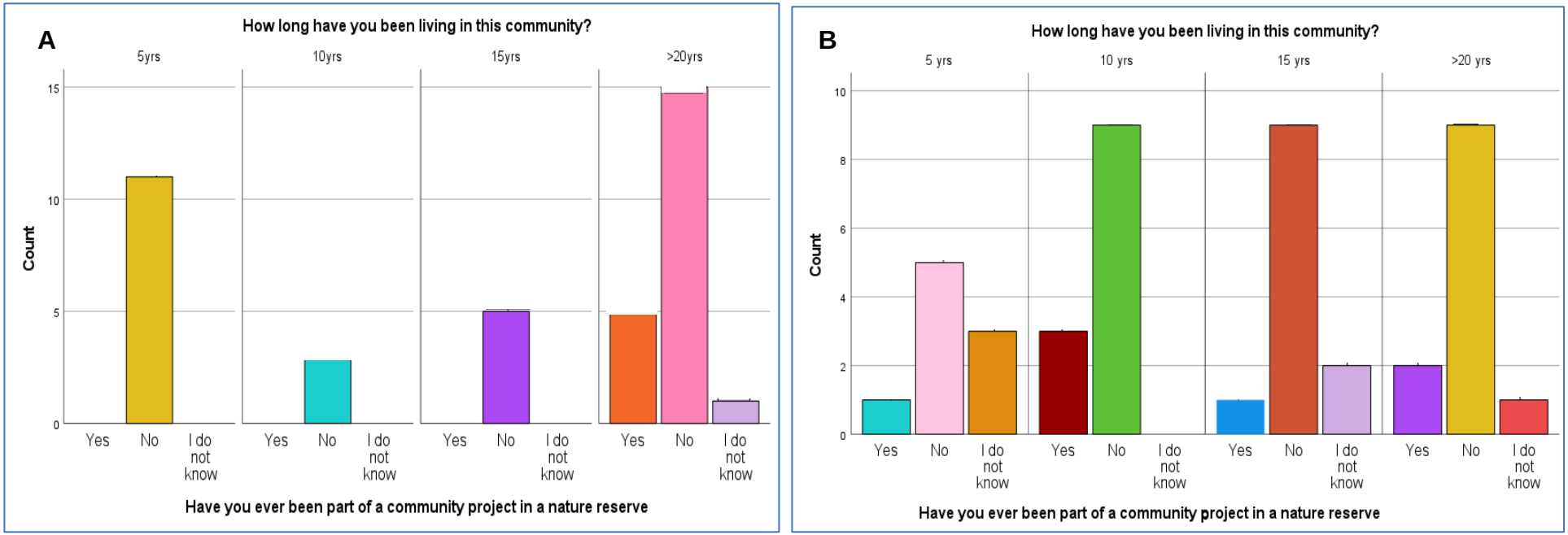


Figure 11: Responses of Atlantis (A) and Khayelitsha (B) resident on their involvement in nature reserve-based projects

4.3.5 A comparison between the time spent in Atlantis and getting to know the conservator.

From the below graph, 21 respondents have lived in Atlantis for more than 20 years, but when they were further asked about their relationship with the surrounding nature reserve and the conservators, a majority (42.86%) of people reported a very good relationship whereas 28.57% was neither here nor there. 14.28% indicated that there's no formal relationship and 9.52 % stated no relationship whatsoever.

Approximately 5 (12.5%) respondents who had lived in the Atlantis area for approximately 15 years, 60% did not know their relationship while 40% represented those who said, "it's good" and those who stated that there's no relationship.

Those who had lived for around ten years (3 participants) claimed to have a good relationship with the conservation area, while those who reported having a minute relationship or no relationship was also 33.33 %. 11 respondents that have been living in the area for approximately 5 years indicated that there's was no relationship (54.55%) whereas 18.18% had a little relationship, and 9.09% respondents had either good, formal relationship or did not know.

According to figure 11, there is a shift in the connection scale, with people who have lived in the region longer having a good relationship with it. According to Eksteen (2012), this might have been while the Cape Flat Nature Programme was still in existence and the connection had various advantages. Furthermore, as time passes, rules and regulations change, putting the community at a disadvantage.

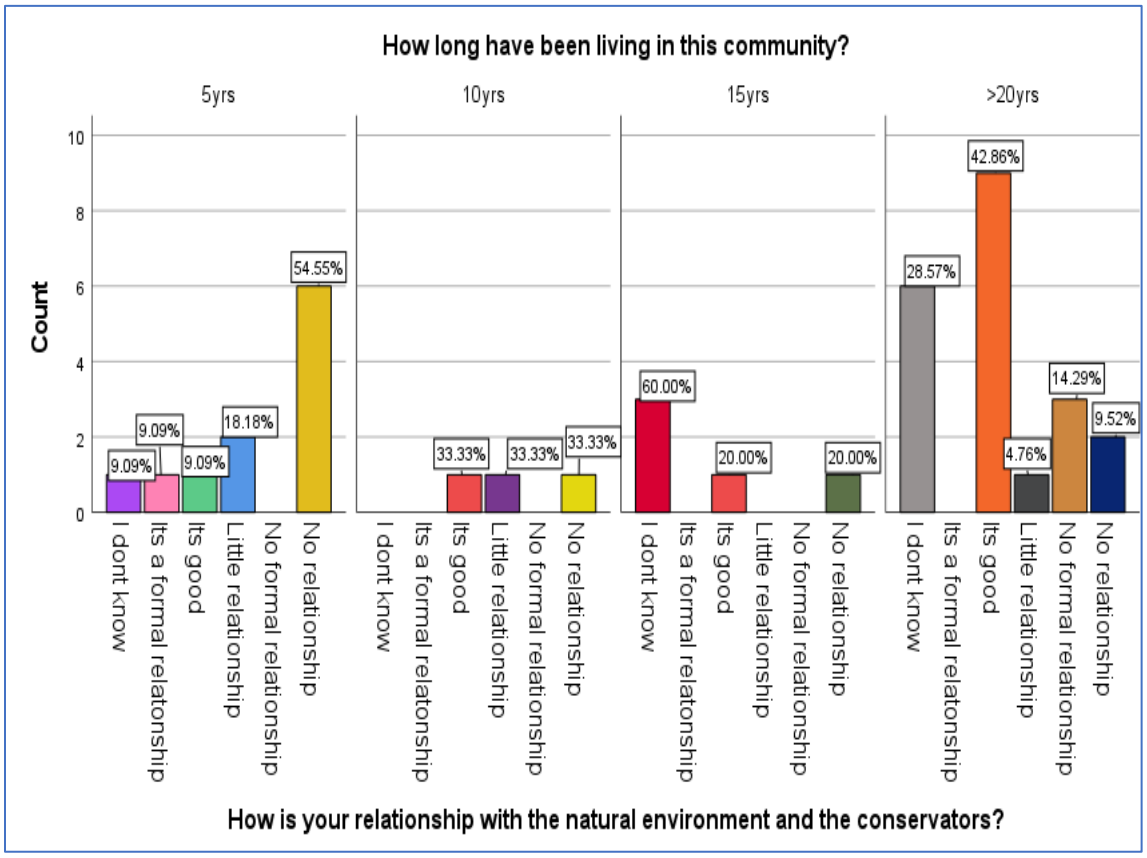


Figure 12: Relationship between respondent and conservator as a marker of residency duration in Khayelitsha

4.3.6 Residency duration vs relationship with the conservator in Khayelitsha.

According to figure 13, 12 respondents have lived in Khayelitsha for more than 20 years, and when asked about their relationship with the surrounding nature reserve and conservators, the majority (33.33%) stated that they didn't know and there was no relationship, while 25% stated that the relationship was good and 8.33% stated that there was a limited relationship.

Twelve (12) respondents who have resided in the neighbourhood for around 15 years reported that 25% were unaware of the nature of the relationship, 25% indicated that there was no relationship, 25% indicated a good relationship, and 25% indicated that there was a minimal relationship.

About 12 participants have lived there for ten years and, based on their responses, 41.67% had a good connection with the conservator, while 25% were not sure and 8.33 % had no formal relationship. A number of 9 people who have lived in the area for around 5 years had an excellent relationship with the conservatory, followed by 33.33% who had no relationship and 11.11% who had little relationship. The resulting findings demonstrate that communities had a good perception of the natural environment and conservationists in general, whereas some individuals had a different perspective. It is vital to gain the support of the local people and politicians (Ferreira & Freire, 2009; Thondhlana & Cundill, 2017). With challenges brought by Covid-19 with loss of employment in cities, this will put so much pressure on the natural environment and lead to an unlawful land occupation if protected areas do not have the working support systems.

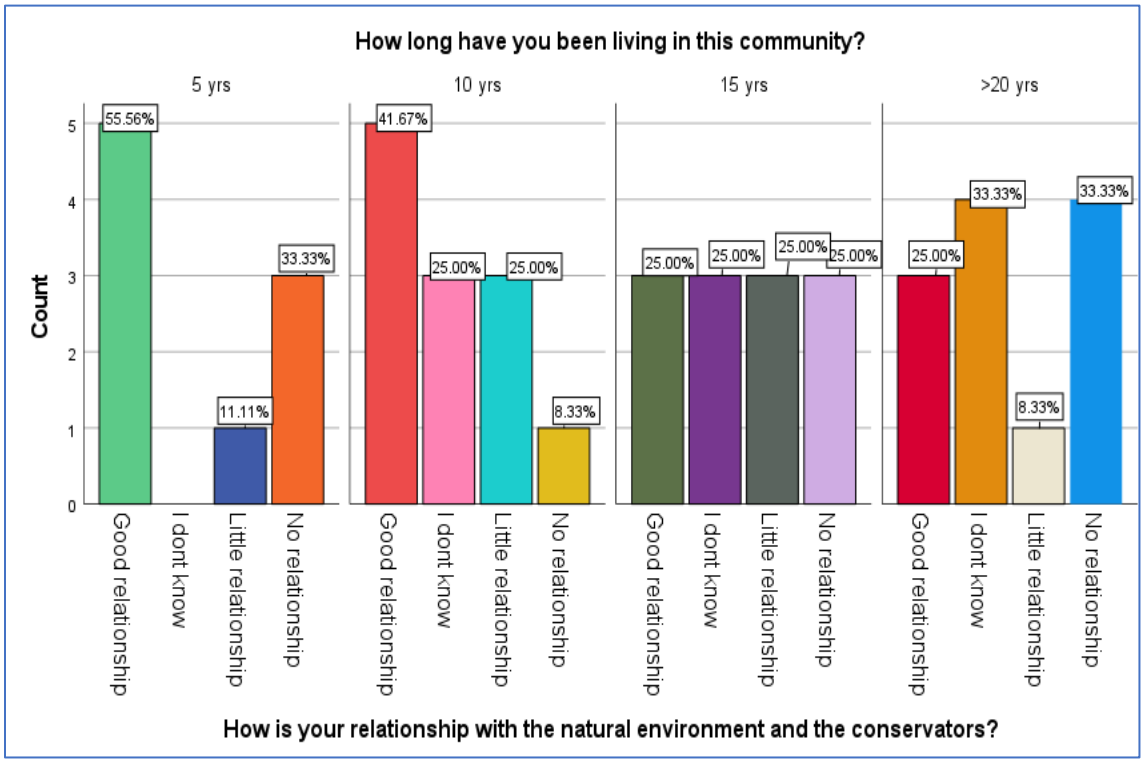


Figure 13: Relationship between respondent and conservator as a marker of residency duration in Khayelitsha

4.3.7 The connection between unlawful dumping and a lack of waste management services (WMS) in Atlantis

Figure 14 shows that 65% of those who took part in the study in Atlantis have witnessed some illegally dumping of waste, and of those, only 80.77% indicated that the municipality provided them with Waste Management Services (WMS), while 7.69% disagreed and 11.54% were unsure. Interestingly, 17.5% of the participants had never seen illegal dumping on a practical basis, and 28.57% agreed that the government offers waste services, while 57.14% disagreed and 14.29% were unsure. Additionally, 17.5% do not know whether they've witnessed any illegal dumping. There is 14.29% of respondents indicated that the municipality provides them with a Waste Management Services (WMS) while 85.71% did not want to comment on the subject, therefore, it was left blank.

Traditional mechanised collection methods have had to be rethought to adapt to changing times such as rapid urbanisation, population growth, and this rapidly changing socio-political situation (Van Niekerk *et al*, 2015). This has presented new problems to waste management agencies in South Africa (Van Niekerk *et al*, 2015), as well as new challenges for protected areas when garbage ends up on their lands.

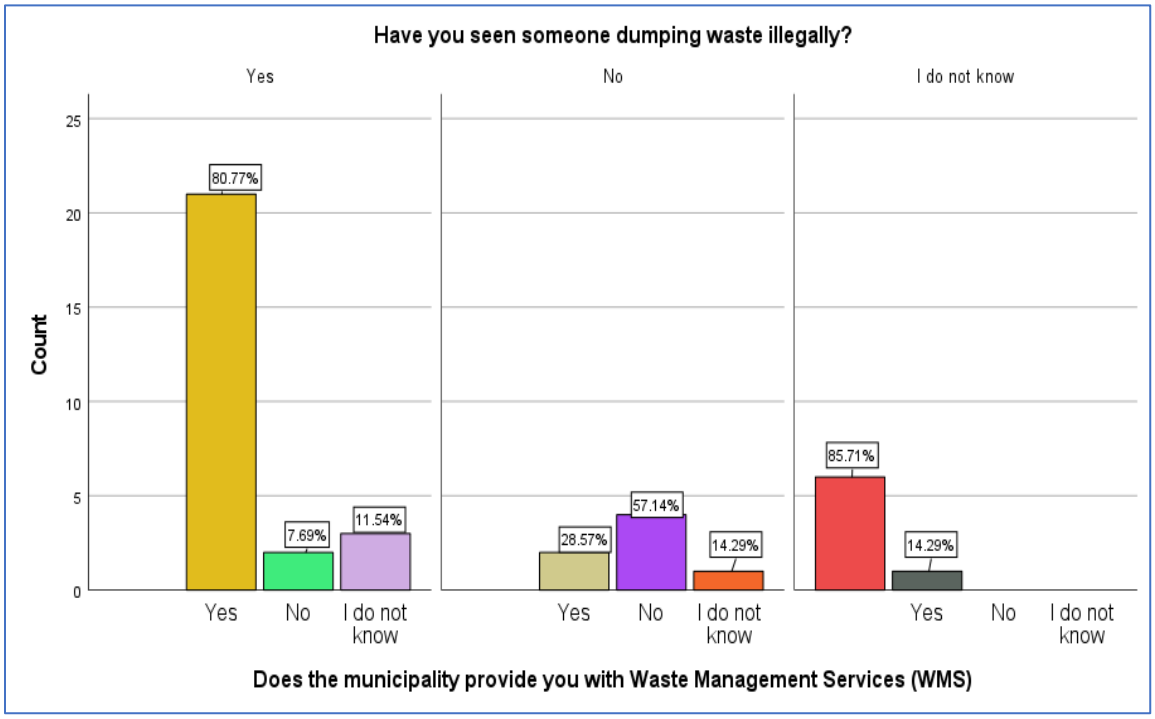


Figure 14: The connection between illegal dumping and lack of adequate collection services

4.3.8 The connection between unlawful dumping and a lack of waste management services in Khayelitsha

Figure 15 shows that out of the people that participated in the study in Khayelitsha, 80% have seen someone dumping waste illegally and out of that, 47.22% indicated that the municipality does provide them with Waste Management. Services (WMS) while 38.89% indicated that the municipality does not provide such services and 13.89% had no knowledge on the subject. Approximately 15.55% stated that they have never seen someone dumping illegally and out of that percentage 57.14% agreed that the government provides waste services while 42.86% did not agree with the statement. 4.4% were unsure if they have witnessed illegal dumping and out of that 4.4%, there is 1 respondent that indicated that the municipality provides them with a Waste Management Services (WMS).

Natural spaces have a high value since they include a range of valuable natural resources; one of the most serious dangers to these protected regions is improper waste management via unlawful trash disposal (Przydatek, 2019).

According to Przydatek (2019), a lack of environmental knowledge, particularly regarding natural values, aided in the destruction of the natural environment. Education that leads to greater environmental awareness, as well as planned solutions that follow sustainable development, is an incredibly essential and straightforward method to tackle the trash problem.

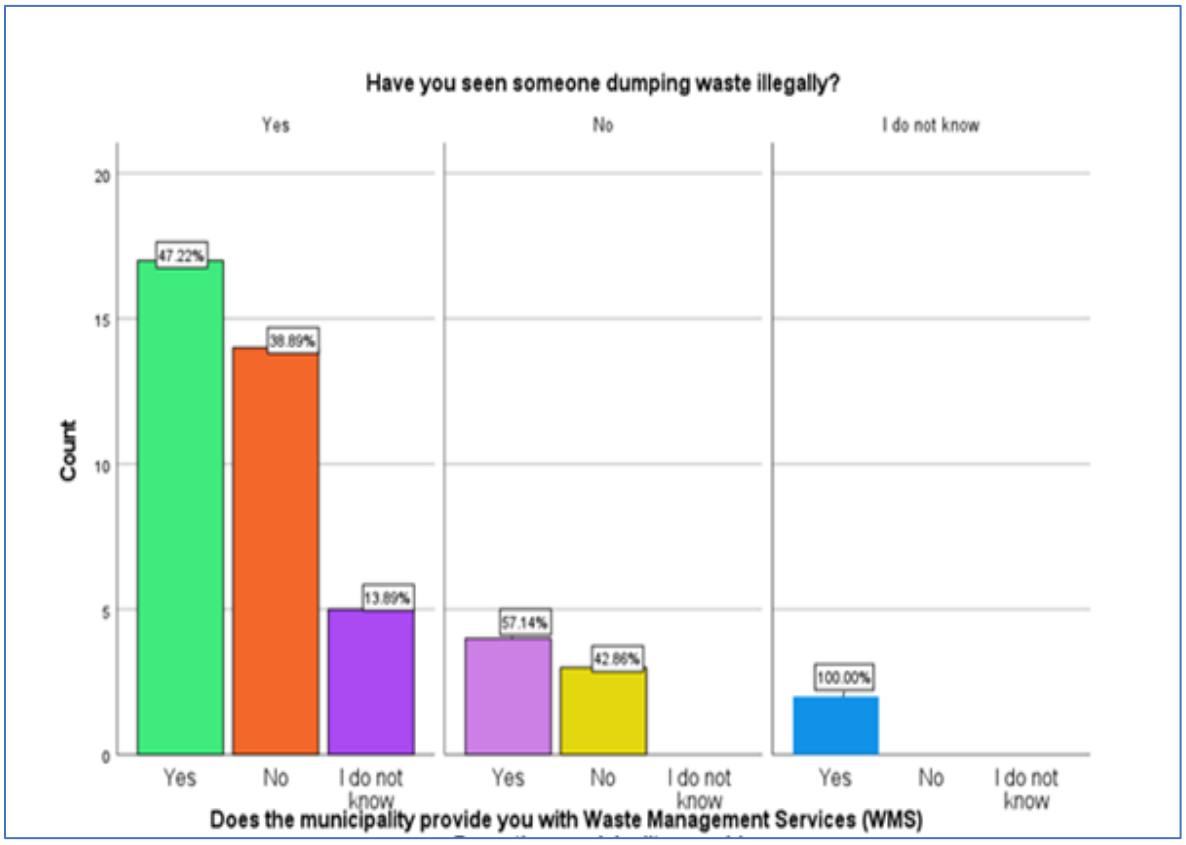


Figure 15: The connection between illegal dumping and insufficient Waste Management Services

4.4 Comparative analysis of Atlantis and Khayelitsha community data.

Both natures' reserves were previously part of the Cape Flats Nature project and were chosen as research sites because of their distinctive size, varied waste management practices, location & accessibility, and closeness to disadvantaged areas. The programmes' goal was to promote best practices in the people-centred management of natural areas in the City of Cape Town's biodiversity network (Eksteen, 2012). During the research, it was discovered that there were

some similarities and differences between the two sites. For example, in terms of community engagement and community-based projects, Witzands Aquifer Nature Reserve did not have any active projects running at the time of the study, and there was limited community interaction, whereas Wolfgat Nature Reserve had several projects with the community and was woefully underutilized. Even though the conservators claimed that the reserve creates jobs through Expanded Public Works Programmes (EPWP), the majority of the community respondents had never visited the nature reserve or had little awareness of the regions. The participants were fairly knowledgeable about the impact of waste on the environment in both areas, but it was noted that due to a lack of proper dumping.

Witzands Aquifer Nature Reserve is a bin-free zone, whereas Wolfgat Nature Reserve has bins on-site and has a positive relationship with its neighbouring communities. However, both nature reserves are dealing with the same environmental issue: illegal dumping. As a result, the study aimed to demonstrate the importance of community empowerment and transparency through the use of a bottom-up approach, in which local communities are involved in the management of the environment. Proactively involving communities closest to nature reserves and recognizing their needs will provide positive outcomes, such as community support.

4.5 Semi-structured interview

The study used the semi-structured interview to gather information from key informants who were the City of Cape Town officials who have experiences and beliefs related to the topic of interest. Thematic analysis was used to identify patterns and themes within the data. To evaluate the trustworthiness of the responses from the key informants. The researcher deployed several criteria to establish trustworthiness: credibility (whether the findings accurately and fairly represent the data by correlating it with the community's responses), transferability (whether the findings can be applied to other settings and contexts), and dependability (whether the findings are consistent with the observation made by the researcher). The results indicated a few variations based on the interview questions for the City of Cape Town's Biodiversity

Management Branch employees, and those differences were connected to nature reserves management features such as the waste management plan and community engagement methods. There were, on the other hand, few similarities.

The below quotes were extracted from the semi-structured interviews conducted with the functional Operational Manager who oversees the operation of the entire Biodiversity Management Branch and ensures the project are completed on time. Furthermore, with the reserve supervisors of each study reserve, this was done to observe trends between the community members and the conservators' answers.

Quotes from City of Cape Town participants on the nature reserve's relationship with the surrounding community:

"*The relationship is going well but in terms of the social standards there are challenges here and there"* (Reserve Supervisor, Wolfgat Nature Reserve)

"It's a work in progress but there's always changing community leadership; it's a constant moving relationship" (Functional Operational Manager)

"The relationship is not as positive but we still do environmental awareness" (Reserve Supervisor, Witzands Aquifer Nature Reserve)

The above findings indicate that the community's relationship with nature reserves is relatively poor; the majority of those who took part in the study had never visited a nature reserve or been a part of a community-based project. This reveals a shortage of marketing and community participation efforts targeted at raising awareness and fostering relationships. Socioeconomic considerations are critical, since a person who is hungry will be apathetic with the protected territory if his or her immediate needs are not satisfied.

Additionally, conservators are aware of this dysfunctional connection, although one interviewee asserts that the tie is developed via education. Indeed, Graham and Ernston (2012) found that cooperation should not just be theoretical, but also practical.

Quotes from City of Cape Town participants on how community conservation is encouraged in their nature reserve and if any initiatives are currently underway:

"*We have certain projects within our OPA which consist of working hand in hand with Environmental Education Officer to host fun days, cultural programmes with local neighbouring communities. We have an allocated budget from the sub-council which is used to give back to the community by giving them plants and 300 plants have been planted around the community so far"* (Reserve Supervisor, Wolfgat Nature Reserve)

"A coffee shop will be opened at Witzands Aquifer Nature Reserve and preference for tender will be given to locals residing within the nature reserve parameters, the reserve issues permit to woodcutters and there's growing partnership with other stakeholders" (Functional Operational Manager)

According to the City of Cape Town staff, there are few to no community projects in place at Witzands Aquifer Nature Reserve compared to Wolfgat Nature. As seen in Figure 11, more responses suggested participation in a project for Wolfgat Nature Reserve than for Witzands Aquifer Nature Reserve. Although when the two nature reserves were compared, Wolfgat Nature Reserve had a higher proportion of participants in nature reserve projects but also had a lower proportion of overall participants when the nature reserve was analyzed individually. This revealed that the management supports the communities' responses. We had to take into account the statutory difference between the two locations, which means that although nature reserves desire local people to benefit, they can only give a minimum amount of support (e.g cash incentives) for a limited period.

What are some of the environmental challenges the nature reserve is facing and In terms of waste management, is the current system working efficiently, according to City of Cape Town participants:

"*There are a lot of challenges that the nature reserve is facing at present, however, illegal dumping is a major challenge especially near the fence separating the nature reserve and houses.*

Yes, we do have a waste management in place and so far, it is working meaningfully" (Reserve Supervisor, Wolfgat Nature Reserve)

"The Witzands Aquifer Nature Reserve is not heavily impacted by illegal dumping but the remote sites are affected.

Witzands Aquifer Nature Reserve is a bin free nature reserve, people bring their bags and leave with their waste and so far that has been working meaningfully" (Reserve Supervisor, Witzands Aquifer Nature Reserve)"

According to the conservators' semi-interviews, illegal dumping and litter brought into the reserve from neighbouring communities were identified as the primary environmental issues for both nature reserves, despite the fact that respondents indicated that their reserves' waste management plans were effective. The communities surrounding both areas have indicated that they have seen people dumping illegally and they knew what role they could play as community members. Although people are aware of the issue and nature reserves are protected by specific laws and regulations, they continue to face waste difficulties. According to Joseph (2006) to make real progress in waste management, it is necessary to include local communities but collaborative approaches have led to attitude changes without behavioural cooperation.

Quotes about the nature reserve's strategies for ensuring sustainable yield, promoting compliance with applicable laws, integrating biodiversity issues with waste management, and promoting sustainable eco-tourism. What are these techniques?

"*Due to visitors leaving their litter on the reserve unattended, we have adapted to new policies; some of our reserves are now "Bin Free" reserves and regular patrols are being done to monitor illegal dumping, in terms of promoting eco-*

tourism we allow harvesting of alien plants (wood species) through permit systems" (Functional Operational Manager)

"We have methods in terms of compliance; we have coordinated with the law enforcement and field rangers to conduct patrols. Jerome September integrates biodiversity concerns with waste management through working with local people such as Sangomas, Khoisan etc. through education" (Reserve Supervisor, Wolfgat Nature Reserve)

The local communities from both nature reserves have indicated that the municipality provides them with Waste Management Services; however, illegal dumping is still an environmental issue for nature reserves regardless of the methods and laws that have been implemented. Well known conservation agencies such as SANParks have adopted a proactive strategy to ensure community support, and this includes establishments of various community developing projects. A study by Dube (2018) states that local communities should be one of the important stakeholders in protected area management as they have valuable information to share about the area.

4.6 Conclusion

The study was conducted to evaluate the relationship between the communities and the conservators; to assess the awareness of the community members situated in close proximity to the selected study sites. Literature has shown that the majority of the world's population is migrating to urban areas for economic opportunities (Seekings & Nattrass, 20053), however, such migration often leads to unlawful land occupation with no proper dumping facilities and lack of proper sanitation facilities (Obi-Ani & Isiani, 2020; Jakiel *et al*., 2019). Therefore, this puts pressure on natural resources and further threatens the existence of fragmented conservation space in these urban areas.

We explored the relationship between conservators and communities and the study found that there is a relatively poor to a good relationship between the conservator and the local communities. Staff from the Biodiversity branch mentioned that the relationship is constantly ever changing due to changes in community leaders and socio-economic needs. However, they have made significant developments in trying to improve these relationships through providing temporary job and environmental education programmes. According to Eksteen (2012), it is imperative that these relationships are not developed to fulfil biodiversity needs but conservation should be used in a way that it assists people with some of their social needs.

A conservator-community positive relationship in this study was highlighted a huge contributor towards the longer-term security and sustainability of highly threatened ecosystems. Although, the majority of respondents from both sites have never been to a nature reserve or part of any community conservation project but they were knowledgeable about the environmental impact of waste on the nature reserve. Therefore, this indicated that as much as communities knew their role in tackling environmental challenges but due to the exclusionary approach when it comes to decision making in conservation-related activities, they lacked the sense of ownership and belonging in these nature reserves. Therefore, their concerns were more on challenges such as inequality, marginalisation and poverty.

CHAPTER FIVE: CONCLUSION AND RECOMMENDATION

This chapter provides an overall conclusion of the research study, and provide recommendations for future similar studies and recommendations to the nature reserves. The study investigated how community conservation can be incorporated with waste management in the Wolfgat Nature Reserve and Witzands Aquifer Nature Reserve. Indeed, the study managed to achieve all its listed objectives. In the end, the research was able to discover the following important findings:

- Illegal dumping is one of the biggest environmental issues in both nature reserves.
- Due to inadequate waste management services in some surrounding communities, the reserve gets affected by the waste.
- The conservator-community relationship still needs some work; it is an ongoing constantly changing relationship. However, the relationship does exist in both study sites.
- It was discovered that based on the two study nature reserves, age and remoteness were one of the cause of insufficient community projects.
- A community-conservator positive relationship is vital for the protection of these areas and the survival of those areas.
- Conservators attitude towards the local communities plays a crucial role in how local people view the areas

5.1 Conclusion

Urban nature reserves are faced with several environmental challenges, and proper waste management is a matter of importance to keep these areas pristine, with less impact from visitors. The study aimed to investigate how local communities positive relationship with the natural area and conservator can influence their behaviour in waste management in these areas to minimise

human impacts. The study revealed that the level of awareness and attitude of individuals to protected areas is conditioned by several factors such as exclusion and past experiences, the conducted study showed a few similarities with other previously conducted similar studies in terms of how people behave when they are excluded and how the level of education should be considered when these nature reserves create community projects. Although, these areas are guided by many laws and regulations such as the National Environmental Management: Protected Areas Act 57 of 2003 and National Waste Management Strategy (NWMS) of 1999 (legislative requirement of the National Environmental Management: Waste Act 59 of 2008) which falls under National Environmental Management Act 107 of 1998.

The study revealed that once the public is ignored they tend to ignore the laws in place. As much as people and management have different opinions, however, it is very important to improve communication with communities to encourage involvement in the affairs of the city and to encourage dialogue between the line departments and the communities to build resilient communities. In many instances, managers of protected areas take decisions without involving the local communities. This, in many cases, leads to protected areas being viewed as isolated. According to the research findings, few locals are aware of the nature reserves and have visited them, whilst other respondents are unaware of the natural reserves, implying that the communities are not proactively engaged in nature reserve operations. Several studies have shown that the management of these nature reserves is responsible for forging the relationship with the communities. Therefore, it is up to the conservators to create and make amendments in order to have a firm relationship with the residents. Wolfgat Nature Reserve has a better rapport with the community than Witzands Aquifer Nature Reserve because it understands community needs and conservationists are more visible in the regions through project creation. Furthermore, Witzands Aquifer Nature Reserve is currently addressing these relationship-related challenges. According to Stats SA (2011), both areas are relatively poor with a high unemployment rate.

While previous research has demonstrated that a higher level of education is associated with increased environmental awareness and a more positive attitude, our study revealed a disparity in the level of education between the two sites, necessitating additional research to determine whether pre-existing education is a critical measuring tool. We are of the view that, in order to address the local needs and conditions the bottom-up approach needs to be followed to understand the local people's challenges.

Although the study highlighted the critical role of public participation in waste management in nature reserves, a more in-depth investigation with a larger sample size is recommended in the future.

5.2 Recommendations

The following recommendations offer ways in which conservators might guarantee that local residents are actively engaged in nature reserves.

- The local communities should be treated as stakeholders; therefore, their opinion should be taken into consideration.
- More community projects should be created for people to see the value of those areas.
- When it comes to involving communities, it should be more than environmental education.
- The conservation goals must align with the surrounding community's needs to avoid conflict.
- Benefits should not be used to gain people support because once better benefits come, the areas will be rejected.
- The bottom-up approach must be followed at all times, the conservators are employed people coming from different areas, unlike the residents who have a better understanding of the area.

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APPENDIX A: QUESTIONNAIRE FOR COMMUNITIES AROUND THE NATURE RESSERVES

Incorporating community conservation with waste management

NB: This questionnaire is strictly anonymous and no person under the age of 18 years will participate. **The questionnaire is divided into three sections and no personal information will be required during completion of this questionnaire. It is strictly for academic and research purpose.**

The following questionnaire is about Incorporating community conservation with waste management in protected areas. It consists of no more than 30 questions. Please tick or cross where applicable and answer as honest as possible.

Section A (DEMOGRAPHIC)

1. Please specify your gender

A. Female ☐ B. Male ☐

2. What is your age range?

A. <18 ☐ B.18-24 ☐ C. 25-34 ☐ D. 35-44 ☐ E. 45-54 ☐ F. >55 ☐

3. Please specify your occupation

A. Student ☐ B. Unemployed ☐ C. Employed ☐ D. Pensioner ☐ E. Other ☐

4. Level of education

A. No formal education ☐ B. Primary education ☐ C. Secondary education ☐ D. Post-secondary education ☐

5. How long have you been living in this community?

5yrs ☐ 10yrs ☐ 15yrs ☐ >20 yrs ☐

Section B (community perceptions toward nature reserves)

6. Do you work in a nature reserve?

A. YES ☐ B.NO ☐ C. I do not know ☐

If **YES**, what is your role there?

If **No**, do you know someone who works there?

7. Have you ever been in a Nature reserve before?

Yes ☐ No ☐ I do not know ☐

8. In your own understanding, what is a Nature Reserve?

9. What is your understanding about conserving/preserving nature?

10. Have you ever been part of a community project in a Nature Reserve?

Yes ☐ No ☐ I do not know ☐

If yes, please briefly explain your role.

11. How do you feel about protected areas/ Nature Reserves?

12. Based on your knowledge, what is the purpose of Protected Areas/ Nature Reserve?

13. Do you think the surrounding communities should be included in the management of the Protected Areas/Nature Reserve?

A. Yes ☐ B. No ☐ C. I do not know ☐

Please explain your answer.

14. Do communities feel a sense of belonging to protected areas?

A. Yes ☐ B. No ☐ C. I do not know ☐

Please explain your answer.

15. How is the Nature Reserve affecting you and your community?

16. During which era was the Nature Reserve properly managed?

A. Pre(Before) Apartheid ☐ B. Post (After) Apartheid ☐

Please explain your answer?

17. Before apartheid and now, has the accessibility to the Nature Reserve improved or not?

A. Yes ☐ B. No ☐ C. I do not know ☐

Please explain your answer.

18. How is your relationship with the natural environment and the conservators (employees of the Nature Reserve)?

19. Do you think the Nature Reserve is providing services (e.g. temporary jobs) to reduce poverty?

A. Yes ☐ B. No ☐ C. I do not know ☐

Please explain your answer.

20. Do you feel the nature reserve is doing enough to help you as a community?

A. Yes ☐ B. No ☐ C. I do not know ☐

Please explain your answer.

21. Do the nature reserve/community have programs that seek to empower the community economically?

A. Yes ☐ B. No ☐ C. I do not know ☐

Please explain your answer.

22. Do you get any benefits if you or others participate in programs aimed at protecting the nature reserve?

A. Yes ☐ B. No ☐ C. I do not know ☐

Please explain your answer.

23. In your own opinion, how should the Nature Reserve operate?

Waste Management issues (community and protected areas)

24. Does the municipality provide you with Waste Management Services(WMS)?

A. YES ☐ B.NO ☐ C. I do not know ☐

If **YES**, is it adequate? If it is not adequate, please explain what you do with the waste collected.

If **NO**, how do you dispose of your waste?

25. Have you or seen someone dumping waste illegally?

Yes ☐ No ☐ I do not know ☐

If **YES**, what was your reaction?

26. Do you think illegally dumped waste has a negative impact on the nature reserve?

A. YES ☐ B.NO ☐ C. I do not know ☐

Please explain your answer.

27. In your understanding what is the role of the community in dealing with illegal dumping?

28. Do you think it's your responsibility to protect the nature reserve against illegal dumping?

A. YES ☐ B.NO ☐ C. I do not know ☐

Please explain your answer.

29. Since democracy, do you feel waste management has improved?

A. YES ☐ B.NO ☐ C. I do not know ☐

Please explain your answer.

APPENDIX B: SEMI-STRUCTURED INTERVIEW QUESTIONS WITH COCT STAFF

Interview questions for the City of Cape Town (including reserve managers)

1. What are some of the environmental challenges the nature reserve is facing?
2. How are those challenges dealt with/solved?
3. How is the nature reserve relationship with the surrounding communities?
4. What could be the possible reasons for such relationship?
5. In what way is Community Conservation promoted in your Nature Reserve?
6. Are there any Community Conservation projects in place?
7. In terms of waste management, is the waste management in place working meaningfully?
8. How is the Nature Reserve managed as a system in order to manage waste coming from the surrounding areas (illegal dumping)?
9. Are the surrounding community members included in the waste management plan as crucial stakeholders?
10. Based on your knowledge, do you think surrounding communities can play a vital role in tackling some of the environmental challenges (such as waste pollution) the Nature Reserve is dealing with?
11. What is the aim of the Integrated Reserve Management Plan (IRMP) to ensure that the Wolfgat and Witzands Aquifer Nature Reserve has clearly defined objectives and activities to direct the protection and sustainable use of its natural, scenic and heritage resources over a five-year period?.

12. Does the nature reserve have methods to ensure sustainable yields, promote compliance with laws, integrate biodiversity concerns with waste management, and promote sustainable eco-tourism? What are those methods?.
13. What programmes are in place to inspire visitors and communities to consider the environment as an interrelated and interdependent system, of which they are an integral part?.
14. Does the IRMP make a meaningful contribution to management of the Wolfgat and Witzands Aquifer Nature Reserve
15. Are sufficient staff members with the right qualifications allocated to each waste management activity?
16. What are some of the sustainable environmental awareness and encourage participation in conservation initiatives?
17. Does the Nature Reserve provide any programs to lower poverty?

APPENDIX C: CONSENT FORM

Department of Environmental and Occupational Health, Cape Peninsula University of Technology, District, South Africa, Kaizergracht, 8000, Cape Town.

I…….....agree to participate in Xolisiwe Sinalo Grangxabe (214261867) study as she will be conducting an interview requiring me to answer questions related to her study. I also understand that the information will be used for the completion of her dissertation titled 'Incorporating community conservation with waste management in the Wolfgat and Witzand Aquifer Nature Reserve, Cape Town, South Africa'.

Signature:

Date:

…….. ……..

If you have any ethical concerns about this study, please contact the ethics committee chair: Prof F. Nchu

Email: nchuf@cput.ac.za

Tel: 0219596473

APPENDIX D: PERMISSION TO CONDUCT RESEARCH AT CITY OF CAPE TOWN MANAGED NATURE RESERVES

CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD

DIRECTORATE: SPATIAL PLANNING AND ENVIRONMENT
DEPARTMENT: ENVIRONMENTAL MANAGEMENT
BIODIVERSITY MANAGEMENT BRANCH, CONSERVATION SERVICES UNIT

Penelope Glanville
Senior Professional officer: Knowledge manager
T: +27 21 444 9624
E: Penelope.Glanville@capetown.gov.za

ATT: Xolisiwe Grangxabe 01.03.2021
Contact email: XolisiweSinalo.Grangxabe@capetown.gov.za

Affiliated Institution: CPUT
MTech: Environmental Management
Student number: 214261867
Supervisor: Dr. BS. Chidi

Dear Xolisiwe
PERMIT AND LAND OWNERS PERMISSION TO CONDUCT RESEARCH ON CITY OF CAPE TOWN NATURE RESERVE
Title: Incorporating community conservation with waste management in protected areas: a case study of Wolfgat Nature Reserve and Witzands Aquifer Nature Reserve.

The Biodiversity Management Branch of the City of Cape Town (the Branch) has granted landowners permission for research to be conducted at Wolfgat Nature Reserve and Witzands Aquifer Nature Reserve. This permission allows you to conduct the following activities, from **01 March 2021 to 01 January 2022**:

1. It is mandatory that before the final thesis is published or shared publicly, that the Biodiversity Management Branch is provided a draft publication for ethical considerations and to ensure that the City of Cape Town is not portrayed in a negative light.
2. Only the approved questionnaire with correct Nature Reserve name can be used.

This permission has been granted on the following conditions:

- You inform the Site Manager of your access and activity on site:

Jacques Küyler
Biodiversity Area Coordinator, Witzands Aquifer Nature Reserve
Tel: 021 400 6300
Etienne.Kuyler@capetown.gov.za

Lewine Walters
Biodiversity Area Coordinator : Wolfgat Nature Reserve
Tel: 021 400 3856 | **Fax:** 021 400 3855 | **Cell:** 082 900 8630 |
Email: LewineMegan.Walters @capetown.gov.za |

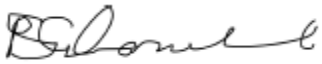
- The researcher will need to arrange with Nature Reserve management if staff may accompany him/her on the reserve.
- The locations of the survey and one site work are to be communicated to the reserve manager.
- Any changes to your methods will require an updated version of this permit and thus need to be submitted in writing to the Branch for consideration via Penelope.Glanville@capetown.gov.za.
- Access to the Nature Reserves is subject to the City of Cape Town By-laws and the Cape Nature Conservation Ordinance No 19 of 1974 as amended by Act No 3 of 2000.

This permission is valid from 01.03.2021 to 01.01.2022. The City of Cape Town reserves the right to terminate this approval at any time without further notice. A progress report will be required at the end of this term to support extension of this permission period if required.
The Branch must be provided with a copy of the final report on the findings of this research, as well as any project metadata, spatial data, photographs to allow for further analysis and monitoring for management purposes.

In addition: Please note that the following is <u>NOT</u> allowed at this site:

1. Introduction into or removal of, picking of or damaging of flora, fauna, nests, etc.
2. Damaging or destruction of municipal property, fences or any natural objects
3. Dogs, vehicles, any weapons, catapult, bow-and-arrow, traps, explosives, poison or any other object or thing of this kind that could be used in hunting or exercising control over any animal
4. Littering or dumping of rubbish
5. Pollution of water
6. Lighting of fires, no smoking
7. Creating a disturbance, nuisance or hindrance to any visitor, animal, bird, etc.
8. Hindrance or obstruction of any authorised officer in the execution of his duties
9. Camping or staying on site overnight

Any transgression of any of the above conditions or those imposed by CapeNature will result in the cancellation of this permission. The City of Cape Town reserves the right to withdraw this permission at any time.
Your entry to and activities on this site are undertaken at your own risk.
Any queries regarding this permit please contact the Branch via Penelope Glanville at telephone number 021 444 9264 or email: Penelope.glanville@capetown.gov.za.
Regards



01.03.2021 on behalf of CD

.....

Clifford Dorse
Chairperson of the Biodiversity Management Branch Ecological Management Committee

APPENDIX E: ETHICAL CLEARANCE LETTER

Cape Peninsula University of Technology

P.O. Box 1906 · Bellville 7535 South Africa ·Tel: +27 21 953 8677 (Bellville), +27 21 460 4213 (Cape Town)

Ethics Approval Letter **Reference no: 214261867/06/2021**

Office of the Chairperson **Research Ethics Committee**	**Faculty of Applied Sciences**

On 30 June 2021, the Faculty Research Ethics Committee of the Faculty of Applied Sciences granted ethics approval to Grangxabe, X.S. for research activities related to a project to be undertaken for a degree (Master of Environmental Management) at the Cape Peninsula University of Technology.

Title of project:	Incorporating community conservation with waste management in the Wolfgat and Witzands Aquifer Nature Reserves, Cape Town, South Africa

Comments (Add any further comments deemed necessary, e.g. permission required)

1. Humans are involved in the study.
2. This permission is granted for the duration of the study.
3. Research activities are restricted to those detailed in the research proposal.
4. The research team must comply with conditions outlined in AppSci/ASFREC/2015/1.1 v1, CODE OF ETHICS, ETHICAL VALUES AND GUIDELINES FOR RESEARCHERS.

Signed: Chairperson: Faculty Research Ethics Committee	**15/07/2021** **Date**

APPENDIX F: WASTE REMOVAL, DELIVERED TO FALSE BAY COASTAL PARK LAND FILL DURING JULY TO SEPTEMBER 2021

DATE 2021	FROM	WEIGHT (KG)	COST (R)
JULY			
05 Jul	WNR	5240	3360.61
05-Jul	WNR	11040	7201.2
05-Jul	WNR	8520	336061
06-Jul	WNR	9000	5760.9
07-Jul	WNR	9660	6241.2
07-Jul	WNR	7460	4800.9
08-Jul	WNR	6980	185.5
08-Jul	WNR	6480	185.5
08-Jul	WNR	4380	2880.6
08-Jul	WNR	9740	6241.2
09-Jul	WNR	5960	159
15-Jul	WNR	6980	185.5
15-Jul	WNR	8660	5601.1
16-Jul	WNR	7620	4961
16-Jul	WNR	7000	4480.7
26-Jul	WNR	7680	4961
27-Jul	WNR	7640	4961
27-Jul	WNR	6820	4480.7
27-Jul	WNR	2240	1440.3
28-Jul	WNR	2240	1440.3
29-Jul	WNR	2340	1600.4
21 Days	**TOTAL**	**136 000 Kg**	**R 407 189,61**

AUGUST			
11-Aug	WNR	480	3600
12-Aug	WNR	480	3600
20-Aug	WNR	3140	2080.4
23-Aug	WNR	2020	1440.3
23-Aug	WNR	3160	2080.4
23-Aug	WNR	1400	960.3
25-Aug	WNR	5760	3840.6
25-Aug	WNR	7680	212
25-Aug	WNR	5260	3520.71
30-Aug	WNR	3300	2240.5
8 Days	**TOTAL**	**32 680 Kg**	**R 23 575,21**
SEPTEMBER			

(Source: Zandisile Biko, WNR Reserve Supervisor)

Delivered to Drop of Facility Spine Road during JULY TO SEPTEMBER 2021

DATE 2021	FROM	WEIGHT (Ton/Kg)	COST
JULY			
28 Jul	WNR	16 bags	
29 Jul	WNR	16 bags	
Total		**32 Bags, Ton/ Kg**	

AUGUST			
16 August	Macassar West	100 Bags	
Total		**(100 bags) Ton/ Kg**	
SEPTEMBER			
		Bags/Ton = Ton/ Kg	
1 Sept	Macassar West	34 Bags	
2 Sept	Macassar West	50 Bags	
8,9 & 10	Macassar Beach Clean-up	87 Bags	
9 Sept	WNR	11 Bags	
14 & 15	Macassar Beach Clean-up	197 Bags	
20 Sept	WNR	26 Bags	
20 Sept	WNR	03 Bags	
21 Sept	WNR	36 Bags	
21 Sept	WNR	24 Bags	
22 Sept	WNR	32 Bags	
22 Sept	WNR	37 Bags	
23 Sept	WNR	33 Bags	
27 Sept	WNR	05 Bags	

GRAND TOTAL	**(conversion 1Ton = 1016Kg)**	**575 (Bags) ,Tons / Kg**	

(Source: Zandisile Biko, WNR Reserve Supervisor)

APPENDIX G: LITTER CLEAN UP AT WOLFGAT NATURE RESERVE

Figure S1: Litter dumped on site (source: Z. Biko)

FigureS2: Illegally dumped domestic waste on vegetation

Figure S3: Staff working together to clean the site (source: Z. Biko)

FigureS4: Waste stacked up for grabber to collect easily

FigureS5: Team working on site

FigureS6: Scattered waste on the nature reserve fire belt

FigureS7: Team cleaning up what's left of the waste (source: Z. Biko)

FigureS8: After the area has been cleaned