Stereotypic behaviour of captive New Zealand zoo mammals: attitudes of zoo staff, prevalence, and effectiveness of short-term environmental enrichment

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Lydia Roma Lowe

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“Until one has loved an animal, a part of one's soul remains un-awakened”

Anatole France 1844-1924

Abstract

Modern captive animal institutes (zoos) focus on conservation, entertainment, education, research and the welfare of the animals. A good indicator that there could be underlying welfare issues, caused by physical or managerial inadequacies for example, is the display of stereotypic behaviour. Stereotypic behaviour refers to repetitive or abnormal actions, such as pacing or self-mutilation. In this study, I firstly examined the prevalence of stereotypies in captive mammals, and associated risk factors, in three New Zealand zoos (in Auckland, Hamilton, Wellington) using a questionnaire to examine staff perceptions and attitudes towards stereotypical behaviour and its mitigation. Secondly, I observed behaviours of eight species (African wild dogs [AWDs], chimpanzees, giraffes, meerkats, otters, southern white rhinoceroses, tigers, and zebras) housed at the three institutes to document the occurrence of stereotypical behaviour. Thirdly, I investigated the efficacy of short-term enrichment on three target species (chimpanzees, giraffes, AWDs) that displayed stereotypies.

At each institute, zoo staff recognised the occurrence of stereotypic behaviour and they agreed that such behaviour indicates underlying welfare issues. My observations confirmed that stereotypical behaviour did occur at each institute, with six of the eight species displaying stereotypies including pacing, licking inedible objects, begging, circling, head shaking/tossing, hair picking, body rocking, and coprophagy. Neither meerkats nor rhinos displayed stereotypies, however, indicating that these species may be better suited to captivity than the others. The enrichment program I developed for three species (AWDs, giraffes, and chimpanzees) was partly successful in that the animals engaged with the range of toys and devices provided, but the frequency of stereotypies was not reduced. Consequently, enrichment alone cannot be used to treat stereotypical behaviour. My findings are important for helping to improve the welfare of captive zoo mammals.

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Chapter 1

Introduction

"May all that have life be delivered from suffering"

Gautama Buddha 566 BC - 480 BC

1.1 Introduction

Every day numerous species join the road to potential extinction because of habitat destruction, overfishing, poaching, pollution and other causes. One way to save some species from such a fate is to house and breed them in captivity. However, this solution can then become a problem of animal welfare because animals confined in captivity are prone to behaviour problems known as stereotypic behaviour, e.g. pacing (Mason, 1991, Vickery and Mason, 2005, Hogan and Tribe, 2007). Environmental enrichment, or generating tasks such as hiding food to make animals perform, is a method used to alleviate unwanted stereotypic behaviours displayed by captive animals (Robinson, 1998, Kuczaj et al., 2002). My main purpose in undertaking this project is to help improve the life of captive animals, and mammals in particular, kept in New Zealand zoos. My motivation is that we humans, who are the paramount destroyers of lives and the environment, owe it to the animals.

1.2 Background to animal captivity and stereotypic behaviour

Animal species of many kinds have been housed and kept in captivity for numerous reasons and for thousands of years (Kisling, 2001). Some of the earliest collections of mainly exotic species was undertaken by the ancient Egyptians, roughly 2,500 B.C.E. (Hosey et al., 2009). They collected them for either religious significance or as a status symbol (Bostock, 1993, Young, 2003). After the ancient Egyptians and until the 1800s, many rich and royal families around Europe and the Middle East continued to use captive animals as a status symbol (Bostock, 1993). It was not until scientists, such as Charles Darwin, started taking a significant interest in the animal kingdom that small desolate enclosures of exotic wildlife, known as menageries (Hosey et al., 2009), became established for scientists to observe (Bostock, 1993, Young, 2003). Paying members of the public were soon allowed into these facilities which led to the establishment of zoos for entertainment purposes (Young, 2003). Since the establishment of the first zoos, members of the public have criticised zoo practices regarding issues such as high death rates or unnatural enclosures as time has progressed (Young, 2003). Until the late 19th Century, zoos generally housed exotic animals in barren concrete “dungeons”, now referred to as first generation exhibits. Subsequent changes eventually led to the development of larger and more open

enclosures, or second generation exhibits, during the 20th Century (Norton et al., 1995, Tribe, 2008). These exhibits were still made out of cement and often had a moat surrounding the perimeter. More naturalistic enclosures, third generation exhibits, were established in middle of the 20th Century and their development continued, resulting in the contemporary zoo (Norton et al., 1995, Tribe, 2008). Since the start of the 21st Century, the contemporary third generation zoos, with large naturalistic enclosures, have continued to develop. They are now seen in many, but not all, parts of the world (Tribe, 2008). Although public entertainment is still one of the five main principles on which zoos focus, conservation, public education, research, and animal welfare are also key features of modern zoos (Fernandez et al., 2009). However, zoos must establish a point of balance that provides members of the public with animals to view and at the same time maintain a level of animal welfare. If zoo visitors are not entertained, the other four principles would be hard to maintain (Fernandez et al., 2009). Managing this conflict, between animal welfare and the need to display animals, is a task faced by captive wildlife institutes. If zoo visitors are not entertained, they may cease to visit the zoo. On the other hand, if the welfare of animals is compromised, visitors may also form negative perceptions. Careful management of zoos, zoo animals, and enclosure design is needed to ensure that the animals' welfare is not compromised. At the same time most animals, if not all, should be on display for zoo visitors.

A well known example illustrates the marked changes in attitudes and philosophies regarding the condition of animals kept in captivity. It is the story of a lowland gorilla (*Gorilla gorilla*) named Willie B who was born in Africa in 1958 and captured by an animal collector in 1961. He was transported to the Atlanta Zoo in Georgia, USA, where he was housed on his own in a barren, tiled indoor enclosure with concrete floors and iron bars (Hosey et al., 2009) (Fig. 1.1).

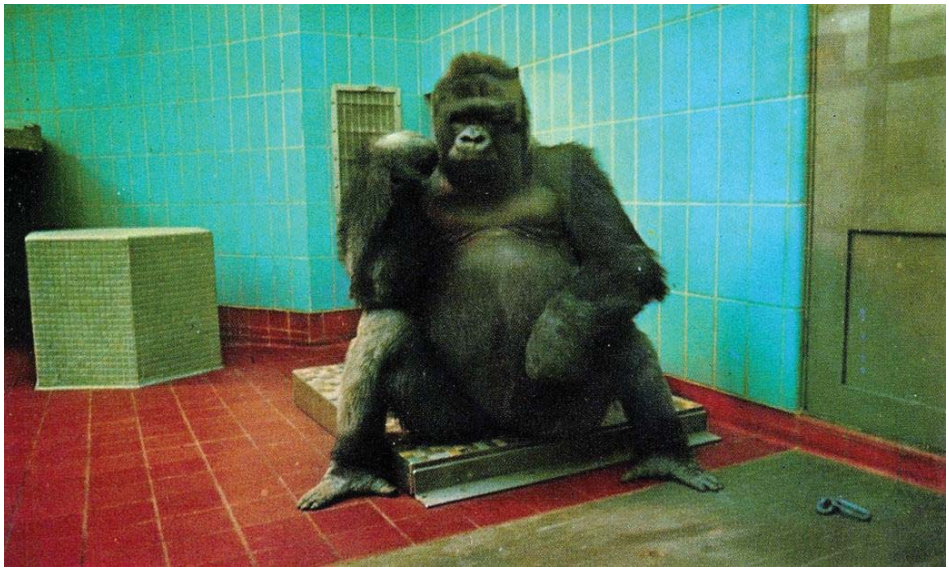


Figure 1.1 Willie B in his barren sterile enclosure (Accessed 12.1.12 from: http://www.atlantatimemachine.com/misc/zoo_02.htm)

Willie B lived in these conditions for twenty years before public complaints concerning his lonely appearance led to his enclosure being re-evaluated. The solution to his loneliness was treated by providing him with a television. Willie B watched programmes such as *MASH* and *60 minutes* to pass the time, but issues regarding his living conditions were still a matter of both public and institutional concern. It was not until 1988, twenty-seven years after his capture, that Willie B stepped outside for the first time into a newly designed naturalistic enclosure. For the remainder of his life (12 years), Willie B lived in this outdoor natural enclosure with other gorillas until his death at age 41, in the year 2000. Willie B's story not only illustrates how views have changed, but also shows how his pitiful circumstances helped initiate the transformation that has progressed to what we now know as the modern zoo and the end of first generation exhibits (Hosey et al., 2009). These first generation exhibits refers to the sterile enclosure designs, i.e. tiled walls, concrete floors, and iron bars, in which the animals were kept before the change to more naturalistic enclosures (second and third generation exhibits).

This change to the more naturalistic exhibit environment, primarily third generation exhibits, means that zoos are not only better for the animals because their

needs are more adequately met but also such environments keep the public happy. The more naturalistic exhibit tends to promote more natural behaviours by the animals, which is seen by zoo visitors as a positive attribute (Fernandez et al., 2009). Another way of stimulating a wider variety of behaviour in captive animals is to provide them with environmental enrichment (Tofield et al., 2003). Environmental enrichment is designed to motivate captive animals by providing them with choices and new situations that invigorate one or more of an animal's senses (Hoy et al., 2010). Enrichment has also been incorporated into the management plans for captive species to alter other behaviours such as increasing daily activity and decreasing aggression. It is also beneficial for improving reproduction rates and overall health by increasing and strengthening social interactions which can lead to an increase in sexual arousal (Carlstead and Shepherdson, 1994). Health is improved as the animals are less stressed and feel more in control of their environment. This increases the chances of survival both in captivity and in the wild if captive-bred animals are to be released (Carlstead and Shepherdson, 2000). Providing the animals with an enriched environment also appeals to the public because, again, the animals display behaviours that are more attractive and acceptable to the public (Robinson, 1998). Maintaining natural behaviours by animals in captivity is very important for captive wildlife institutes (Rabin, 2003). If the animals appear to be suffering either physically or psychologically, or both, the conservation goals and educational advocacy would be compromised, and thus zoos and captive wildlife institutes have attempted to maintain high levels of animal welfare (Robinson, 1998, Mason, 2000).

Because animals are confined in captivity, their welfare has become an important issue (McPhee and Carlstead, 2010), although it can be very difficult to measure and assess (Bassett and Buchanan-Smith, 2007). In developed countries there are already minimum standards for the care of most zoo animals (Wielebnowski, 2003). Most have a mandatory code of animal welfare. In New Zealand, these codes are reviewed and revised roughly every ten years by a committee that sets out the minimum standards regarding the care of all zoo animals (NAWAC, 1999, NAWAC, 2005). This committee is known as the National Animal Welfare Advisory Committee (NAWAC) and comprises people who collectively have knowledge and experience in

the following fields: veterinary, agricultural and animal science, commercial animal use, the husbandry of animals, animal ethics and welfare, and environmental and conservation management. There is also a period of public consultation before these 'codes' are finalised (NAWAC, 2009).

The New Zealand code covers issues including the housing, husbandry, behaviour, and transport of all animals as well as the treatment of the animals by people (NAWAC, 1999, NAWAC, 2005). These animal welfare standards ensure that the level of care provided for the animals meets the minimum standard of the relevant captive animal welfare act. These welfare standards can be broken down to what is known as the five freedoms that have been established in the international literature (Wielebnowski, 2003). The five freedoms are to ensure that the welfare of the captive animals is not compromised and that they have freedom from (1) hunger and thirst, (2) discomfort, (3) pain, injury, or disease, (4) fear and distress, and (5) freedom to express natural behaviour (Young, 2003, Melfi, 2009). Although many zoos maintain excellent levels of animal welfare, thus ensuring that the animals are kept in both good physical and psychological health (Young, 2003), there are also gaps in knowledge regarding the behavioural husbandry of many species (Melfi and Hosey, 2011).

A commonly used indicator for measuring animal welfare is to examine the type and variety of behaviours the animals are displaying. For example, behaviours that are not exhibited in the wild but which are only exhibited in captivity by the same species are good candidates for assessing the level of welfare provided for the animals. For example, stereotypies are a class of behaviour that are more frequently exhibited by animals kept in captivity than by their wild counterparts (Mason, 1991, Rees, 2004, Vickery and Mason, 2005, Hogan and Tribe, 2007, Miller et al., 2011). Stereotypic behaviour generally refers to behaviours that are displayed by animals as being repetitive, serve no apparent function, and which may occur often as a result of boredom, frustration, stress, or as a coping mechanism (Mason et al., 2007). Stereotypic behaviours can also occur because the animal is attempting to control its environment (Garner et al., 2003, Hogan and Tribe, 2007). Examples of stereotypic behaviours include pacing, pattern swimming, hair picking, body rocking, and licking inedible objects (Hosey et al., 2009). Some species are also more susceptible to

problems such as stereotypies than other species that may, instead, thrive in captivity (Bertram, 2004, Clubb and Mason, 2007, Mason, 2010). For example, polar bears (*Ursus maritimus*) (Bertram, 2004, Mason, 2006) and giraffes (*Giraffa camelopardalis*) do not cope as well as ring-tailed lemurs (*Lemur catta*) in captivity (Mason, 2010). However, the underlying reasons why animals display stereotypic behaviours in captivity are not well understood (Vickery & Mason, 2005). The display of stereotypic behaviours is often linked to underlying issues of animal welfare (Mason, 1991, Dawkins, 2004, Mason and Latham, 2004). But other reasons for stereotypic behaviours include problems relating to the environment in which the animal is being kept, a lack of stimuli, or an enclosure that is desolate or too small. Another possible cause is a negative experience in the past which may result in an animal displaying stereotypic behaviour even though there is no current welfare problem (Swaisgood, 2007). All these conditions may lead to the display of less natural behaviours that are often replaced with stereotypic behaviours (Garner et al., 2003). However, while poor animal welfare is often indicated by the presence of a stereotypic behaviour, the assessment of welfare should not be based solely on the presence or absence of a stereotypy (Bassett and Buchanan-Smith, 2007, Swaisgood, 2007). Other signs of welfare issues can also include other behaviours that are out of character for the animal as well as general health and physical appearance of the animal.

Understanding and assigning causes of stereotypies in animals from our human perspective can be difficult. Generally, anthropomorphic interpretations about the stereotypies, the identification of causes through past research, observing animals and the conditions under which they are being kept, examining the past history of the animals, and husbandry procedures, are all used when investigating stereotypic behaviours. Across a diverse range of species there is a positive correlation between the level of stereotypic behaviour and welfare. Environmental enrichment, mentioned previously, is a strategy used by zoos to help alleviate or eliminate the display of abnormal or stereotypic behaviours (Robinson, 1998, Mellen and MacPhee, 2001).

Figure 1.2. Enrichment toy for tiger.

The interaction between animal welfare and stereotypic behaviour require further investigation. Welfare issues are extremely important because we have a duty of care to animals confined in captivity and it is therefore essential to ensure they are looked after to the highest possible standard. Developing a better understanding of the welfare issues that result in stereotypies for captive animals, and possible methods to improve welfare by using enrichment, we can ensure that animals kept in captivity are being cared for at the highest possible standard. It is also important to note that although there has been extensive research carried out on domesticated animals, such as pigs (*Sus scrofa domesticus*), and associated stereotypic behaviour, I chose to focus my literature review on zoo animal behaviour only. Although some of the information about domesticated animals can be insightful for captive zoo animals, the process of domestication can alter the behaviour of the species. Moreover, much research concerning this topic focuses on the welfare of animals for production rather than behaviour.

1.3 Problem statement

The presence of stereotypic behaviours displayed by captive animals suggests that there are underlying causal welfare issues. Research concerning stereotypic behaviours and environmental enrichment is limited for many species kept in captivity. The underlying causes of these behaviours are typically unclear and the effects of implemented enrichment programmes are often insufficient. Because the type of

environmental enrichment required depends on the species and on the stereotypy that is being displayed, the overarching purpose of my study is to try to develop environmental enrichment programmes that match closely the species observed to be displaying stereotypic behaviours.

1.4 Aims and objectives of the study

The main aim of this study is to investigate the risk factors and prevalence of stereotypic behaviours of animals in captive wildlife institutes and to test the effectiveness of short term environmental enrichment devices on the expression of stereotypic behaviour on a selected group of species.

The three main objectives to meet this aim are as follows.

Objective 1. Examine the risk factors and prevalence of stereotypic behaviours of animals held in captive wildlife institutes by using a cross-institutional survey. This objective was attained using an online questionnaire designed for zoo staff at three New Zealand zoos (Chapter 3).

Objective 2. Determine the risk factors and prevalence of stereotypic behaviours of animals held in captive wildlife institutes. Prevalence at three New Zealand zoos were compared by observing the behaviour of eight species at each zoo (Chapter 4).

Objective 3. Evaluate the effectiveness of short–term environmental enrichment programmes to reduce the frequency of stereotypic behaviour. Three species that frequently display stereotypic behaviour were selected from the observational data and were provided with short-term enrichment to assess its effectiveness (Chapter 5).

1.5 Thesis outline

The thesis comprises 6 chapters. After this introduction (Chapter 1), a review of the literature regarding stereotypic behaviours and environmental enrichment is presented (Chapter 2). Associated studies that surveyed zoo staff and questioned them about stereotypic behaviours, as well as other studies that tested the efficacy of environmental enrichment, will also be covered.

Chapter 3 comprises the work relating to objective 1, the survey and its results relating to the responses and perceptions of staff at three New Zealand zoos about stereotypic behaviours in captive mammals. It is written as a stand-alone journal article (paper 1).

In Chapter 4 I examine and discuss the observations of eight species at three New Zealand zoos. It is written in the format of a stand-alone journal article (paper 2).

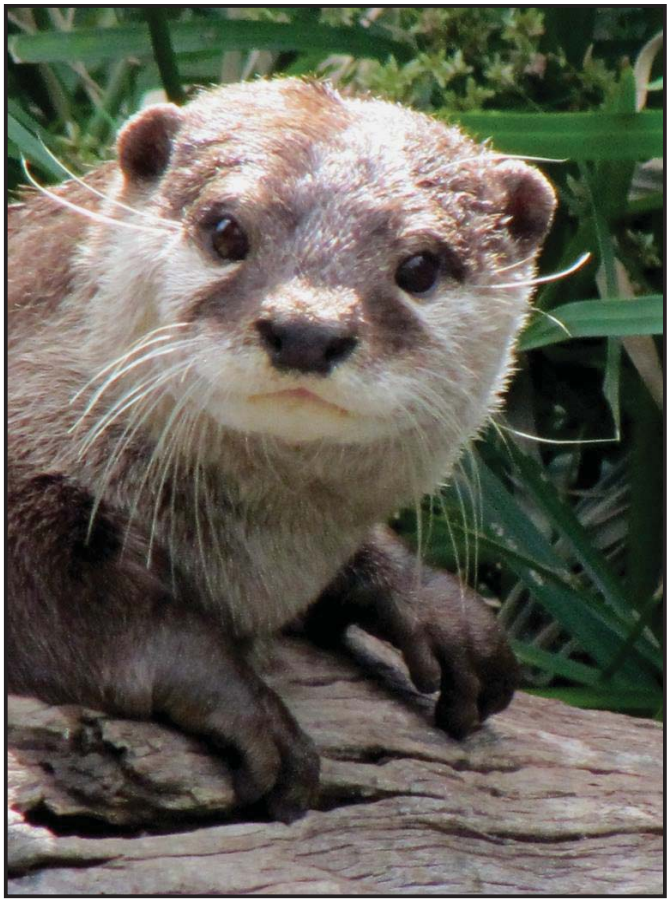
In Chapter 5 I assess the efficiency of short term environmental enrichment on stereotypic behaviours in three captive mammal species, namely African wild dogs (*Lycaon pictus*), chimpanzee (*Pan troglodytes*), and giraffe (*Giraffa camelopardalis*). It is written in the format of a stand-alone journal article (paper 3).

In the final chapter, Chapter 6, I summarise the main findings and discuss their significance. In addition, I note recommendations for further research.

References

Chapter 2

A review of stereotypic behaviour and environmental enrichment in zoos



"No one can do everything, everyone can do something"

Gil Scott-Heron 1949-2011

2.0 Introduction

In this chapter, I initially define stereotypic behaviour and then examine its causes and effects. I then discuss the classification of stereotypic behaviours before considering the treatment of stereotypic behaviours with five forms of environmental enrichment. Finally, I describe potential problems with environmental enrichment programmes.

2.1 Defining stereotypic behaviour

There have been several definitions of stereotypic behaviour. Two common definitions are: (1) "a series of movements of the whole or parts of the animal's body which are repeated regularly and which serve no apparent function" (Dantzer and Mormede, 1983); and (2) "a repetitive behaviour induced by frustration, repeated attempts to cope and/or C.N.S. (central nervous system - brain) dysfunction" (Mason et al., 2007). There is controversy associated with these definitions. Mason *et al*. (2007) outlined why Dantzer and Mormede's (1983) definition is inaccurate and constructed a new definition as listed above. Mason *et al.* (2007) pointed out that Dantzer and Mormede's (1983) definition is inaccurate as firstly it can be difficult to determine a behaviour that appears to have no apparent function as some behaviours, such as some oral movements in captive ungulates, can have underlying benefits. Secondly, Mason *et al.* (2007) also indicated that behaviours that are deemed to be stereotypic cover a very broad category and do not necessarily match Dantzer and Mormede's (1983) definition of a stereotypic behaviour. Research has been carried out which looks at indentifying the fine line between behaviours that count as stereotypic but may also be deemed "abnormal" or even normal. Mason (1993) earlier acknowledged how difficult it is to define the line between behaviours that could be stereotypic (or 'stereotypies'). He stated that there are two main reasons for this difficulty (Mason, 1993): (1) When do we class a behaviour as stereotypic, i.e. for how long must the behaviour be displayed and how repetitive must it be?; and (2) Definitions are frequently so broad that multitudes of behaviours are included but not all can be classed as stereotypic (Mason, 1993). Often stereotypic behaviours can include repetitive behaviours such as head tossing and pacing whereas behaviours regarded simply as 'abnormal' such as regurgitation have no apparent function (Hare

and Zee, 2010). Complications arise when pacing felids, prior to feeding, are deemed stereotypic because of their repetitive behaviour. However, in the wild, felids "walk" (pace) around to hunt for food and in some cases on select routes they walk to mark their territory. But, due to the confinements of captivity, felids are forced to pace in small confined areas and hence this otherwise normal walking behaviour, an attempt to mimic wild and natural behaviours, becomes much more noticeable and hence may have been erroneously described as stereotypic (Meyer-Holzapfel, 1968, Jenny and Schmid, 2002). This walking or pacing behaviour may also be due to feed anticipation (Montaudouin and Le Pape, 2004), i.e. the animal may be motivated to perform food acquisition behaviours prior to feeding such as hunting, in this case, or foraging (Carlstead, 1996). Stereotypic behaviour can also be manifested as the display of redirected behaviours, for example neurotic behaviour. These neurotic behaviours are abnormal behaviours that are not derived from normal ones such as self directed aggression in dogs that may chew their own tail (Gregory, 2004). In these cases an animal displays inappropriate or pointless behaviours possibly because of inadequate or unsuitable captive conditions (Gregory, 2004). Typical stereotypic behaviour patterns in animals include repetitive movements such as pattern swimming in harbour seals (Hunter et al., 2002) and sea turtles (Therrien et al., 2007), giraffids licking non-food objects (Figs. 2.1-2.2) (Fernandez et al., 2008), pacing by felids (Dybowska et al., 2008), and hair pulling and hair eating in primates (Fig. 2.3). Generally, stereotypic behaviours are identified by anthropomorphic interpretations about the stereotypies, past research on causes that have been identified in the literature and observing the animals and looking at the conditions they are being kept in along with past history of the animals, and husbandry procedures. The underlying issues that are causing these stereotypic behaviours also need to be investigated and the connection between welfare and stereotypies is important to understand.

Although there are acknowledged difficulties in working out the exact causes of stereotypies and whether the behaviour is stereotypic, abnormal or normal Mason *et al*'s. (2007) paper will be used for the definition of stereotypic behaviour in this study. That, stereotypic behaviour, is "a repetitive behaviour induced by frustration, repeated attempts to cope and/or C.N.S. (central nervous system - brain) dysfunction" (Mason

et al., 2007). Repetitively displayed behaviours that appear functionless, and are displayed by the animals, will be classed as stereotypic in this project although where such behaviours might have different interpretations, this is discussed further.

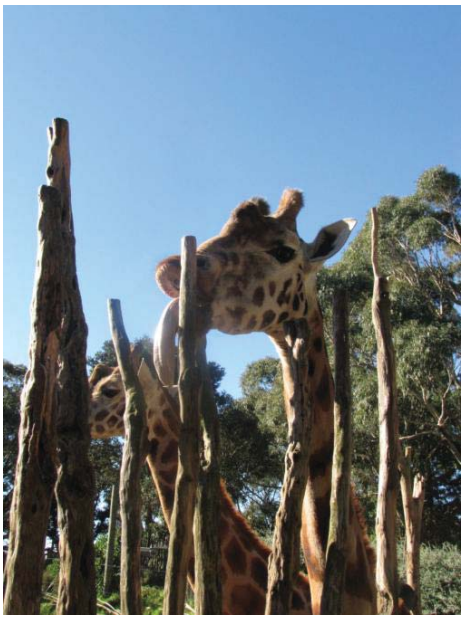


Figure 2.1 Giraffe licking a stick

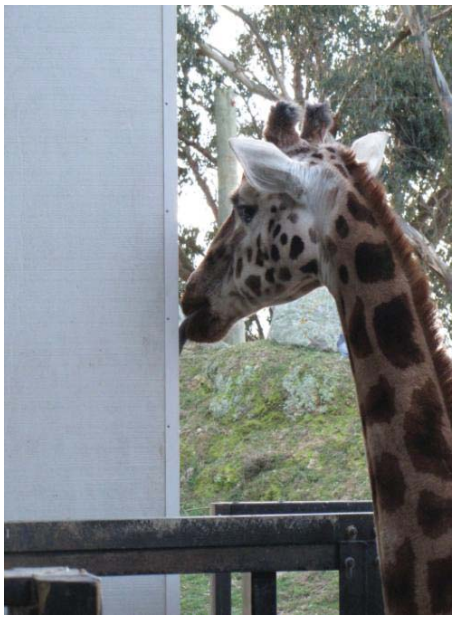


Figure 2.2 Giraffe licking wall

Figure 2.3 Bald patches on a chimpanzee arising from hair pulling.

For the purpose of my study, four general categories of stereotypic behaviours are recognised. These are (1) locomotion (e.g. pacing, pattern swimming, and circling,); (2) self mutilation (e.g. hair pulling and biting); (3) oral (e.g. licking or chewing of inedible objects and crib biting); and (4) repetitive body movements (e.g. body rocking, swaying, and head tossing). These four categories cover the main stereotypic behaviours that are displayed by animals in captivity. Aggressive behaviours will not be evaluated because aggression occurs naturally in the wild and it can often be difficult to distinguish between stereotypic aggression and aggression deemed to be normal, if undesirable, social interaction.

2.2 Causes and effects of stereotypic behaviour

The welfare of an animal is difficult to evaluate because every species and individual, is different and each has different needs which have to be considered by captive wildlife institutes (Hosey et al., 2009). Individual animals differ from one another by factors including age, sex, rearing history, social rank (Stoinski et al., 2001b, Hosey et al., 2009) and personality (Reddon, 2012). There are also characteristics, often physical, which can be observed as being identical or similar between individuals of the same species, but which can be different from those of other species. Genetic make-up contributes, along with past experiences, to an animal's personality or temperament which then influences how it copes with its environment (Swaisgood, 2007, Hosey et al., 2009). In a captive situation the temperament of each individual animal is very important because each individual's needs have to be considered when designing and developing environmental enrichment programmes – animals may react differently to the same factor (Carlstead and Shepherdson, 2000, Hosey et al., 2009). For the purpose of this study, two categories have been evaluated that could potentially be the cause for stereotypic behaviours in captivity. They are: (1) enclosure environment and design, and (2) unnatural conditions due to confinement in captivity. A breakdown of potential causes in these two categories will be discussed in further detail presently. I will also discuss some behaviours (e.g. pacing and coprophagy) which have been classified as stereotypies, that may have different underlying causes.

2.2.1 Enclosure environment and design

Enclosure environment and set-up refers to the type, size, location, and design of the enclosure and the management regime of animals in those enclosures. If areas are inadequately designed and managed, this has been associated with the development of stereotypic behaviours due to a number of reasons, which are outlined below.

2.2.1.1 Lack of retreat space and enclosure size

Captive animals may suffer in fearful situations because they are not able to respond as they would in a natural environment by avoiding, withdrawing, or escaping from the situation (Shyne, 2006). Captive animals can show a variety of maladaptive behaviours including self injury or stereotypic behaviour because they are not able to escape or to avoid people in fearful situations (Meyer-Holzapfel, 1968, Carlstead and Shepherdson, 2000, Hosey, 2000, Shyne, 2006, Morgan and Tromborg, 2007). This lack of retreat space also includes security from zoo staff that carry-out the daily husbandry routines and care of the captive animals. A lack of 'retreat space', and the restriction in enclosure size, have been found to have a positive correlation with an increase in stereotypic locomotion behaviours, such as pacing, as well as other indicators of maladaptation such as infant mortality in carnivores (2003, Clubb and Mason, 2007, Hogan and Tribe, 2007).

Lack of space, in general, can also result in the development of stereotypic behaviours because an enclosed animal does not attain adequate amounts of exercise or satisfactory hunting opportunities (Gregory, 2004). Further studies on captive animals that are kept in groups, such as pigs, have also found that the lack of space leads to an increase in agonistic behaviour (Morgan and Tromborg, 2007). However, a study of the habitat and structural use of their enclosure by a group of gorillas at Atlanta zoo found the quality of space available, i.e. environmental enrichment, was more important than the quantity of space (Stoinski et al., 2001b). Nevertheless, the development of larger enclosures for both solitary and social animals has progressed significantly since the 1970s/80s (Norton et al., 1995).

2.2.1.2 *Location of the enclosure within the zoo*

The location of the enclosure in the zoo can also lead to the development of stereotypic behaviour due to exposure to other species of animals. For example, exposure to other species can be as limited as odours of predators travelling to enclosures of prey species, and this constant odour exposure can result in distress for prey species (Morgan and Tromborg, 2007). Numerous studies in laboratory rats have indicated that the ongoing exposure to cat odour has negative effects on them such as increased blood pressure and anxiety-like behaviour (Dielenberg and McGregor, 2002). These negative effects of prey species being exposed to predator odours have also been recorded in voles, spotted frogs, and cotton top tamarins (*Saguinus Oedipus*) (Morgan and Tromborg, 2007). Stereotypic over-preening in chaffinches when housed next to stuffed predators has also been recorded (Shyne, 2006).

2.2.1.3 Enclosure quality in regard to enrichment

2.2.1.3.1 Causes of stereotypies due to an unstimulating environment

Barren environments can lead to the development of stereotypies and to the decline in animal welfare in species, such as rabbits (Hansen and Berthelsen, 2000) and deer mice (Hadley et al., 2006), in comparison to the activities of species kept in enriched environments (Grindrod and Cleaver, 2001, Shyne, 2006). This is thought to be because the environments are barren, they do not provide any physical or psychological stimulation, and that this results in bored and/or frustrated animals. Stereotypies may develop as it is the animal's way of coping with its frustration and boredom and being unable to control its environment. As a result, animals in barren environments display fewer natural behaviours and an increase in stereotypic behaviours, such as body rocking and crib biting, as a coping mechanism (Garner et al., 2003).

2.2.1.3.2 Causes of stereotypies due to irregular introduction of enrichment – neophobia

Due to the confinements of captivity, animals are often less stimulated and exposed to changes or novel experiences as they have reduced environmental complexity in their daily lives than their wild counterparts (Hosey et al., 2009). This can

result in animals experiencing and expressing a degree of neophobia, which is a dislike, fear, or avoidance of anything new or novel, or neophilia, which is the attraction or interest in novel items (Hosey et al., 2009). Neophobia can occur from the introduction of novel enrichment devices, which are generally used to stimulate the animals physically or psychologically in captivity, but which neophobic animals would perceive as being negative (Hosey et al., 2009). Thus, resulting in the development of unwanted behaviours, such as stereotypies, as the animal's welfare has been compromised (Hosey et al., 2009). Neophobic animals may also respond poorly to rapid changes in husbandry and management practices in captivity by developing or increasing stereotypic behaviours (Hosey et al., 2009). Enrichment programmes must be introduced very gradually to neophobic animals.

2.2.1.4 Loss of scent markers – husbandry practices

Another problem that can arise in enclosure design is that cleaning of cages or enclosures removes the scents used by animals as cues or territorial markers. The loss of scent can result in stress because most mammals (excluding primates) are macroosmatic (Morgan and Tromborg, 2007). Macroosmatic species are animals that use odours as their primary sense, thus relying mainly on olfactory cues to regulate their daily activities, such as scent marking (Morgan and Tromborg, 2007). Removal of these scents can result in highly stressed out animals which has the potential to lead to the formation of stereotypic behaviours.

2.2.2 Unnatural conditions in captivity

2.2.2.1 Social groupings and sexual frustration

Abnormal social groupings, such as keeping solitary animals in social groups, or vice versa, can have marked effects on the stress levels of captive animals, and that can lead to the development of stereotypic behaviours (Morgan and Tromborg, 2007). Problems can also arise from the forced pairing of mates chosen by people and not by the animal naturally (McDougall et al., 2006, Morgan and Tromborg, 2007). This problem also relates to the forming of social groups which are also not naturally selected by individuals but by zoo staff (Stoinski et al., 2001a). Unnatural social/or

familial groups comprising a variety of individuals that were selected by zoo staff can result in highly stressed out animals, some individuals more so than others. For example, in captivity a juvenile male gorilla cannot express his natural behaviour by leaving his family group but is forced to remain with them in a troop that already has a dominant adult male silverback (Morgan and Tromborg, 2007). However, there is not an even number of males and females born in captivity and in some cases, for example in gorillas, it would be preferred to have an alpha male to a troop of females, but this is not always possible and this results in surplus individuals. Therefore the forming of either 'all-male' or 'all-female' groups or keeping juveniles in their family group is commonly practiced. Constraints, such as these and also lack of space makes it hard to alter the social dynamics within groups by natural immigration or by moving animals between zoos (Stoinski et al., 2001a). Similarly, species that are normally solitary but which are kept in an abnormal social groups, or where members of a social species are kept in solitary confinement, will all be affected negatively in the long term (Morgan and Tromborg, 2007). For example, primates housed alone develop stereotypic behaviour and this often leads to the development of self mutilation behaviours (Hosey and Skyner, 2007). Abnormal social stresses such as this can result in the development or increase frequency of stereotypic behaviours being expressed. In some cases the lack, or unsuitability, of companions can lead to sexual frustration which also can lead to the development of stereotypic behaviours including self-mutilation (Gregory, 2004). It is also important to note that some animals which have not developed social skills may not be able to be introduced into these groups later in life.

Stereotypies may also be transmitted between animals in social groups (passed down from older to younger generations) in some species. For example, chimpanzees (*Pan troglodytes*) kept in inadequate conditions may have developed stereotypic behaviours such as hair picking which has resulted in subsequent generations displaying it as well (Krief et al., 2004, Sakamaki, 2010). However, past histories of the chimpanzees, primarily the older animals, and the conditions they were kept in should be investigated before assumptions are made on these grounds. But, this may be

another cause of stereotypic behaviours seen in animals that have never been kept in inadequate conditions but have been or are housed with older generations that have.

2.2.2.2 *Sound*

It has been suggested that exposure to unnatural anthropogenic sounds such as zoo visitors, machinery, urban life (e.g. cars, fireworks), and from cleaning and maintenance of the captive enclosures may result in the expression of stereotypic behaviour. These unnatural noises have sound pressure levels different from those that occur in the animal's natural habitat and are quite often out of the human hearing range and hence are not noticed and considered by zoo staff as being a potential problem for the animals. These varying frequencies of sound, which may be unpredictable and often of short duration, can have long-lasting negative effects on captive animals, especially on species that are naturally alert (Morgan and Tromborg, 2007). Numerous studies that have investigated the effects of unnatural sounds on animals have found a variety of results, ranging from increased heart rates and blood pressure to an increase in constant alertness and fear in species such as orang-utans (Birke, 2002, Morgan and Tromborg, 2007).

2.2.3 Alternative explanations for some stereotypic behaviour e.g. pacing and coprophagy

Some authors suggest that not all stereotypic behaviours indicate poor welfare, for example pacing can also be a form of an anticipatory behaviour that can generally be in relation to food. For example, anticipatory feeding behaviour (AFB) is suggested to occur because the animals are anticipating food arriving and being fed and as a result, pace specific areas of their enclosure (Kistler et al., 2009, Shyne and Block, 2010). This behaviour is common in felids kept in captivity but can often be misconstrued as unwanted stereotypic behaviour because of the repetitive nature of pacing (Szokalski et al., 2012). It is hypothesised that animals pace prior to being fed to mimic natural wild behaviours, i.e. in preparation for a kill by hunting/locating prey items by walking/running.

Coprophagy, or the consumption of faecal material, has been classed as both stereotypic/abnormal and natural behaviour depending on the species and the manner in which it is performed, i.e. is it repetitive (Krief et al., 2004). However, it is a topic that has been widely discussed by scientists and whether to deem it in some species as a stereotypic behaviour, rather than abnormal or normal, varies with each person's opinion. For example, species such as rabbits (*Oryctolagus cuniculus*) consume their faeces to obtain microbial proteins and vitamins that were not absorbed the first time they were ingested as food items (Soave and Brand, 1991, Hirakawa, 2001). However, it has been less clear whether coprophagy in chimpanzees is a natural behaviour, a stereotypic one or another type of pathological behaviour. Initially coprophagy in captive chimpanzees was thought to be stereotypic as a result of being confined in captivity. In contrast, wild chimpanzees and bonobos (*Pan paniscus*) also perform coprophagy to obtain missing nutrients and to re-digest food items (Krief et al., 2004, Sakamaki, 2010, Bertolani and Pruetz, 2011). This may be the case for the captive chimpanzees also and assuming it is a stereotypic behaviour before investigating on whether it is in fact a nutrient deficiency could be detrimental to the long term health of the animal. The faecal nutrient content should be examined to ascertain whether the animals are possibly nutrient deficient or are performing coprophagy for other reasons, such as a stereotypic behaviour due to a barren environment.

2.3 Identifying stereotypic behaviours

A major problem when it comes to identifying stereotypic behaviours, as mentioned previously, is identifying when behaviours develop or become definitively "stereotypic". Because stereotypic behaviours can develop from current existing normal behaviours, the decision to identify such behaviours as stereotypic is often random and impromptu (Mason, 1993). Some animals may have encompassed stereotypic behaviours into normal behavioural patterns for long periods of time, thus making it difficult to clearly identify them as such. Various institutes may also consider certain behaviours to be stereotypic on the basis that they could be considered abnormal or repetitive, such as pacing in felids prior to feeding, but which are in fact the animal's way of mimicking wild behaviours instead (Mason, 1993). Stereotypies

develop over time; they do not just appear (Mason, 1993). They are also influenced by factors such as the age, sex, or characteristics of the individual animal (Montaudouin and Le Pape, 2004). Therefore, it is important to note any changes in behavioural patterns, or environmental conditions, in captive animals that could have the potential to develop into stereotypic behaviours. Ultimately, prevention is better than cure and it is important that any sign of a stereotypic behaviour is acted upon promptly and aggressively (Swaisgood and Shepherdson, 2005).

Because the boundary between 'normal' and stereotypic behaviour often overlaps, the identification of stereotypic behaviour can be helped by knowing the amount of time the animal spends displaying such behaviour (Mason, 1993). Noting how long the animal has been displaying a particular behaviour and the nature of it (e.g. is it abnormal?), are two important processes when identifying stereotypies. By recording regular observations of animals, their daily behaviour can be better understood and it can be noted whether they perform the same activity/behaviour at the same place and/or at the same time or consistently throughout the day (Fraser, 2008). Some stereotypic behaviours, such as self mutilation, can also be more noticeable than others, for instance, oral behaviours or the licking of inedible objects (Fraser, 2008). The perception of what is stereotypic behaviour may also change from person to person.

2.4 Questionnaires to zoo staff: identification and perceptions of stereotypic behaviours

Questionnaire-based studies can be used to investigate human and animal relationships. For example, Carlstead (2009) asked how zoo keepers treated and behaved around the animals they cared for, and how the animals responded towards them. Questionnaires designed to find out information about individual animals and species have also been used. Whitham and Wielebnowski (2009) asked zoo keepers to fill out questionnaires for each individual chimpanzee at their zoo, and to rate the animals on a scale of how "happy" they thought they were. The res**u**lts from the questionnaires were considered reliable because experienced staff get to know individual animals personally (Whitham and Wielebnowski, 2009). Alternatively, questionnaire based studies deal with the perceptions of zoo staff rather than direct

observation of animals. However, it is important to acknowledge that the perceptions vary between individuals (Whitham and Wielebnowski, 2009).

Questionnaires to zoo keepers can provide insightful information about animals in captivity because zoo staff are with them every day and, in most cases, get to know each individual much more than an outside observer can. However, although zoo staff get to know individual animals, an outsider's opinion is also valuable because outsiders might be able to pick up specific behaviours that keepers have overlooked. An outsider's observations may be more objective being unbiased by expectations of an animal's history and previous behaviour. Zoo staff cannot be with specific animals all day, every day, and therefore cannot observe their behaviours throughout the day (Hoy et al., 2010). This scenario means that observations carried out by an outside individual, who has the time to observe the animals throughout the day, or at key times, are also beneficial in understanding the daily activities of captive animals. Research by Hoy *et al.* (2010) examined the amount of enrichment provided for captive mammals across 25 zoos worldwide. Hoy *et al.* (2010) designed a questionnaire that was completed by 238 participants and found that the most common mammals that were provided enrichment were primates followed by carnivores. Hoy *et al.* (2010) concluded that zoo staff thought more enrichment should be provided for the animals, but time constraints were the biggest barrier in doing so. Hoy *et al.* (2010) also found that although enrichment within zoos has improved over the past thirty years, especially with regard to food and structural enrichment, there was still considerable scope for improvement. As mentioned earlier, observing the animals is a good way to establish if there are stereotypic behaviours present. As part of the response to Hoy *et a*l's (2010) questionnaire, zoo staff indicated that when time permitted, observations were carried out to see not only if any stereotypies were present but also if more enrichment was needed. Other important issues, such as enrichment outside zoo operating hours, and enrichment for nocturnal species, were also considered (Hoy et al., 2010). At Kuala Lumpur Zoo, Haque (2006) observed the animals and questioned the zoo staff about the animals' behaviour. She concluded that, although the zoo staff were doing their best to maintain animal welfare

standards, the animals were unable to interact with their environment and express "normal" behaviours.

In addition to zoo staff completing questionnaires on topics regarding the care of their animals, stereotypic behaviours, and environmental enrichment, zoo patrons and people on the street can also partake in surveys. One such survey was completed by 216 visitors to the Edinburgh zoo who were canvassed for their opinions on how happy the animals looked at the zoo. Reade and Waran (1996) surveyed people in the street and found they were more inclined to have negative viewpoints regarding the confinement of animals in captivity than zoo visitors and often stated that the animals appear sad or depressed. In comparison, zoo patrons who completed the survey felt that the zoo was very focused on conservation, had a more positive outlook about the animals, and understood the importance of environmental enrichment (Reade and Waran, 1996). Reade and Waran (1996) attributed these different perceptions between street and zoo patrons to the visual appeal of the enclosures, signage, and positive atmosphere at the zoo. However, if people are critical of zoo philosophy, I would assume it to be unlikely that they would visit a zoo.

Other questionnaires that are presented to zoo visitors, as well as staff, have assessed respondents preferences for third generation enclosures over second generation ones (Shettel-Neuber, 1988). Second generation enclosures are made out of concrete, and members of the public are separated from the animals via a moat, whereas the third generation enclosures are the modern day naturalistic enclosures that are prevalent today (Shettel-Neuber, 1988).

2.5 Treatment of stereotypic behaviours with environmental enrichment

As previously mentioned, environmental enrichment is one strategy, used by zoos, to help alleviate or eliminate stereotypic behaviours, that are displayed by animals (Hunter et al., 2002, Montaudouin and Le Pape, 2004). Or, in other words, environmental enrichment is used to promote natural behaviours and to increase mental stimulation because animals confined in captivity have considerably more 'spare time' than their wild counterparts, which have to hunt or collect enough food to survive (Slater, 1999). Others refer to environmental enrichment as improving the

"quality of life" of the animals that are kept in captivity (Kuczaj et al., 2002). When it comes to planning enrichment programmes two steps are recommended by Swaisgood and Shepherdson (2005). These are to firstly envisage what stereotypic behaviour may develop, when they developed and why i.e. what was the cause, and which species is displaying them. Secondly, deciding what type of enrichment should be used to alleviate the problem should it arise (Swaisgood and Shepherdson, 2005). A number of key indicators are used to determine the need to enhance current enrichment programmes or to develop new ones. These indicators include the overall condition of the animal, i.e. body condition, dull or lifeless fur, decrease in weight, lack of interest in their surroundings and/or the development or increased frequency of stereotypic behaviours (Popov et al., 2007). However, these are also common signs of sick animals and that has to also be taken into consideration. Zoo or captive wildlife institute personnel aim to increase the 'quality of life' by means of environmental enrichment thus benefitting and enhancing the animals physiological and psychological welfare (Kuczaj et al., 2002).

Enhancing the environments in which captive animals are kept, results in the display of more attractive and acceptable behaviours that appeal to the public. Thus, environmental enrichment is an important aspect in zoo management (Robinson, 1998). The term 'environmental enrichment' refers to a number of different enrichment techniques that have evolved considerably over the last couple of decades (Coe, 1997). These different environmental enrichment techniques can be broken down and separated into five distinct categories. These five categories are (1) food-based or nutritional enrichment, (2) sensory enrichment, (3) physical enrichment, (4) social enrichment, and (5) cognitive or occupational enrichment (Hosey et al., 2009, Hoy et al., 2010). These types of enrichment are recommended and enforced in New Zealand captive wildlife institutes to alleviate the presence of stereotypic behaviours in all captive species (NAWAC, 2005). It is a recommendation, and an aim, for captive wildlife institutes to provide all five types of enrichment for all captive mammals because it can be difficult to gauge which type of enrichment is required at certain times (Hoy et al., 2010). Environmental enrichment will only eliminate stereotypic behaviours that are due to barren enclosures and have not become habitual in nature.

However, the broad consensus of several studies is that environmental enrichment will reduce the frequency of stereotypic behaviours regardless of cause. But, although there are strategies such as environmental enrichment to alleviate or eliminate the development of stereotypic behaviours, some behaviours are so strongly ingrained in the animals as a consequence of previous experiences they will never cease (Montaudouin and Le Pape, 2004). The age, as well as the conditions in which the animals have been kept, are substantial factors in this regard (Montaudouin and Le Pape, 2004).

2.5.1 Food enrichment

Food-based enrichment refers to the provision of a variety of food items, or the presentation of food in a different way or manner, to the animal or groups of animals (Hosey et al., 2009). The different presentations may include actions as simple as scattering food around a different part of the enclosure, or all over it, which forces the animals to forage for their food (Fig. 2.4). Alternatively, food enrichment can be beneficial to captive animals because it can be used and adapted to suit the different needs of different species to help encourage more naturalistic behaviours in captive animals (Sommerfeld et al., 2006). For example, arboreal feeding boxes for captive white-fronted lemurs may be provided around the enclosure, encouraging normal feeding behaviours (Sommerfeld et al., 2006). Sommerfeld *et al*. (2006) concluded that the white-fronted lemurs spent more time in trees when they were presented with arboreal feeding boxes, and more time carrying out more naturalistic behaviours.

Figure 2.4 Food scattered around to encourage the animals to forage

However, prior to implementing any form of feeding enrichment, the foraging/feeding behaviour of the species has to be assessed and understood (Young, 2003). This is to ensure that the best sort of food enrichment, i.e. to mimic hunting, foraging, opportunistic feeding behaviours etc, is provided for the animal(s) (Young, 2003). Some other questions that need to be asked prior to implementing any form of food enrichment programme, are: (1) is the animal a social or solitary feeder; (2) how does the animal find/catch its food – foraging, hunting and with what senses e.g. odour, visual; (3) how long does the animal feed; and (4) how often does the animal feed? (Young, 2003).

Due to species differences, different forms of enrichment are needed that are also designed to target the problem behaviour. For example, providing carnivores with whole carcasses (McPhee, 2002), bones or live fish (Bashaw et al., 2003), has been found to decrease the frequency of stereotypic behaviours because the provision of substantial food items take longer to consume and require more effort. Bashaw *et al.* (2003) concluded that when presented with live fish and bones, the captive felids, African lions (*Panthera leo*) and Sumatran tigers (*Panthera tigris sumatrae*), displayed less stereotypic pacing behaviours. This reduction in the frequency of stereotypies, by using food enrichment, is suggestive of an improvement in the overall well-being of the animals as well as enhancing the zoo experience for members of the public

(Bashaw et al., 2003). McPhee (2002) concluded that although stereotypic behaviours decreased 'off-exhibit', after carnivores were provided with whole carcasses, it did not affect or decrease any 'on-exhibit' stereotypic behaviour. However, more natural feeding behaviours did increase, such as hiding the whole carcass and it was concluded that provision of whole carcasses is an important form on enrichment for large captive carnivores (McPhee, 2002).

Electronic feeding boxes are another form of food enrichment because they deliver food at different and unpredictable times throughout the day. This practice is to try to minimise anticipatory feeding behaviours, which often develop in captivity, and instead mimic more natural wild behaviours by providing food sporadically (Kistler et al., 2009). Electronic feeding boxes are suitable for carnivores because, in most circumstances, live prey is not allowed to be fed to captive animals for ethical reasons. Electronic feeding boxes were found to be successful at decreasing anticipatory behaviour and increasing foraging and explorative behaviour in captive red foxes (*Vulpes vulpes*) (Kistler et al., 2009), as well as reducing pacing in Amur tigers (*Panthera tigris altaica*) (Jenny and Schmid, 2002).

Herbivores, such as giraffes, can have food presented in specialised feeders (Fig. 2.5) (Hosey et al., 2009). These feeders are designed to encourage tongue manipulation in giraffes (Fernandez et al., 2008) and trunk manipulation in elephants (Hosey et al., 2009), as well as hand/finger manipulation for other species such as primates. This dextrous activity occupies the animal for a longer period of time and also makes them 'work' for their food. Therefore, the activity can aid in decreasing the presence and occurrence of stereotypic behaviours, such as licking of non food items in giraffe, okapi (*Okapia johnstoni*), and other ungulates (Fernandez et al., 2008). Offering larger quantities of food or providing food more regularly throughout the day can also decrease the presence of stereotypic behaviours because it mimics more naturalistic behaviours. The larger or more regular provisioning of feed keeps grazing/browsing animals, such as giraffes, okapi, and other ungulates, feeding and masticating/ruminating, more or less, continually which is what they would naturally do in the wild (Baxter and Plowman, 2001, Fernandez et al., 2008). However, over-feeding in captivity can lead to obesity and related health issues.

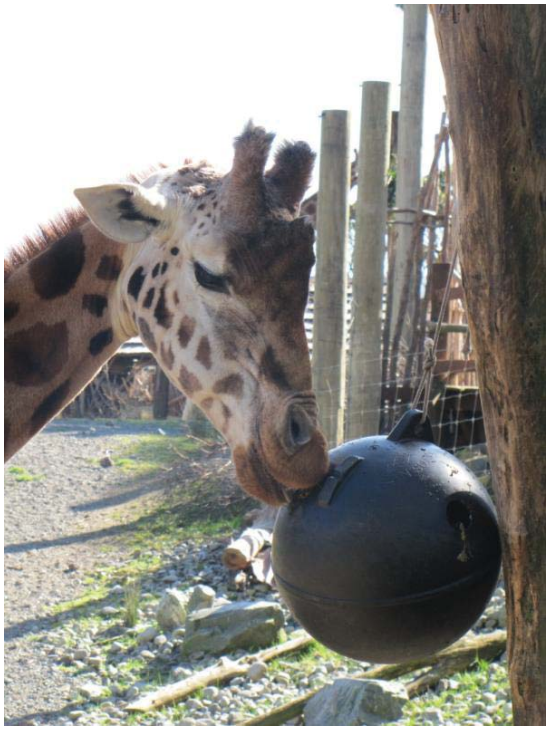


Figure 2.5 Giraffe feeding from a buoy that has been provided for enrichment

Contrafreeloading is another method in food enrichment strategies. It refers to the animal selecting food that requires them to "work" for it rather than selecting something that requires no work, for example selecting a fish embedded in a block of ice rather than a fish alone (McGowan et al., 2010). McGowan *et al*. (2010) examined grizzly bears (*Ursus arctos horribilis*) in captivity and concluded that although more free food was consumed, the bears spent more time with the food items trapped in ice or in a box. Therefore, it was concluded that contrafreeloading as a method of food enrichment is beneficial for captive bears and potentially other species. This type of feeding can also be categorised as motivational feeding and compared to feeding devices that are often provided for birds. Studies concerning birds, such as orange-winged parrots in one case, have found that the birds were motivated to lift lids or extract food from objects when offered rather than eating the same or smaller type food from a bowl (Rozek and Millam, 2011).

Hiding food around the animal's enclosure encourages them to forage and look for the food which is an easy, cheap, and effective form of enrichment. It does, however, have the disadvantage of the food spoiling and going to waste if the animals

do not find and consume all of it. Zoo staff will also have to spend a longer period of time cleaning the enclosure. As with hiding food around the animal's enclosure, altering feeding regimes is enriching because it decreases the onset or presence of anticipatory behaviour which can lead to stereotypic (Hosey et al., 2009, Quirke and O'Riordan, 2011) or agonistic behaviour in species such as chimpanzees (Howell et al., 1993). Also, providing animals with novel food items can be enriching but can also be detrimental as some animals suffer from neophobia, as mentioned previously (Visalberghi et al., 2002). In such cases, slowing the pace of introducing novel items is necessary.

2.5.2 Sensory enrichment

Sensory enrichment refers to the provision of a form of enrichment that results in the animal(s) increasing the use of one, or more, of its senses, such as the visual, auditory, or olfactory senses (Hosey et al., 2009). Sensory enrichment, such as prey odours in a predator's enclosure, is important for captive animals because their wild counterparts are continuously exposed to a multitude of different sensory stimuli throughout their lifetimes whereas captive environments may be relatively monotonous (Wells, 2009). In order to mimic some wild conditions, in captivity, or simply to stimulate the senses, captive wildlife institutes can use a number of different techniques to provide sensory enrichment. The methods used does, however, depend on what sense the staff intend to stimulate, whether they want to stimulate more than one sense, and needs will vary for different species physiology.

One example of auditory sensory enrichment, for captive bred animals, is the playing of either natural sounds, which the animals might encounter in the wild such as the sounds of a rainforest for gorillas (*Gorilla gorilla*), or unnatural sounds such as classical music (Wells, 2009). Bird song, or a sound in conjunction with food being available, can result in leopard cats learning to associate the noise with the presence or reward of food (Hosey et al., 2009). This is the same effect as Pavlov's study of dogs salivating when a bell rings (Tully, 2003).

Some captive wildlife institutes play classical music by the enclosures which not only helps to mask noise associated with people (Wells, 2009) but also has been found

to decrease the frequency of stereotypic behaviours in Asian elephants (*Elephas maximus*) (Wells and Irwin, 2008) and decrease aggression and frequency of stereotypies in gorillas (Wells et al., 2006). However, a more common background sound for captive animals is a live radio broadcast (Wells, 2009). Such broadcasts have helped to decrease frequency of stereotypies in chimpanzees (Howell et al., 2003). In addition, the type of music played can have a drastic effect on the animal (Wells, 2009). Slower, quieter, relaxing music is reported to be more beneficial than rock, fast, loud, or heavy music which have tended to increase aggression and agitation in some species (Wells, 2009). Although most species will habituate to classical music played near or in their enclosure, or live radio, caution is required when first introducing auditory noise as some animals may initially be frightened (Wells, 2009). In contrast, research carried out on cotton-top tamarins (*Saguinus oedipus*) and common marmosets (*Callithrix jacchus*) concluded that, although a preference was given to music with a slow tempo rather than other types of music, silence was preferred most of all and therefore should be considered when attempting to enrich animals with music or sound (McDermott and Hauser, 2007). However, providing animals with a silent environment in a captive wildlife institute, such as a zoo, would be very difficult.

As for radio, television can also be used as a form of visual enrichment and is often provided for primates (Wells, 2009). Bloomsmith and Lambeth (2000) concluded that although television did not alter the behaviour of the chimpanzees, its use preoccupied a larger portion of the primates' time especially when kept in solitary rather than social conditions. For animals that are often kept in social isolation, such as elephants, primates, and horses, the use of mirrors and other reflective devices have been successful in decreasing the frequency of stereotypic behaviours (Wells, 2009). Their value as a visual enrichment device may be greater for some species but in others, rabbits and mice in one instance, it was found to be detrimental as they appeared to find the mirror disturbing (Jones and Phillips, 2005). Animals may also display signs of territorial/aggressive behaviour against their mirror "opponents". Species that have displayed this territorial behaviour against their mirror "opponents" include green anole lizards (*Anolis carolinensis*) (Farrell and Wilczynski, 2006) and a number of fish species (Siamese fighting fish, cichlids) (Lev-Yadun and Katzira, 2012).

Desjardins and Fernald (2011) concluded that territorial aggression displayed towards the mirror opponents in cichlids involved their fear response. While this can be stressful for some animals, mirrors can be an effective form of enrichment for other species or individuals. Thus care should be taken when introducing this form of enrichment.

A simple way to provide short term enrichment for species is the use of colour in their enclosure (Wells, 2009). Colour can have a noticeable effect on moods in people and so research has been carried out to examine its effect on (other) animals. Colour preferences vary between species. For example, chimpanzees and gorillas kept in zoos prefer green and blue objects rather than red; and many birds avoid foods that are red while some species are attracted to red fruit (Wells, 2009). When providing colour for captive animals, their preferences have to be established before anything permanent is introduced because adverse colours can cause unnecessary anxiety in some species which can lead to the development of stereotypes (Wells, 2009). Visual perception varies between species and this must be taken into account also.

Odours are the last major form of sensory enrichment that I will describe. These can be a very important type of enrichment as many species rely on their sense of smell for acquiring food, communication, and for avoiding predators or finding prey (Wells, 2009). Odours of prey species have been used in some cases as well as odours of other species that would naturally be found in the animal's environment. Olfactory stimulation can come in the form of urine sprayed around the enclosure, the provision of bedding used by other animals, hiding a food smell in an object or supplying toys, blankets and the faeces of other animals. Other than potentially increasing anxiety or fear reactions in some animals, the assurance that no diseases are passed from one species to another has to be managed also. Biological samples that are to be given to one species from another have to be from healthy animals to avoid any disease transmission (Hosey et al., 2009). Ensuring the animals are healthy, via observations and knowing their general characteristics, prior any of their biological waste being given to another species is important in reducing the risk of diseases being spread. If there is any concern on the wellness of the animal, their waste should not be used for enrichment and they should be checked by a veterinarian. Research concerning other

types of odours includes spices, herbs, and essential oils such as nutmeg, rosemary, lavender, peppermint, and catnip. One particular study on black-footed cats (*Felis nigripes*) and nutmeg, prey species and catnip odours found that the cats responded more to the odour of a prey species and to the catnip than the nutmeg (Wells and Egli, 2004). Wells and Egli (2004) found that less inactive behaviours were displayed when the cats were presented with these odours that with no odours. Although the cats habituated to the odours during the trial, a wide variety of different odours could be used and reintroduced periodically (Wells and Egli, 2004).

2.5.3 Physical enrichment

Physical enrichment refers to the physical objects within the or structural complexity of an animal's enclosure, which can be added to or modified in some way to continuously revitalise it (Hosey et al., 2009). This continual remodelling is enriching for the animals because it provides them with a new perception on their enclosure environment as well as new objects/toys/structures to explore, investigate and play with (Hosey et al., 2009). Common ways that have been used to physically enrich captive animal environments are the provision of ropes, climbing structures, and various objects or toys such as PVC piping, buoys, cardboard boxes, ice blocks, and balls (Hosey et al., 2009). Studies have been carried out on numerous species to examine the effects of physical enrichment arising from the form of toys on stereotypic behaviours. Stereotypic behaviours decreased in frequency as a result of the provision of toys in captive chimpanzees (Brent and Stone, 1998), bears (polar, sloth, and spectacled) (Altman, 1999), common seals (*Phoca vitulina*) (Grindrod and Cleaver, 2001), and maned wolves (*Chrysocyon brachyurus*) (Vasconcellos et al., 2009). Some safety issues that are associated with toys are discussed in section 2.6.

2.5.4 Social enrichment

For social, non-predatory species, having either mixed-species enclosures, or housing groups of animals, are two ways to increase social enrichment in a captive environment. The provision of other individuals, of the same or different species, allows them to engage with another or many different individuals thus encouraging social behaviours (Hosey et al., 2009). Mixed-species exhibits also provide forms of

enrichment other than social because the animals are able to smell urine and other scents that are left behind (Dorman and Bourne, 2010). These mixed-species exhibits can also portray natural wild environments, both educational for members of the public and more interesting for the animals (Wojciechowski, 2004, Buchanan-Smith, 2012). It is suggested that when mixing species that each species should occupy different ecological niches to avoid competition for resources and unnecessary aggression (Wojciechowski, 2004, Buchanan-Smith, 2012). Care has to be taken, however, when introducing more than one species to an enclosure as it increases the risk of diseases and aggressive behaviour occurring.

However, Wojciechowski (2004) examined the introduction of a fourth primate species to an established mixed-species exhibit that consisted of three species. Red-capped mangabeys (*Cercocebus torquatus*) were introduced to an already mixed-species exhibit containing mandrills (*Mandrillus Sphinx*), sooty mangabeys (*Cercocebus atys*), and black and white colobus monkeys (*Colobus guereza*). Wojciechowski (2004) concluded that although there was some aggression between species, the introduction of the fourth primate species to the already mixed-species exhibit was beneficial overall. Aggressive behaviours were seen to decrease with time allowing other interactive behaviours to increase (Wojciechowski, 2004). Another study with primates looked at the effects of combining capuchins (*Cebus apella)* and squirrel monkeys (*Saimiri sciureus*) in a single enclosure. As found in Wojciechowski's (2004) study, aggression was present initially but decreased allowing the two species to live harmoniously and to mutually benefit from the social interaction (Leonardi et al., 2010).

Mixed-species exhibits of canids and ursids have also been found to be mutually beneficial for each species. For example, a safari park in the United Kingdom has successfully introduced the American black bear (*Ursus americanus*) and grey wolf (*Canis lupus*) (Dorman and Bourne, 2010). However, careful management and planning have to be undertaken prior to such introduction as not all species of canid or ursid are socially compatible (Dorman and Bourne, 2010).

Even though social enrichment has been successful generally, careful management to establish mixed-species exhibits has to be undertaken prior any introduction. Species need to be picked that, preferably, occupy different ecological

niches to avoid unnecessary aggression. All needs of each individual and species have to be accommodated, and unwanted interbreeding or pregnancies need to be avoided also (Dalton and Buchanan-Smith, 2005). The behaviours that species are displaying also need to be considered before adjusting social groups. Similarly to adjusting social groups of mixed species exhibits, adjusting social groups or the hierarchy in a single species exhibit can be a carried out as a form of short-term enrichment. Social groups of species, such as primates, generally have hierarchies that are composed of an alpha individual and dominant and less dominant individuals (Pannozzo et al., 2007). In captivity, all male or female groups of species also occur, that are generally made up of surplus individuals in the breeding programme, and which can still have a dominance hierarchy. Due to the confinements of captivity, animals are restricted which makes it difficult for some species, which generally leave once weaned or have reached sexual maturity, to leave. This can be achieved by swapping individuals between captive wildlife institutes to mimic not only this natural process but also adjust the social group dynamics (Hosey et al., 2009). The introduction of a new young male individual to a group that consists of a dominance hierarchy with an alpha male for example, can also adjust social dynamics as this new male might compete and take the current alpha male's position. This results in a change in social dynamics as this new alpha male will have a different personality and will have a different way of "running things". If this possible outcome is not desired, by a captive wildlife institute, prior investigation and careful managing of the group has to be carried out. As, managing social groups in captivity is a hard task because the introduction of new individuals to a group can result in increased stress, for both established group and newcomer, increased levels of aggression which sometimes can result in death of the new individual, or the new individual may take position of alpha male.

Not all animals, however, are social and although tigers are generally solitary animals, it is not uncommon for them to be housed in groups. It is uncertain if these social housing conditions are beneficial or detrimental for tigers because of their solitary nature. De Rouck *et al.* (2005) examined the behaviours of both social and solitary-kept animals as well as animals housed separately but in adjacent enclosures. De Rouck *et al.* (2005) concluded that solitary-kept tigers displayed more solitary

behaviours, such as flehmen, compared to tigers housed in pairs which displayed less pacing than solitary tigers and more social behaviours such as grooming and head nuzzling. De Rouck *et al*. (2005) define flehmen as "grimacing facial expression with the tongue out of the mouth while drawing scent over the facial glands". Solitary-housed tigers in enclosures adjacent to another tiger displayed the highest level of pacing and stress. Housing tigers in pairs is more beneficial and preferable for them rather than singularly, or singularly and adjacent to another tiger (De Rouck et al., 2005).

Interaction with humans can be a form of social enrichment for captive animals. Prior to any human contact being used as a form of social enrichment, the potential of a relationship forming between a human and animal must be present (Claxton, 2011). This continual contact between the same human and animal, over time, has the potential to form a trusting relationship. However, not all species or individuals of a species can form relationships with people as past negative experiences, with humans, can inhibit them forming (Claxton, 2011). With positive human and animal relationships, training can occur between captive wildlife institute staff and animals which can make handling and health check-ups easier and less stressful for the animal. Although some animals may display less natural behaviours around staff with whom they have a relationship, such displays can be seen as more beneficial than abnormal or stereotypic behaviours being displayed if they are fearful or do not share a bond (Claxton, 2011).

2.5.5 Cognitive enrichment

Animal cognition is broadly defined as "'mechanisms by which animals acquire, process, store and act on information from the environment'' (Shettleworth, 2001). Cognitive enrichment refers to increasing mental stimulation in captive animals by providing them with problems to solve. This problem solving is a very important part of their behaviour and can be observed in their wild counterparts, which have ongoing mental stimuli. In the wild, animals have to continuously solve problems or are encountering problems to which the response is often a matter of life or death (Meehan and Mench, 2007). For example, when requiring food, some animals have to work and coordinate socially in a pack to hunt, form tools to obtain food, remember

where food is stored, or use migratory navigational skills (Meehan and Mench, 2007). Although cognitive enrichment is not as prominent as the use of food or other forms of enrichment, it is often coordinated with food enrichment and is an important part of captive management (Meehan and Mench, 2007). Meehan & Mench (2007) have discussed that often introducing 'problems' to captive animals can result in stress or frustration but, if managed correctly, such introduction has an important role in animal welfare. These problems or challenges that require the animal to work mentally challenges not only their mental capacity, but also encourages learning and problem-solving skills which increases their overall fitness (Meehan and Mench, 2007). Carlstead and Shepherdson (2000) stated that when introducing cognitive challenges to captive animals, they put them in a "position where they can learn to actively control and explore some aspects of their environment". Also, a small amount of stress that results in an animal accomplishing a task is seen to be beneficial when working in a captive environment (Meehan and Mench, 2007).

As mentioned previously, contrafreeloading is a method of food enrichment that results in the animals working for their food and, in some cases, they prefer to do so rather than eating food that is freely available (McGowan et al., 2010). Contrafreeloading can also be considered a method of cognitive enrichment because the animals are required to work and determine how to obtain the food (Hosey et al., 2009). Common contrafreeloading/cognitive enrichment devices include puzzle feeders, hiding food in cardboard boxes, or providing tools for the animals to use to extract food from objects (Meehan and Mench, 2007, Hosey et al., 2009).

Most research on animal cognition has been carried out on great apes, especially chimpanzees (Johnson, 2010). Chimpanzees have been successful in working out puzzles, probing feeders with tools, solving mazes on computers, and removing food that is hidden by using their fingers or tools (Clark, 2011), as well as learning basic human sign language (Johnson, 2010). Birds have also demonstrated a high level of cognition and some species, for example the kea (*Nestor notabilis*), can solve tasks such as retrieving food hanging from a piece of string (Werdenich and Huber, 2006) and working out how to open locks to obtain food (Miyata et al., 2011). Dingoes (*Canis dingo*) have also been found to have high cognitive skills and, when given problems,

e.g. food out of reach or locked inside during mating season, they have moved kennels or tables to stand on to reach food, escaped, or have unlocked doors (Smith et al., 2012). Providing some form of mental stimulation is important for captive animals but it has to be managed so that it is not overly stressful for the animal (Meehan and Mench, 2007).

2.6 Potential problems with environmental enrichment

Although environmental enrichment is supported, and is a big part of captive wildlife institutes around the world, there are some potential drawbacks. Hare *et al*. (2007) argued that an enriched environment could be more hazardous than a sterile one if precautions are not taken when introducing novel objects into captive animal enclosures. Some of these hazards include animals choking on easily breakable or incorrectly sized toys, becoming entangled in cords/ropes or hanging materials that may amputate appendages or result in damaged teeth/horns etc, and ingesting hazardous materials such as plastic or material that may tear or block the gastric-intestinal tract. Further hazards include increased aggression or distress (neophobia) as was seen when a piñata was introduced to a group of Sumatran orang-utans (*Pongo abelii*) which resulted in chaos and panic. In this instance, orang-utans were "trapped" in one area of their enclosure as they were too scared to enter their sleeping quarters by walking past the piñata thus making it difficult for the zoo keepers to remove it (Hare et al., 2007).

Further risks include poisoning from unknown contaminated food stuffs, such as meat, or potential disease causing pathogens from interspecies sharing of blankets or dung for enrichment purposes (Hare et al., 2007). Also, as mentioned previously hiding food around the enclosure can result in food spoiling and being wasted along with it being more time consuming for zoo staff to clean.

Members of the public and staff may also be at risk as certain species may throw enrichment toys, such as ice blocks, balls, or tyres, out of their enclosures if they feel threatened, scared or annoyed. Additionally, some enrichment devices could promote the escape or near escape of some animals. Notably stronger species such as chimpanzees have broken glass walls/viewing areas of their enclosure with

enrichment toys, and bonobos have used logs or browse to escape over walls (Hare et al., 2007).

Paradoxically, enrichment can also be too "successful". Although enrichment is designed to captivate the animals, and to provide them with some form of "entertainment" and to mimic natural behaviours, or just deviate from the normal routine, some enrichment can be so captivating that animals may not enter their sleeping quarters at night, as was seen when burlap was hung from a tree for lions (*Panthera leo*) (Hare et al., 2007).

Hare *et al*.'s (2007) research highlighted the importance of taking all necessary precautions when introducing new enrichment to enclosures. It is important to comprehend all potential outcomes as the reactions of the different species and individual animals are unknown. Possible hazards, e.g. choking, entanglement, and poisoning, may also occur. The safety of zoo staff and members of the public must be established prior to the introduction of enrichment, for example if the animals were to escape with the use of the enrichment item (e.g. tree branch or part of jungle gym falling against wall etc) how would the situation be managed or, in other words a plan of what to do if it all goes wrong (Hare et al., 2007).

One problem that occurs frequently with environmental enrichment programmes is habituation to it (Anderson et al., 2010). The animals habituate by no longer responding or being interested in, for example, the object, odour, or feeding method that is repetitively being used. If the same toy is being provided each day, or every couple of days, the animals will no longer see it as a novelty. Thus they either ignore it or spend very little time with it. Similarly, if food is being left in the same location for too long, the animals will no longer be foraging for their food but going to the designated feeding point or points every couple of days. To avoid habituation occurring, enrichment programmes have to be well designed to ensure that variety, i.e. sensory, cognitive, physical, feed, and social enrichment, is used. Different forms of enrichment in each of these categories can also be designed to provide the captive animals with a varied and stimulating environment.

The introduction, either successively or irregularly, of novel objects, odours, or feeding methods is important to ensure habituation does not occur in captivity and for the long term welfare of the animal (Anderson et al., 2010). Anderson *et al.* (2010) report that sloth bears (*Ursus ursinus*) with successive or irregular introduction of enrichment did reduce stereotypies and increase explorative behaviour. However, enrichment that was introduced irregularly was more beneficial because it occupied the animals for longer periods and the bears were less inclined to habituate as quickly. Kuczaj *et al.* (2002) also concluded that if objects are introduced as a form of enrichment, the introduction should be irregular, at different times of the day, and not in the same sequence if more than one object is being used. This variation will decrease the likelihood of the animals habituating to the enrichment (Kuczaj et al., 2002).

Chapter 3

Attitudes of staff at three New Zealand zoos regarding stereotypic behaviours and environmental enrichment in captive zoo mammals

"The love for all living creatures is the most noble attribute of man"

Charles Darwin 1809-1882

3.1 Introduction

Animals have been housed in captive conditions for thousands of years (Kisling, 2001). Over time, the conditions under which the animals have been kept have markedly improved, and many modern-day captive wildlife institutes such as zoos partly reflect these improvements through their focus now on five main functions, as follows: (1) conservation, (2) animal welfare, (3) research, (4) public education, and (5) public entertainment (Fernandez et al., 2009). Zoos have the hard task of carefully balancing these five functions to ensure none is compromised. However, because of the confinement of wild animals in captivity their welfare can be compromised thus deleterious behavioural problems, such as stereotypic behaviour, are common.

Stereotypic behaviour is common term for a type of behavioural problem found in captive wildlife institutes and refers to repetitive behaviours that often serve no purpose or function (Mason, 1991, Vickery and Mason, 2005, Hogan and Tribe, 2007). These types of behaviours include pacing, hair or feather picking, body rocking, and licking inedible objects. The behaviours develop over time; they do not just suddenly appear (Mason, 1993). The main cause for the development of stereotypic behaviour is generally thought to be due to one or more underlying welfare issues, but they are not well understood (Vickery and Mason, 2005). These underlying welfare problems include unsuitable enclosure design, stress, boredom, lack of physical and psychological stimulation, and negative past experiences (including in some cases stereotypic behaviour learned from older generations) (Garner et al., 2003, Hogan and Tribe, 2007, Swaisgood, 2007). However, because personality has a role in the expression of such behaviours, individual needs have to be considered by captive wildlife institutes as well as other factors such as age, sex, rearing history, and social rank (Stoinski et al., 2001b, Hosey et al., 2009).

Animals are also thought to use stereotypic behaviours as a coping mechanism in their attempt to adapt to their situation as they are unable to control the physical, functional, and psychological features relating to their captive environment. Attempts to adapt or respond to the environment typically result in the animals becoming stressed and frustrated, as they are unable to solve innate tasks, such as finding food

(e.g. hunting and foraging) or a suitable mate (Slater, 1999, Gregory, 2004, Fraser and Weary, 2005, Shyne, 2006).

Attitudes regarding the conditions in which animals are kept in captivity have changed, leading to the establishment of modern zoos throughout the world in developed countries. Although research concerning captive animal welfare, husbandry, and stereotypies is abundant, numerous gaps remain in understanding these related topics with regard to many species (Melfi and Hosey, 2011). It is estimated that of the ca. 600,000 captive wild mammals and birds kept in institutes worldwide, at least ca. 10,000 of them display stereotypic behaviours (Mason et al., 2007, Swaisgood, 2007).

A method used to alleviate stereotypic behaviours is known as environmental enrichment and its purpose is to increase an animal's 'quality of life' by fulfilling its physiological and psychological needs (Hunter et al., 2002, Kuczaj et al., 2002, Montaudouin and Le Pape, 2004). It is comprised of five enrichment categories, namely (1) food-based or nutritional enrichment, (2) sensory enrichment, (3) physical enrichment, (4) social enrichment, and (5) cognitive or occupational enrichment (Hosey et al., 2009, Hoy et al., 2010). These different enrichment methods target different types of stereotypies by trying to provide an animal with the right "stimulant" for its "condition" – for example, by trying to mimic more naturalistic feeding behaviours by providing carnivores with whole carcasses, which take longer to consume than smaller portions of meat (McPhee, 2002). Another example is the provision of chimpanzees (*Pan troglodytes*) with feeder devices that they have to probe with tools to obtain food (Clark, 2011). By providing these forms of enrichment, more naturalistic behaviours of animals are encouraged. Such behaviours generate 'displays' which are more appealing and acceptable by members of the public (Robinson, 1998). These outcomes are beneficial both for zoo management and for the public image portrayed by the zoo. Most importantly, the animals benefit by being stimulated and having something to do, a critical aspect because animals kept in captivity generally have more spare time than their wild counterparts (Slater, 1999). Unfortunately, despite considerable research on numerous species regarding stereotypies and the effectiveness of environmental enrichment programmes, such research has also been limited (Chapter 2). These restrictions relate to funding

constraints, a lack of time available for zoo personnel to implement and monitor enrichment programmes (Hoy et al., 2010), and ethical issues such as being unable to feed live prey to predators (Newberry, 1995).

When designing enrichment programs, it is important to have an understanding about the animals and a good way to gain this understanding than by asking the people who care for them. Previously, questionnaires have been used to gain insight on keeper-animal relationships. Carlstead (2009) investigated how keepers treated and behaved around the animals they cared for, and how the animals responded to them. Whitham and Wielebnowski (2009) asked zoo staff to fill out questionnaires for each individual chimpanzee at their zoo, and to rate the animals on a scale of how 'happy' they thought they were. The results from the questionnaires were considered reliable because experienced staff get to know individual animals personally (Whitham and Wielebnowski, 2009). However, in saying that, the perception of 'happy' differs from one person to the next, which is important to acknowledge (Whitham and Wielebnowski, 2009).

Similarly, questionnaires have been used to examine how much enrichment is provided for captive mammals. For example, Hoy *et al*. (2010) evaluated enrichment in 25 zoos worldwide. They asked zoo staff which mammals were most commonly provided enrichment and what they thought about the enrichment program. Participants said that primates, followed by carnivores, were the most common mammals to receive enrichment and that more enrichment, in general, should be provided. Time constraints of zoo staff were reported as being the biggest barrier to the provision of more enrichment (Hoy et al., 2010). Hoy *et al*. (2010) also concluded that although enrichment has improved over the last 30 years, still more could be provided. Issues such as providing enrichment outside zoo operating hours, and for nocturnal species, were also discussed by Hoy *et al*. (2010). Haque (2006) questioned zoo staff at Kuala Lumpur Zoo about the behaviour of the animals for which they cared. The staff indicated that animals were unable to interact with their environment but that staff were doing their best to maintain welfare standards (Haque, 2006). It was concluded, however, that with increased support from the government through increased funding, and the development of some minimum welfare standards and

yearly inspections, that conditions could improve for the animals at this zoo (Haque, 2006).

Although these questionnaires and evaluations mentioned in the previous paragraph focused on the welfare of the animals, stereotypic behaviours, and environmental enrichment, the questionnaire I designed here primarily aimed to investigate the perceptions of New Zealand zoo keepers about stereotypic behaviour and environmental enrichment of captive mammals.

3.2 Methodology

3.2.1 Study area

Three captive wildlife institutes, located throughout New Zealand's North Island, were used in this study. They are Hamilton Zoo, Auckland Zoo, and Wellington Zoo, but results will remain anonymous in this study. Institutes were randomly labelled 1, 2, and 3 for anonymity. These institutes were selected because they are the three largest zoos in New Zealand, and thus care for a larger number and a more diverse array of species than smaller zoos or game parks. Also, by having access to a greater number of species the research has the potential to extend knowledge to more varieties of species. By having access to a large number of animals presents a better representation of the behaviour and responses for each of the different species kept in captivity as the data will be more general rather than the response of a single or a small group of animals.

3.2.2 Questionnaire

The questionnaire (Appendix 1) was designed specifically to help investigate the risk factors and the prevalence of stereotypic behaviours of mammals in captive wildlife institutes by finding out the views of zoo personnel regarding this topic. The aims were to investigate the perceptions of zoo personnel regarding stereotypic behaviour, and to obtain first-hand opinions on the levels of occurrences of stereotypic behaviour that are seen in captive wildlife institutes. The survey also identified what species are seen to be more affected by stereotypic behaviours and also what the more common stereotypic behaviours were. Questions were asked regarding the personal opinions of zoo staff about whether they think stereotypic behaviours are

desirable or undesirable behaviours, both from an animal and a member of the public's viewpoint. In order to establish the perceptions of the different zoo personnel, a demographics section was included in the questionnaire. It identifies the age, gender, number of years working in the zoo industry, and how many years a person had worked at a captive wildlife institute. By identifying these points I will be able to compare the perceptions of the different zoo personnel and was able to see whether there are any positive (or negative) correlations between perceptions of zoo personnel and how many years they have been working in the zoo industry and whether there is a difference between these relationships at each of the three captive wildlife institutes studied. The survey findings will also indicate whether age is a factor and if one sex is more aware of stereotypic behaviours than the other.

The survey was designed using the online surveying tool, SurveyMonkey (SurveyMonkey.com, LLC, Palo Alto, California, USA). In total, the questionnaire comprised 24 questions which included a demographics section and a section regarding captive mammals and stereotypic behaviours (Appendix 1). This survey was evaluated via peer review and was deemed to be 'low risk'. Consequently, it was approved but it has not been reviewed by one of the University's Human Ethics Committees.

3.3 Data analysis

The questionnaire results were investigated with statistical program SPSS version 20 (IBM-SPSS, IBM Corporation, Armonk, New York, USA) and graphs were constructed using Microsoft Excel 2010. Before the statistics were analysed the answers the participants selected as 'don't know' were excluded. Questions 13–24 were analysed with a chi-square analysis to determine if there were significant differences based on participants' answers with respect to the institute for which they work, their gender, and their level of experience. Any significant differences between participants and their institutes, gender, or years of experience are reported below along with results from each question.

3.4 Results

We received 48 valid responses to the questionnaire out of an estimated target audience of approximately 160 zoo staff (zoo keepers, management, and curators), yielding a response rate of ~30%. This included 23, 10 and 15 responses from the three different institutes, and 14 male and 34 female zoo staff.

Questions 1–12 comprised a demographic section and questions that required participants to provide answers about themselves and the animals they care for in their current role as zoo staff. Their responses to these questions are displayed graphically below (Figs 3.1-3.11).

Question 1. What zoo do you currently work at?

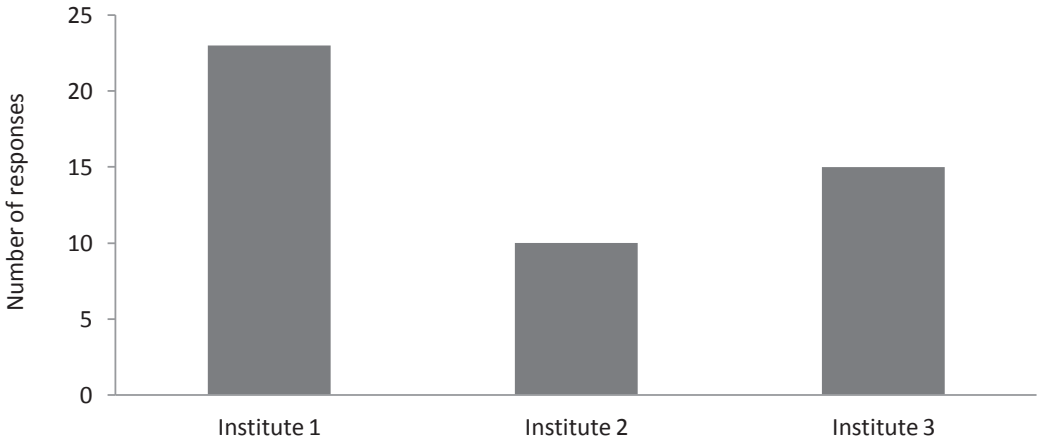


Figure 3.1 The frequency of responses from the institutes surveyed. The number of valid responses to this question was 48.

Question 2. What title best describes your position at the zoo you currently work for?

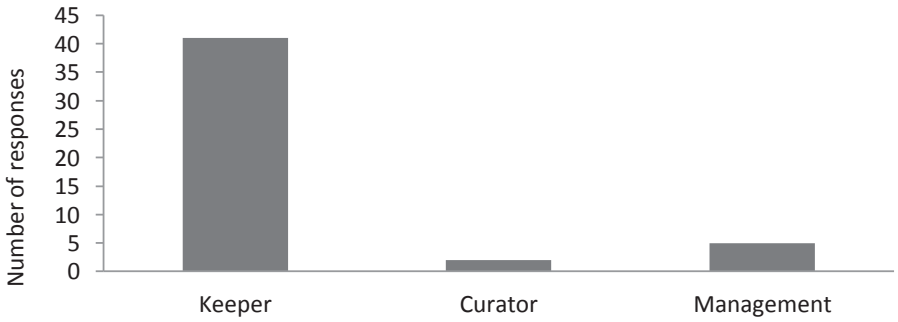


Figure 3.2 The roles of zoo staff responding to the survey. The number of valid responses to this question was 48.

Question 3. Gender

Figure 3.3 The gender frequency of survey responders. The number of valid responses to this question was 48.

Question 4. How old are you?

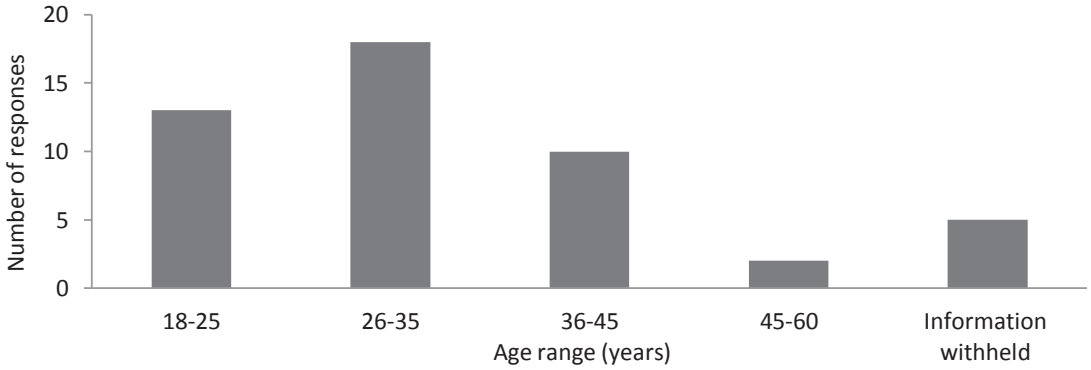


Figure 3.4 Age ranges (in years) of survey responders. The number of valid responses to this question was 43.

Question 5. How many years have you worked in the zoo industry?

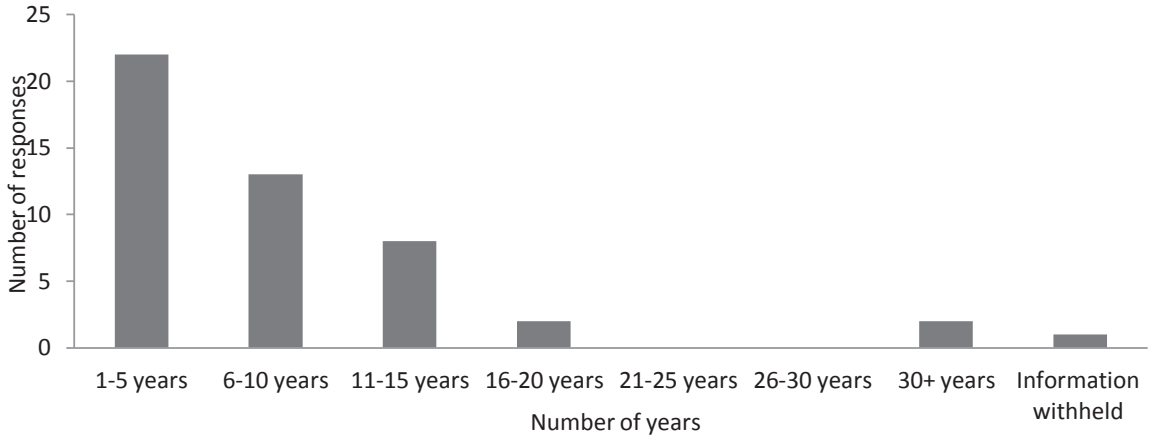


Figure 3.5 The number of years the survey participants have been working in the zoo industry. The number of valid responses to this question was 47.

Question 6. How many years have you been working at the zoo at which you are currently employed?

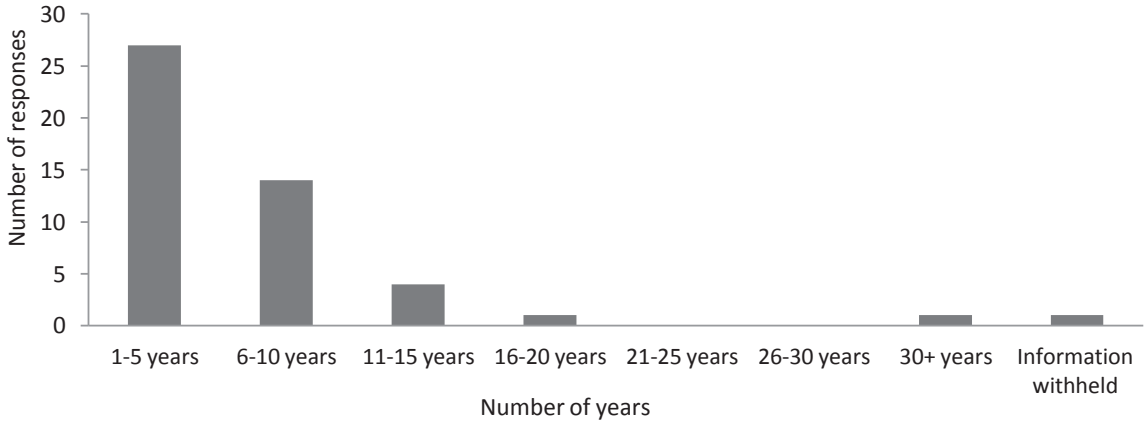


Figure 3.6 The number of years the survey participants have been working at the institute at which they are currently employed. The number of valid responses to this question was 47.

Question 7. List the mammals for which you currently provide care.

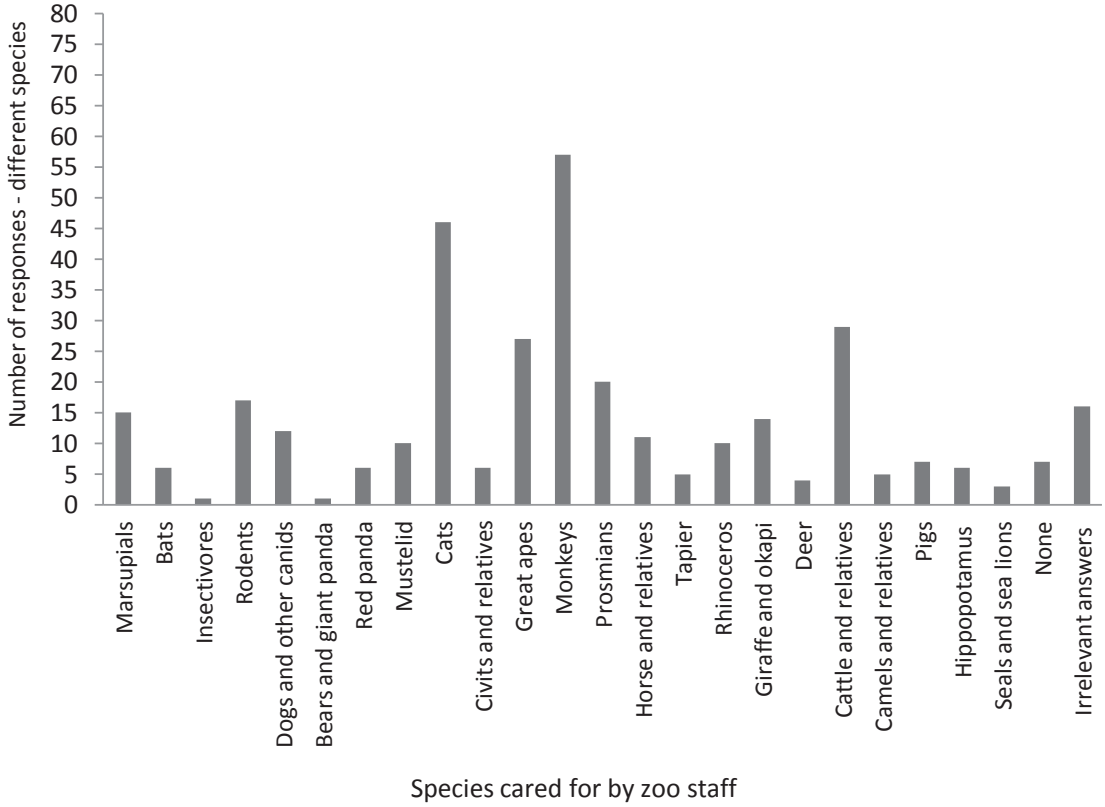


Figure 3.7 The different zoo animal species that survey participants care for at all institutes and the frequency of responses for each of the species. The number of valid responses to this question was 44.

Question 8. Have any of the mammals that you currently care for displayed a stereotypic behaviour?

Figure 3.8 Number of responses from participants concerning whether they had seen any of the mammals they currently care for display a stereotypic behaviour. The number of valid responses to this question was 44.

There was a significant difference (χ^2=6.026, df=2, p=0.049) in the response to this question between zoo staff from different institutes (Fig. 3.9) There was no significant difference in the response to this question between zoo staff of different genders or different levels of experience.

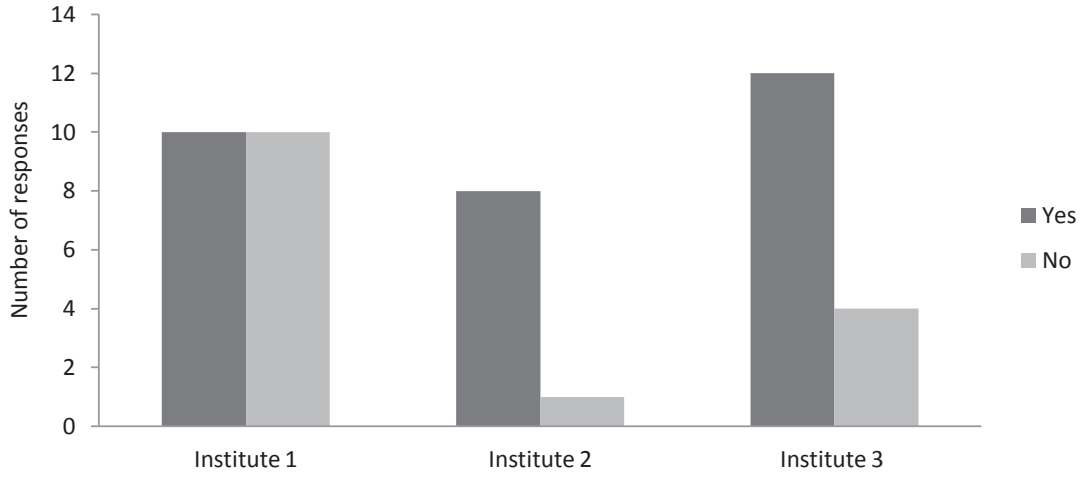


Figure 3.9 Number of responses from participants concerning whether they had seen any of the mammals they currently care for display a stereotypic behaviour by institute. Responses from Institute 1 responders are significantly different from the others.

Questions 9-11 With respect to the animals you currently care for, please indicate which species displayed the stereotypic behaviour and what the behaviour was. Please note: Q 9-11 were broken down into three questions to allow better readability in the questionnaire, however the results have here been summarised into a single figure (Figure 3.10)

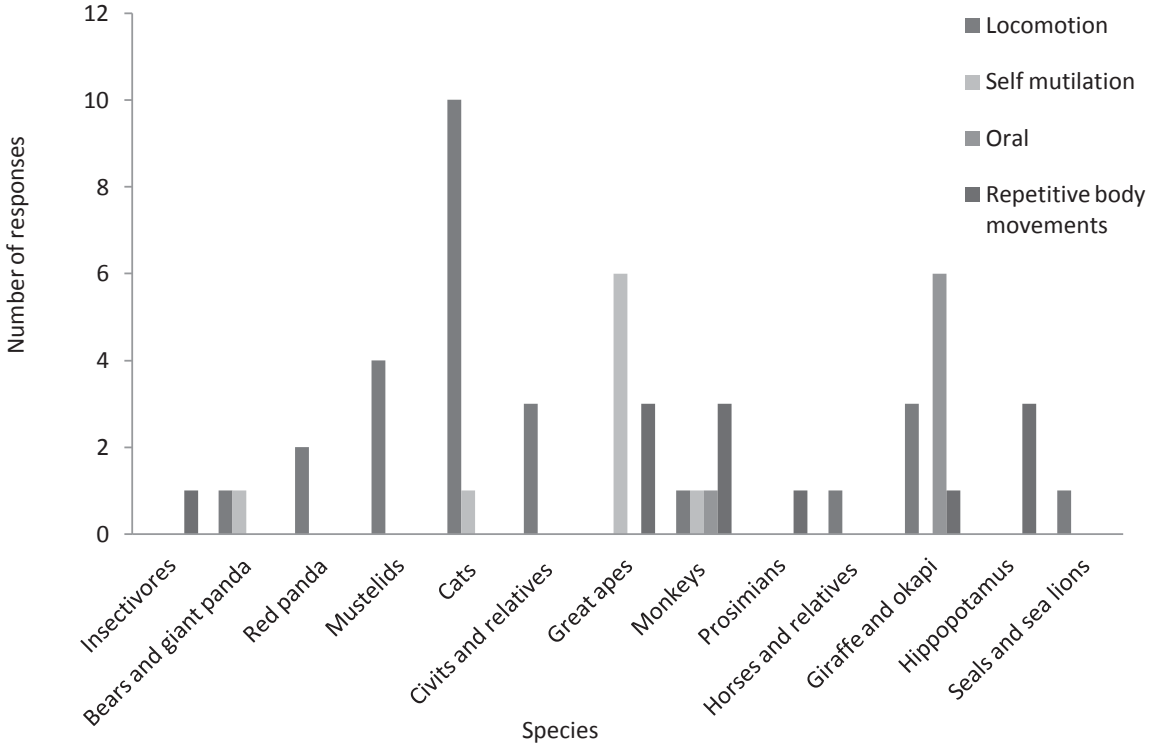


Figure 3.10 The range of zoo mammals affected by stereotypic behaviour and categories of this behaviour reported by New Zealand zoo staff.

Question 12. From what you have experienced in your career, which species most often display stereotypic behaviours?

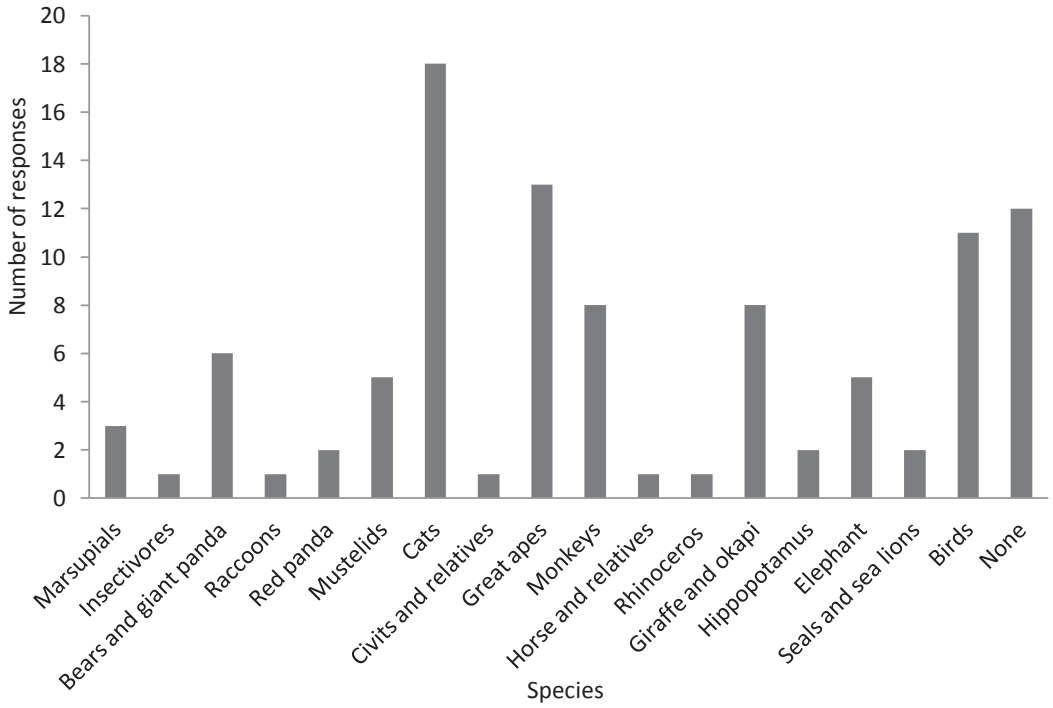


Figure 3.11 Zoo staff perceptions as to the types of zoo animals that most often display stereotypic behaviour. The number of valid responses to this question was 39.

Questions 13–24 allowed participants to express their opinion on topics such as whether common factors contribute to stereotypic behaviours, which stereotypic behaviours are most common, if they should be treated, and how. To develop an understanding on the different viewpoints of staff from different institutes, differences relating to gender, and numbers of years of experience, answers for each question were compared and analysed with regard to these three categories. The responses to these questions and any significant differences found between different institutes, gender, and numbers of years of experiences, are displayed below (Figs 3.12 – 3.49).

Question 13. Rate the extent to which you think, in general, the following factors contribute towards the development of stereotypic behaviour.

a. *Abnormal social groups*

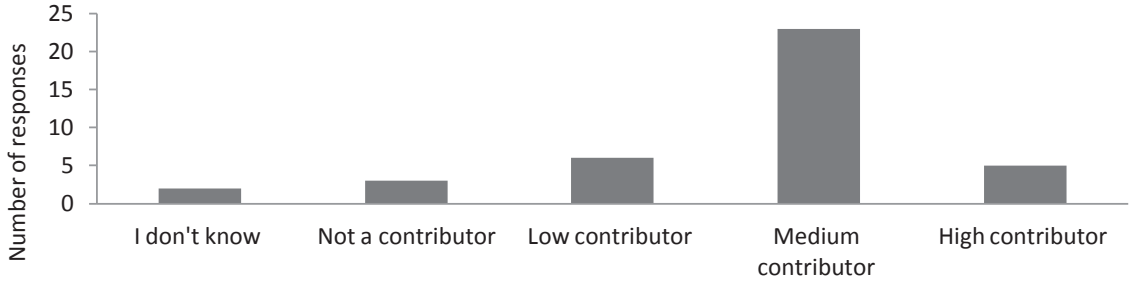


Figure 3.12 The perspectives of New Zealand zoo staff on the relative contribution that abnormal social groups make to the development of stereotypic behaviour. The total number of valid responses to this question was 39.

There was no significant difference in the response to this question between zoo staff from different institutes, of different genders, or of different levels of experience.

b. *Unnatural lighting (e.g. cycles, intensity)*

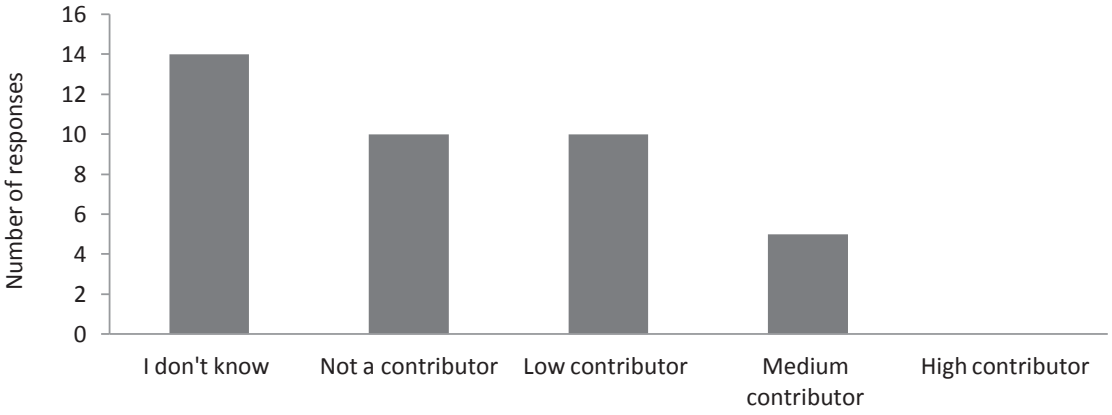


Figure 3.13 The perspectives of New Zealand zoo staff on the relative contribution that unnatural lighting makes to the development of stereotypic behaviour. The total number of valid responses to this question was 39.

There was no significant difference in the response to this question between zoo staff from different institutes, of different gender, or different levels of experience.

c. *Unnatural sounds (to the animal e.g. machinery)*

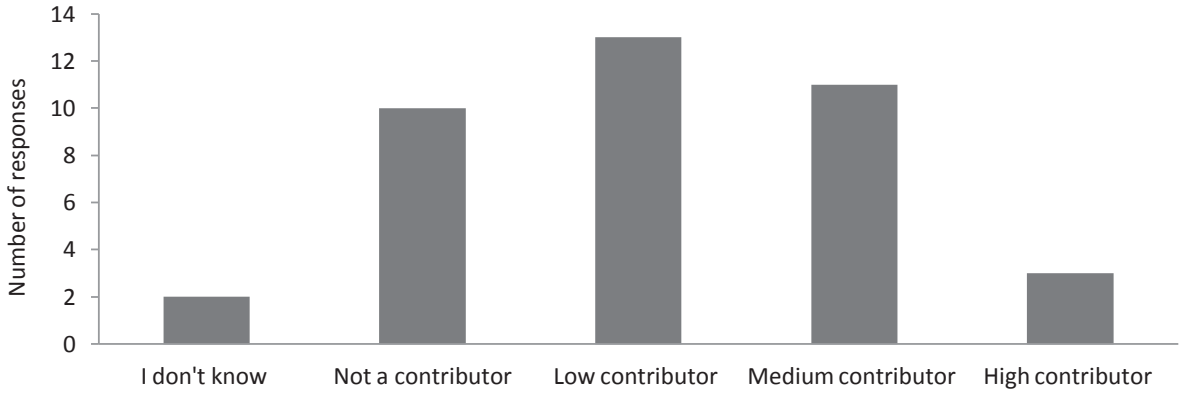


Figure 3.14 The perspectives of New Zealand zoo staff on the relative contribution that unnatural sounds make to the development of stereotypic behaviour. The total number of valid responses to this question was 39.

There was no significant difference in the response to this question between zoo staff from different institutes, gender, or levels of experience.

d. *Restricted area*

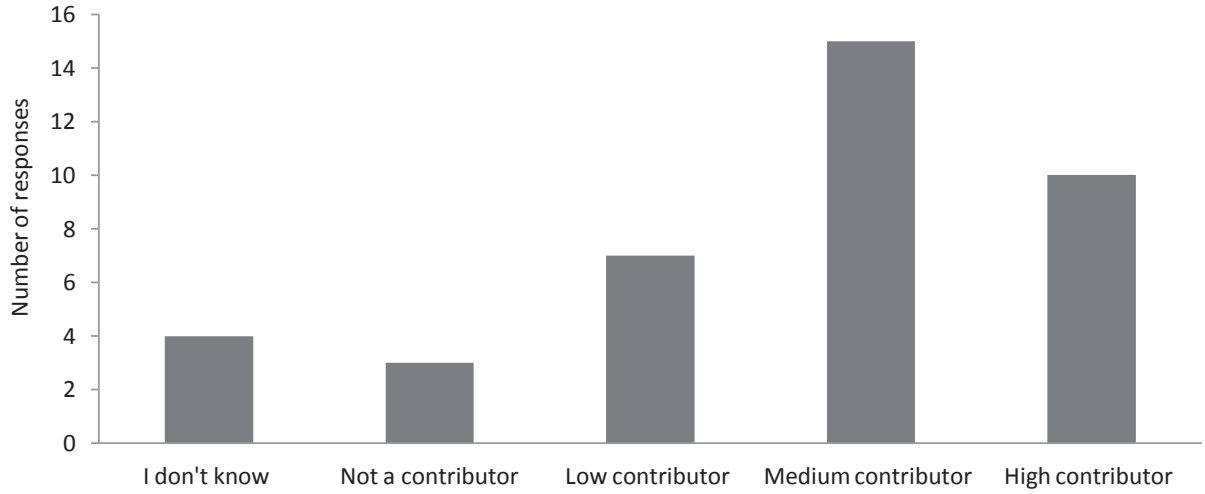


Figure 3.15 The perspectives of New Zealand zoo staff on the relative contribution that abnormal social groups make to the development of stereotypic behaviour. The total number of valid responses to this question was 39.

There was no significant difference in the response to this question between zoo staff from different institutes, of different genders or of different levels of experience.

e. *Absence of retreat space*

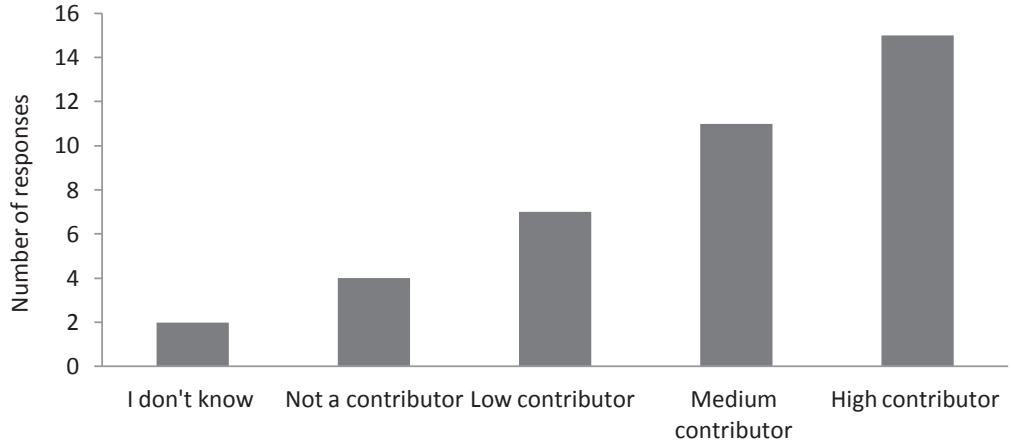


Figure 3.16 The perspectives of New Zealand zoo staff on the relative contribution that an absence of retreat space makes to the development of stereotypic behaviour. The total number of valid responses to this question was 39.

There was a significant difference (χ^2=16.43, df=8, p=0.037) in the response to this question between zoo staff from different institutes (Fig. 3.17). There was no significant difference in the response to this question between zoo staff of different genders or levels of experience.

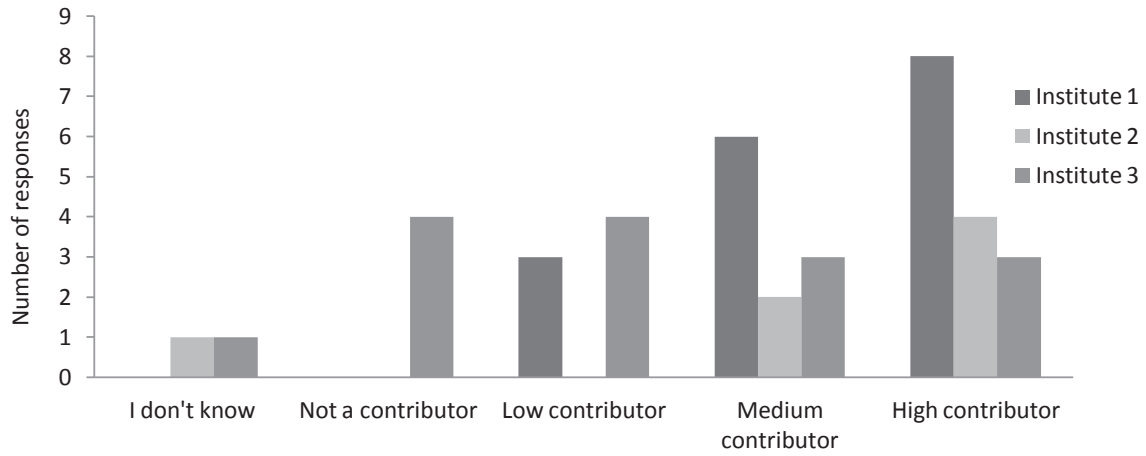


Figure 3.17 The difference between institutes in the perspectives of New Zealand zoo staff on the relative contribution that an absence of retreat space makes to the development of stereotypic behaviour. There is a significant difference in the pattern of response of staff from Institute 2 from the other institute staff. The number of valid responses to this question was 39.

Institute 2 participants had very similar viewpoints whereas participants from Institutes 1 and 3 were varied.

f. *Forced proximity to humans*

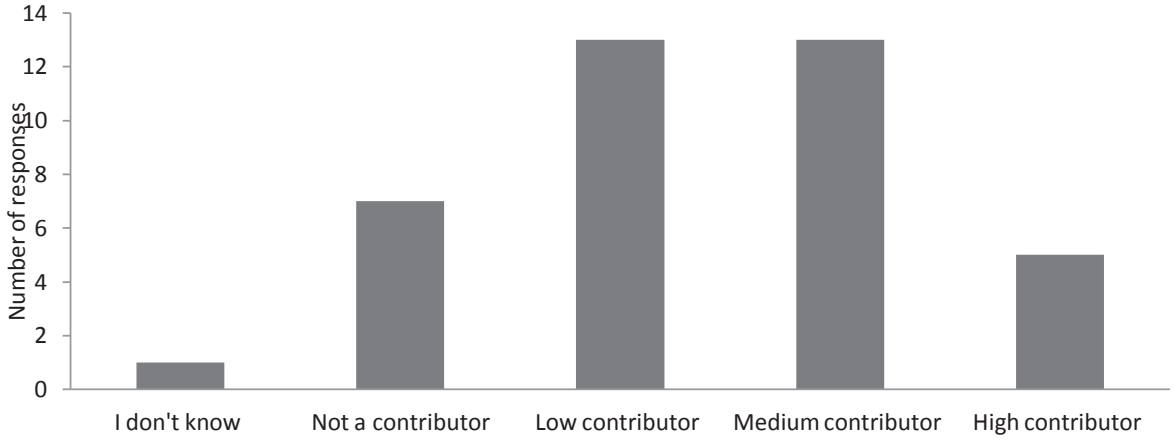


Figure 3.18 The perspectives of New Zealand zoo staff on the relative contribution that forced proximity to humans makes to the development of stereotypic behaviour. The total number of valid responses to this question was 39.

There was a significant difference (χ^2=23, df=8, p=0.003) in the response to this question between zoo staff from different institutes (Fig. 3.19). There was no significant difference in the response to this question between zoo staff of different levels of experience or of different gender.

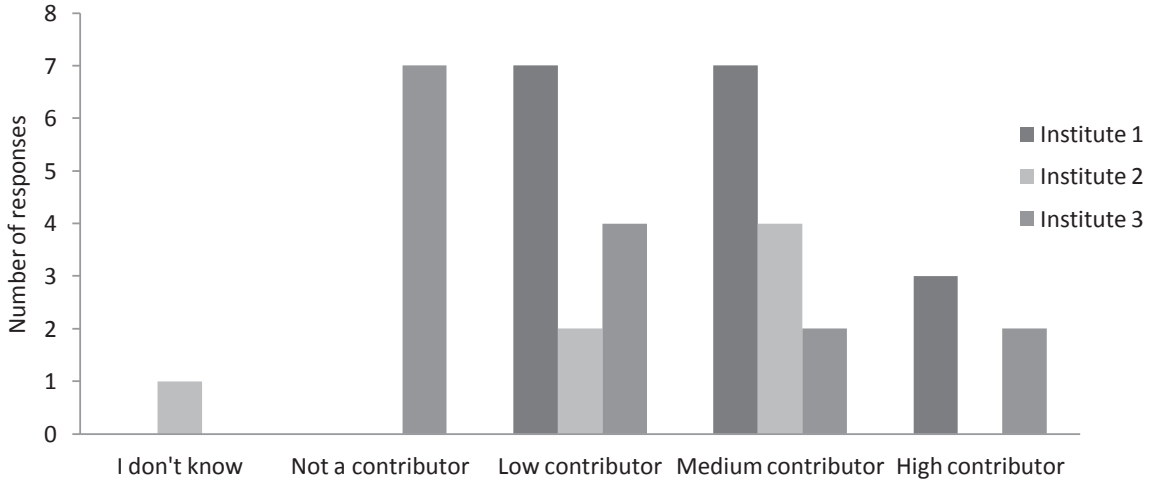


Figure 3.19 The difference between institutes in the perspectives of New Zealand zoo staff on the relative contribution that forced proximity to humans makes to the development of stereotypic behaviour. There is a significant difference in the pattern of responses of institute 2's staff from the other institutes' staff. The number of valid responses to this question was 39.

Institute 2 participants had very similar viewpoints whereas participants from Institutes 1 and 3 were varied.

g. *Restricted feeding and foraging opportunities (e.g. food in bowl and not hidden/scattered around enclosure)*

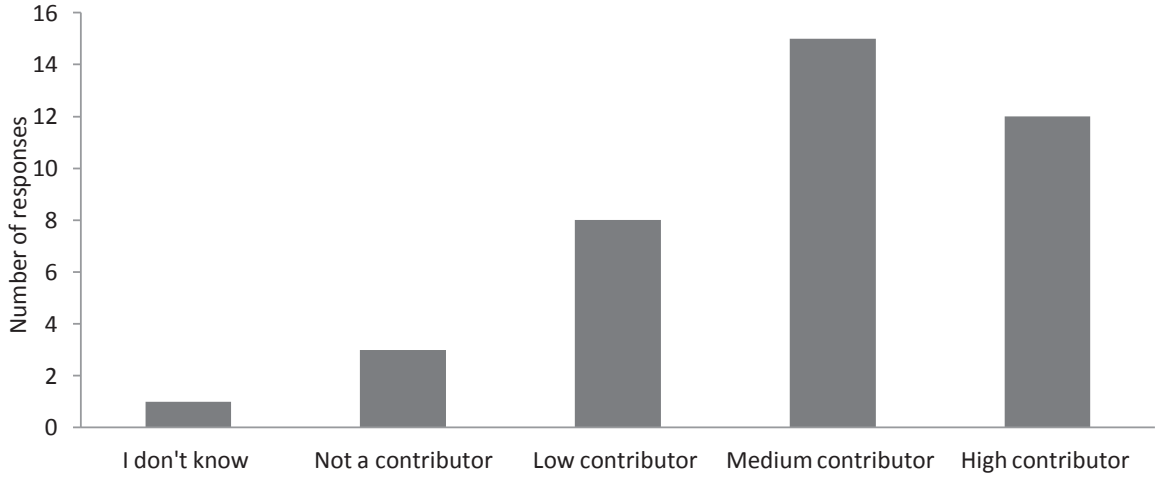


Figure 3.20 The perspectives of New Zealand zoo staff on the relative contribution that restricted feeding and foraging opportunities makes to the development of stereotypic behaviour. The total number of valid responses to this question was 39.

Restricted feeding and foraging opportunities were thought to be a medium or a high contributor to stereotypic behaviours by participants. There was not a significant difference in the response to this question between zoo staff from different institutes, of different gender, or different levels of experience.

h. *Unnatural odours*

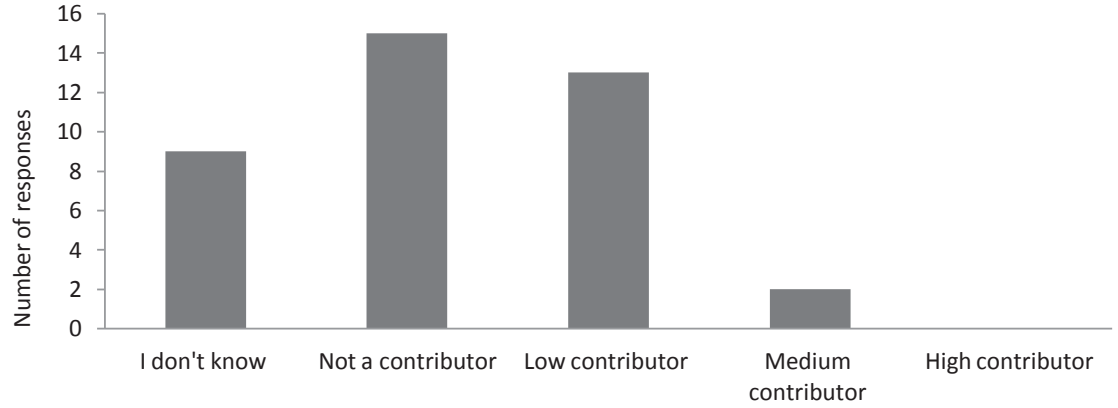


Figure 3.21 The perspectives of New Zealand zoo staff on the relative contribution that unnatural odours make to the development of stereotypic behaviour. The total number of valid responses to this question was 39.

Unnatural odours were thought by participants to not be, or are a low contributor to, stereotypic behaviours by animals. A large number of participants did not know whether unnatural odours were or were not a contributor. There was no significant difference in the response to this question between zoo staff from different institutes, of different gender, or different levels of experience.

i. *Husbandry procedures*

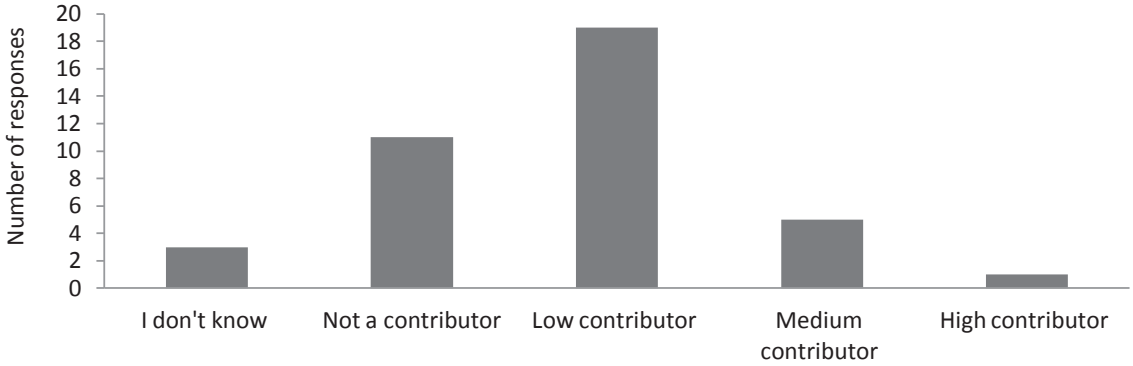


Figure 3.22 The perspectives of New Zealand zoo staff on the relative contribution that husbandry procedures make to the development of stereotypic behaviour. The total number of valid responses to this question was 39.

Participants thought that husbandry procedures were primarily a low contributor to stereotypic behaviours with the secondary group indicating that they were not a contributor. There was a significant difference in response to this question between zoo staff of different gender (χ^2=10.85, df=4, p=0.028) (Fig. 3.23). There was no significant difference in the response to this question between zoo staff from different institutes or of different levels of experience.

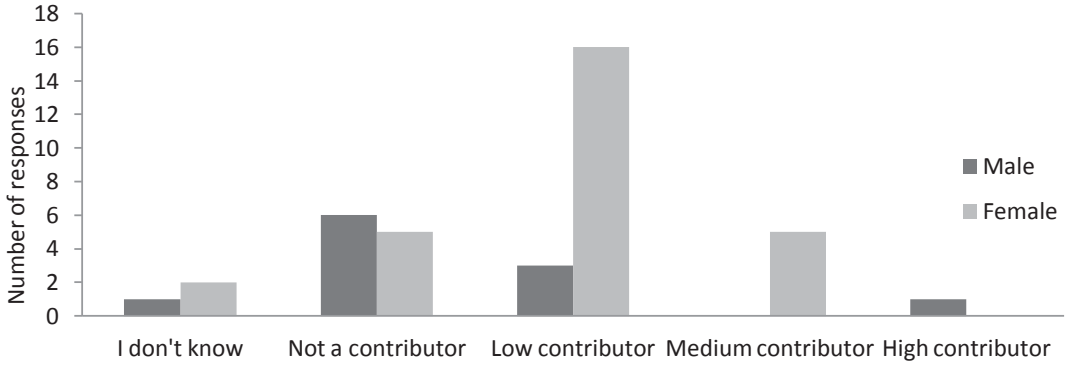


Figure 3.23 The difference between genders in the perspectives of New Zealand zoo staff on the relative contribution that husbandry procedures makes to the development of stereotypic behaviour.

j. *Lack of environmental enrichment (e.g. natural, trees)*

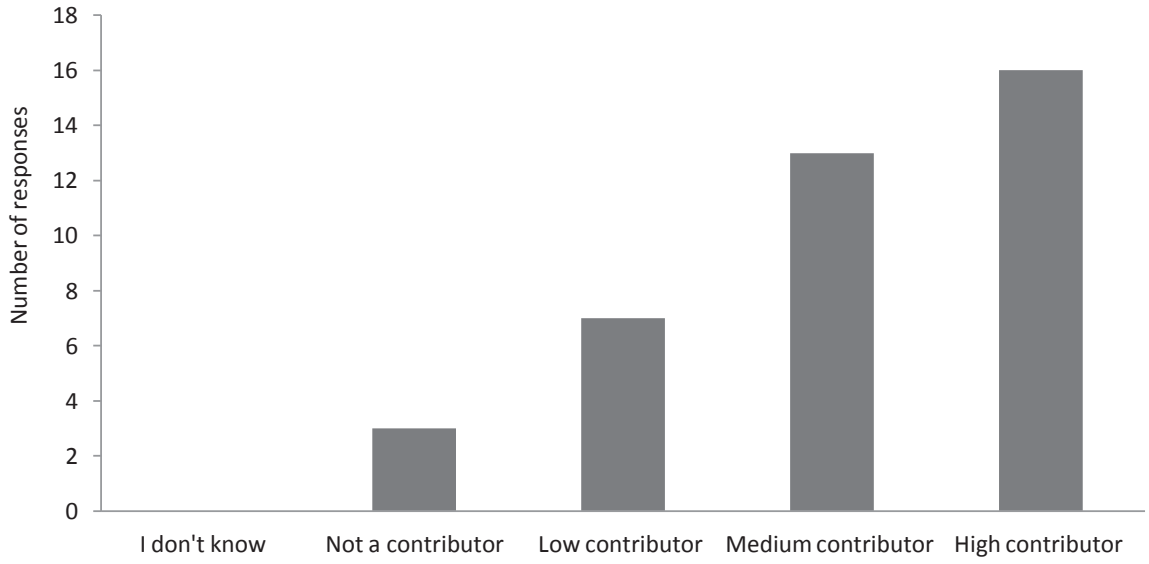


Figure 3.24 The perspectives of New Zealand zoo staff on the relative contribution that lack of environmental enrichment makes to the development of stereotypic behaviour. The total number of valid responses to this question was 39.

Lack of environmental enrichment was thought by participants to primarily be a high or a medium contributor to stereotypic behaviours. There was a significant difference (χ^2=18.6, df=6, p=0.005) in the response to this question between zoo staff from different institutes (Fig. 3.25). There was no significant difference in the response to this question between zoo staff of different genders or of different levels of experience.

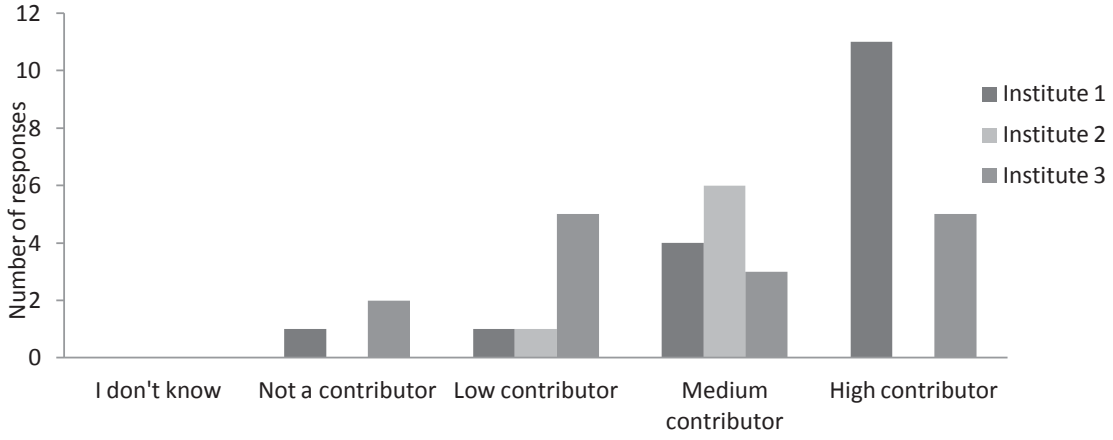


Figure 3.25 The difference between institutes in the perspectives of New Zealand zoo staff on the relative contribution that lack of environmental enrichment makes to the development of stereotypic behaviour.

Institute 2 is significantly different because staff primarily selected 'lack of environmental enrichment' as being a medium contributor to the treatment of stereotypic behaviour, thus making the range of responses unimodal (i.e. narrow). Participants from Institutes 1 and 3 had more varied answers to this question.

k. *Lack of structural enrichment (e.g. human made structures, swings)*

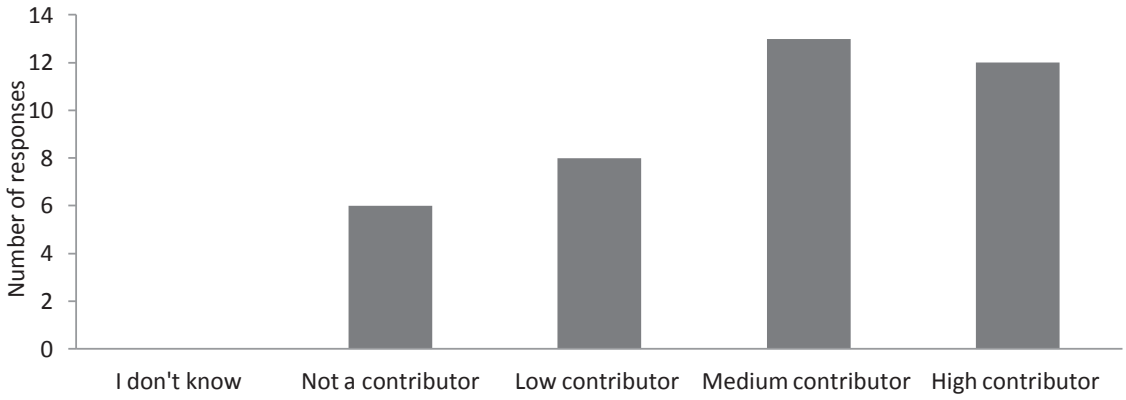


Figure 3.26 The perspectives of New Zealand zoo staff on the relative contribution that lack of structural enrichment makes to the development of stereotypic behaviour. The number of valid responses to this question was 39.

There was a fairly even spread on whether lack of structural enrichment was a contributor of stereotypic behaviour. Primarily participants said it was a medium contributor with the 'high contributor' response being secondary. There was a significant difference in the response to this question between zoo staff from different institutes (χ^2=14.9, df=6, p=0.021) (Fig. 3.27). There was no significant difference in the response to this question between zoo staff of different genders or of different levels of experience.

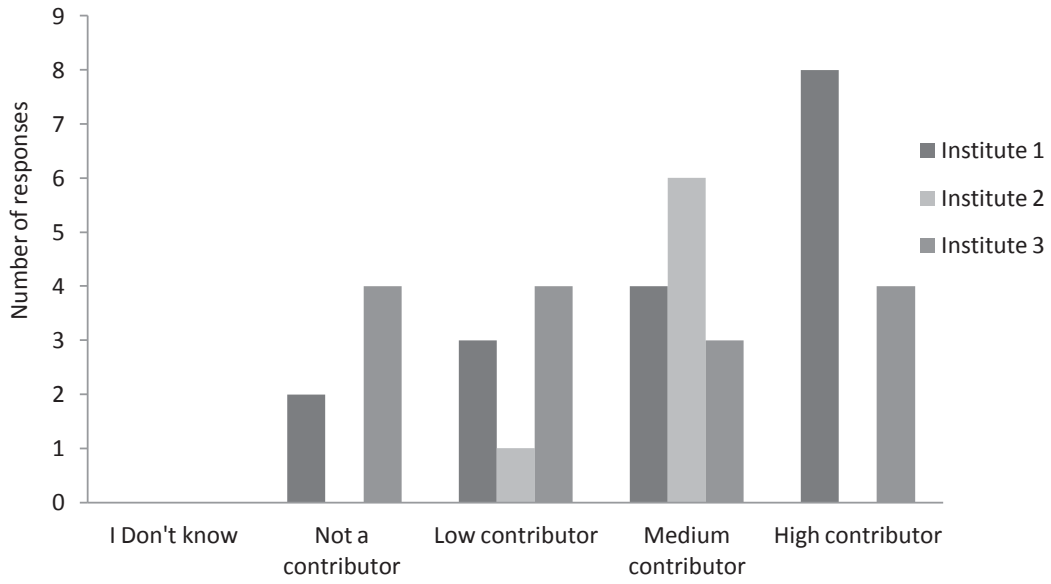


Figure 3.27 The difference between institute in the perspectives of New Zealand zoo staff on the relative contribution that lack of structural enrichment makes to the development of stereotypic behaviour.

Institute 2 participants shared very similar viewpoints whereas participants from Institutes 1 and 3 had more varied answers.

l. *Lack of behavioural enrichment (e.g. work for food)*

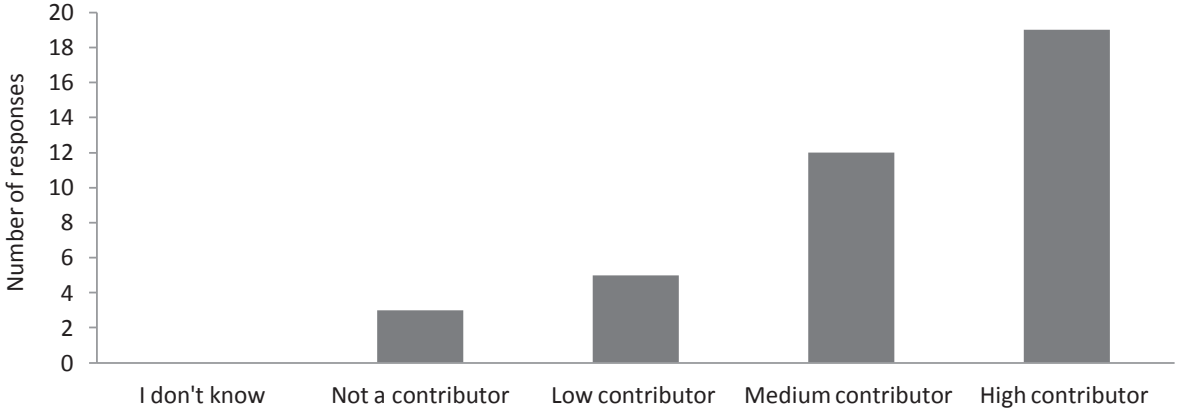


Figure 3.28 The perspectives of New Zealand zoo staff on the relative contribution that lack of behavioural enrichment makes to the development of stereotypic behaviour. The total number of valid responses to this question was 39.

Participants primarily thought that lack of behavioural enrichment was a high contributor to stereotypic behaviour followed by a medium one. There was no significant difference in the response to this question between zoo staff from different institutes of different genders or of different levels of experience.

m. *Unnatural temperatures*

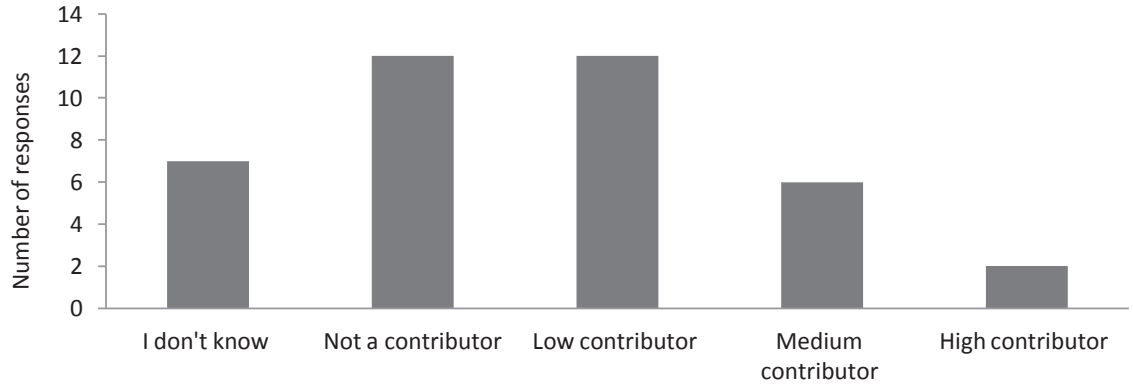


Figure 3.29 The perspectives of New Zealand zoo staff on the relative contribution that unnatural temperature makes to the development of stereotypic behaviour. The total number of valid responses to this question was 39.

Participants primarily thought that unnatural temperatures were not, or were a low contributor, of stereotypic behaviours. Secondly, participants' response 'did not know' was closely followed by some thinking unnatural temperatures were a medium contributor. There was no significant difference in the response to this question between zoo staff from different institutes, of different gender, or different levels of experience.

n. *Unsuitable enclosure design*

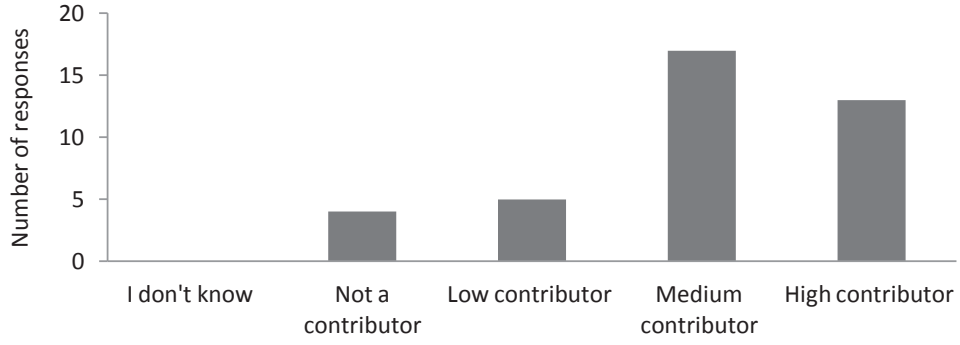


Figure 3.30 The perspectives of New Zealand zoo staff on the relative contribution that unsuitable enclosure design makes to the development of stereotypic behaviour. The total number of valid responses to this question was 39.

Unsuitable enclosure design was primarily thought by participants to be a medium contributor followed by a high contributor. There was no significant difference in response to this question between zoo staff from different institutes, of different gender or of different level of experience.

Question 14. What single category of stereotypic behaviour do you think is most common in zoo mammals?

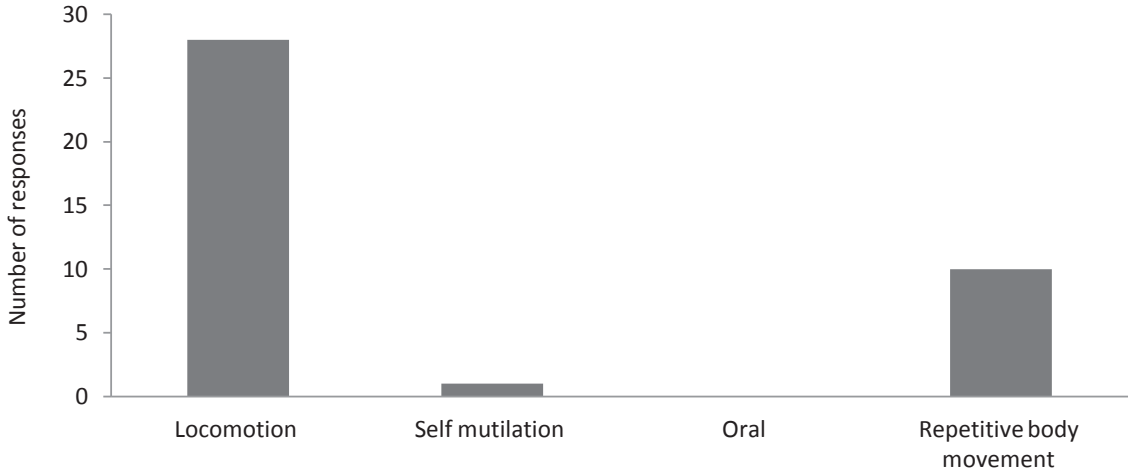


Figure 3.31 The perspectives of New Zealand zoo staff on the most common categories of stereotypic behaviour encountered in zoo mammals. The total number of valid responses to this question was 39.

Locomotion is thought by the participants to be the most common category of stereotypic behaviour displayed by zoo mammals with repetitive body movements being second. There was no significant difference in the response to this question between zoo staff from different institutes, of different genders or of different levels of experience.

Question 15. From an animal's perspective, stereotypic behaviour is...

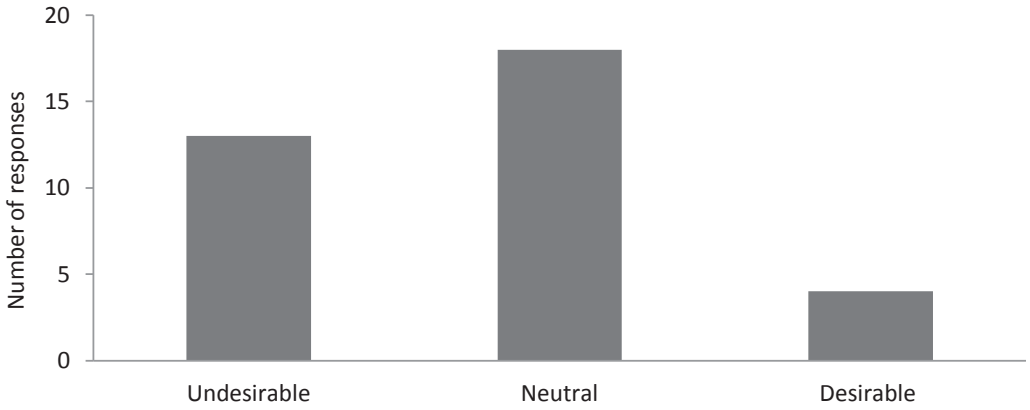


Figure 3.32 The perspectives of New Zealand zoo staff on whether stereotypic behaviour is desirable/undesirable from an animal's perspective. The total number of valid responses to this question was 35.

Participants thought that, from an animal's perspective, stereotypic behaviour was primarily neither desirable nor undesirable (i.e. a neutral behaviour). Secondly, it was undesirable. There was no significant difference in the response to this question between zoo staff from different institutes, of different gender, or different levels of experience.

Question 16. To what extent do you agree with the following statement, from an animal's perspective. "I believe that stereotypic behaviour is a desirable behaviour because it is a good coping mechanism"

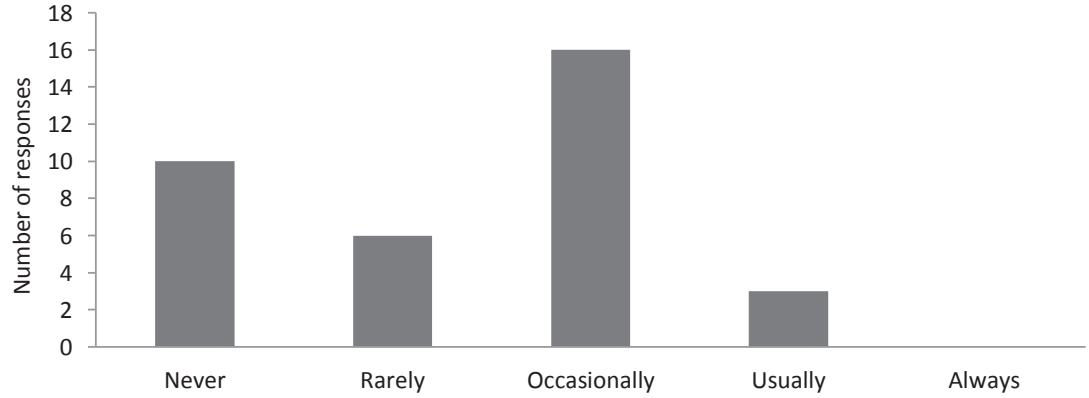


Figure 3.33 The perspectives of New Zealand zoo staff on the applicability from an animal's perspective of the statement "*I believe that stereotypic behaviour is a desirable behaviour because it is a good coping mechanism."* The total number of valid responses to this question was 35.

Most participants occasionally believed that stereotypic behaviour is a desirable behaviour from an animal's perspective because it is a good coping mechanism, with the second highest group of participants saying they never believed this. There was no significant difference in the response to this question between zoo staff from different institutes, of different gender, or different levels of experience.

Question 17. To what extent do you agree with the following statement, from an animal's perspective. "I believe that stereotypic behaviour is an undesirable behaviour because it indicates a level of distress and underlying welfare issues"

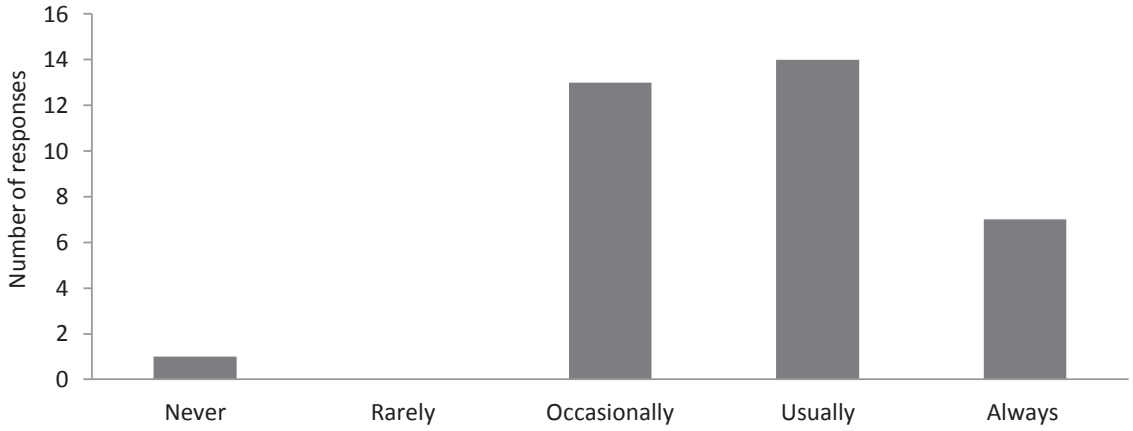


Figure 3.34 The perspectives of New Zealand zoo staff on the applicability from an animal's perspective of the statement *"I believe that stereotypic behaviour is an undesirable behaviour because it indicates a level of distress and underlying welfare issues."* The total number of valid responses to this question was 35.

Most participants primarily indicated 'usually' and secondly indicated 'occasionally' in response to the statement that stereotypic behaviour is undesirable because it indicates a level of distress and underlying welfare issues. There was no significant difference in the response to this question between zoo staff from different institutes, of different gender, or different levels of experience.

Question 18. From the public's perspective, stereotypic behaviour is...

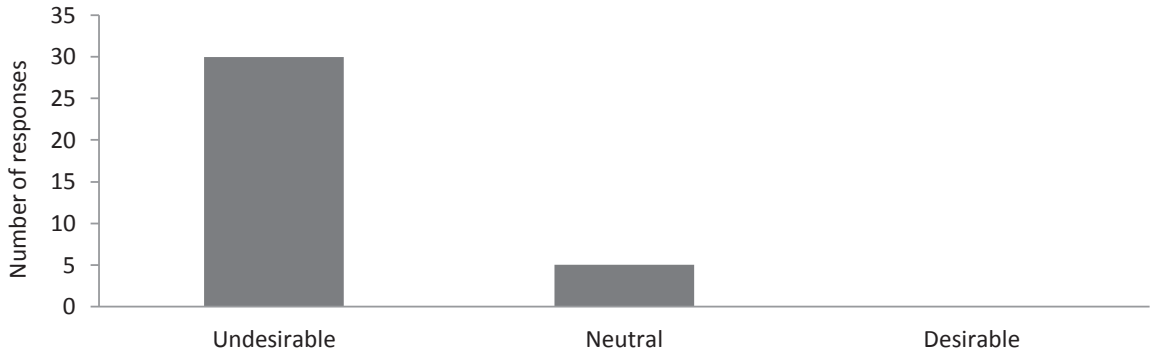


Figure 3.35 The perspectives of New Zealand zoo staff on the desirability of stereotypic behaviour from the public's perspective. The total number of valid responses to this question was 35.

Most participants said that from the public's perspective that stereotypic behaviour was undesirable. There was no significant difference in the response to this question between zoo staff from different institutes, of different gender, or different levels of experience.

Question 19. To what extent do you agree with the following statement, from the public's perspective. "I believe that stereotypic behaviour is a desirable behaviour because the animals look occupied, can be more easily seen and provide entertainment"

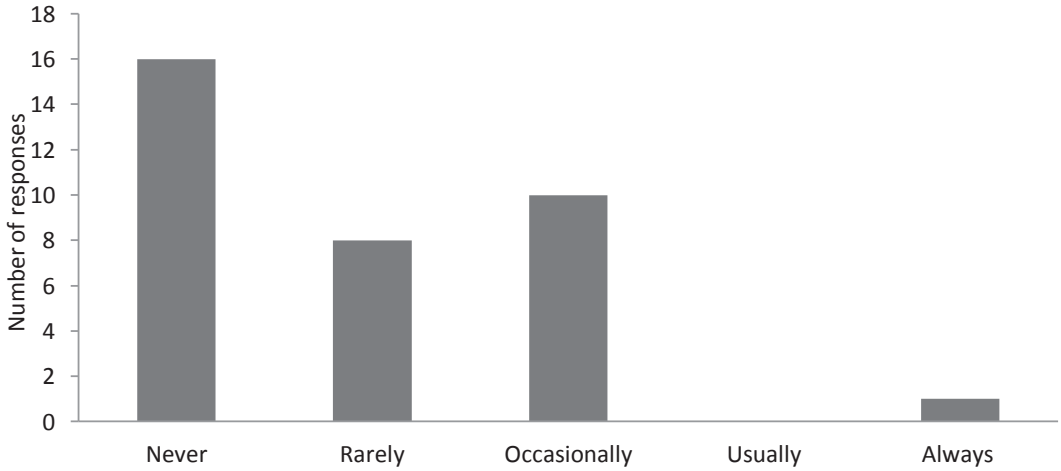


Figure 3.36 The perspectives of New Zealand zoo staff on the applicability from the public's perspective of the statement *"I believe that stereotypic behaviour is a desirable behaviour because the animals look occupied, can be more easily seen and provide entertainment."* The total number of valid responses to this question was 35.

Participants primarily said that they never and, secondly, occasionally, believed that stereotypic behaviour is desirable because the animals look occupied and can be more easily seen and provided entertainment. There was no significant difference in the response to this question between zoo staff from different institutes, gender or different levels of experience.

Question 20. To what extent do you agree with the following statement, from the public's perspective. "I believe that stereotypic behaviour is an undesirable behaviour because it indicates a level of distress and underlying welfare issues"

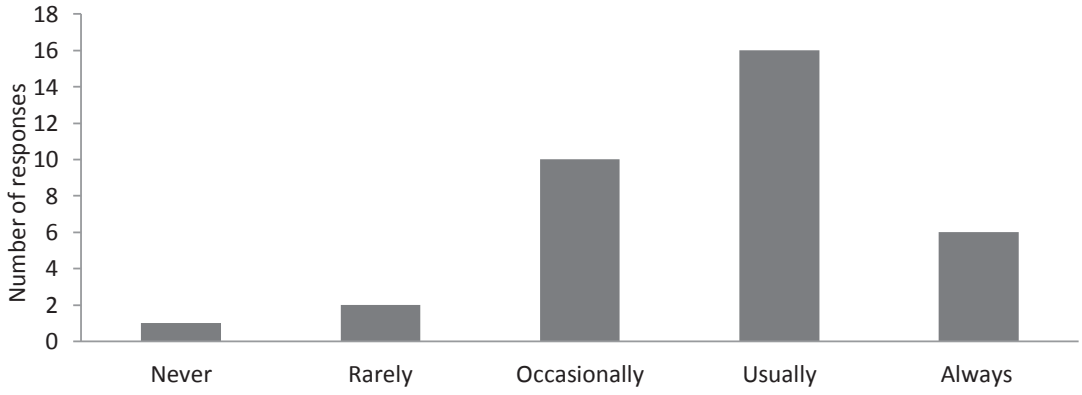


Figure 3.37 The perspectives of New Zealand zoo staff on the applicability from the public's perspective of the statement *"I believe that stereotypic behaviour is an undesirable behaviour because it indicates a level of distress and underlying welfare issues."* The total number of valid responses to this question was 35.

Most participants said they usually believe that stereotypic behaviour is an undesirable because it indicates a level of distress and underlying welfare issues. Participants secondly said they 'occasionally' and thirdly 'always' believed. There was a significant difference in the response to this question between zoo staff of different gender (χ^2=10.7, df=4, p=0.03) (Fig. 3.38). There was no significant difference in the response to this question between zoo staff from different institutes or of different levels of experience.

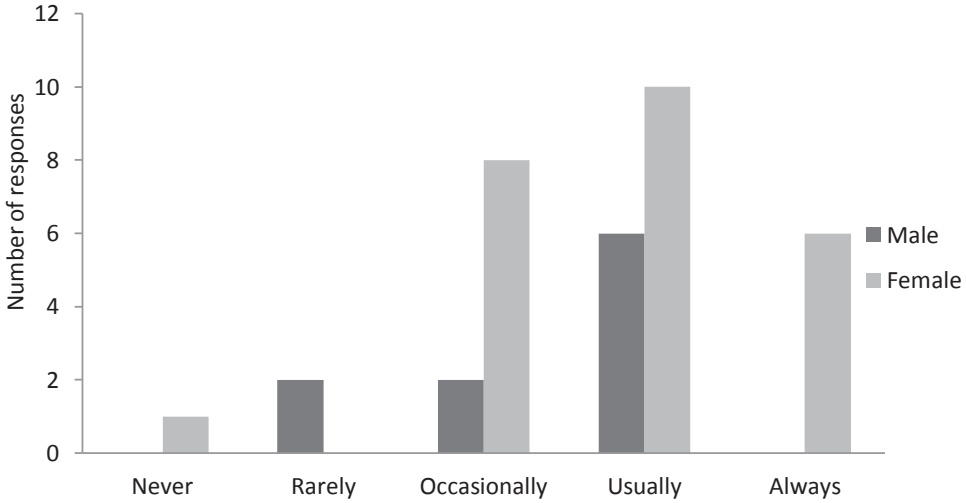


Figure 3.38. The difference between genders in the perspectives of New Zealand zoo staff on the applicability from the public's perspective on the statement *"I believe that stereotypic behaviour is an undesirable behaviour because it indicates a level of distress and underlying welfare issues."*

A larger number of male participants felt that they usually believed that stereotypic behaviour is an undesirable behaviour because it indicates a level of distress and underlying welfare issues from a human perspective. The female participants had more of a mixed response to the question.

Question 21. In general, do you treat an animal with stereotypic behaviour if it is being displayed?

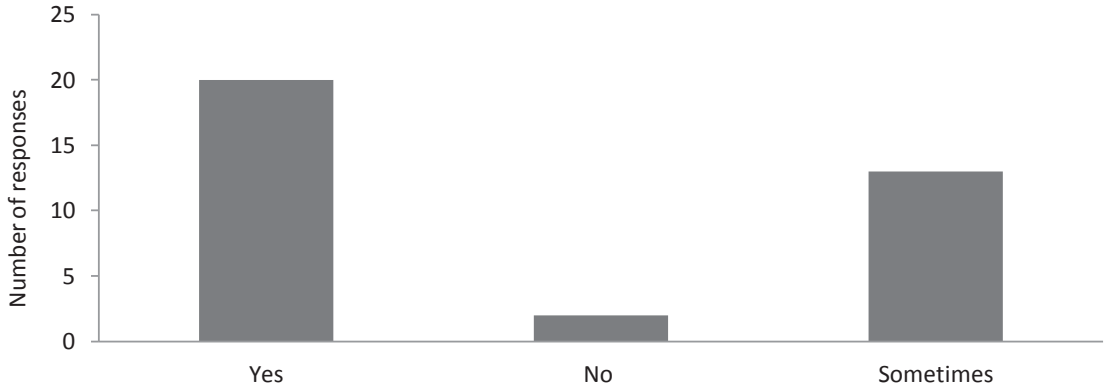


Figure 3.39 The perspectives of New Zealand zoo staff on whether they treat an animal that is displaying stereotypic behaviour. The total number of valid responses to this question is 35.

Most participants said that they would treat an animal with stereotypic behaviour if it is being displayed and a large proportion said they would sometimes treat it. There was a significant difference (χ^2=10, df=4, p=0.04) in the response to this question between zoo staff from different institutes (Fig. 3.40). There was no significant difference in the response to this question between zoo staff of different genders or of different levels of experience.

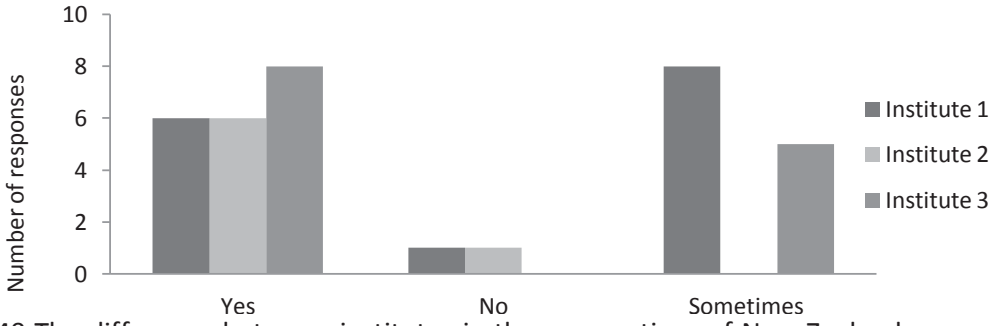


Figure 3.40 The difference between institutes in the perspectives of New Zealand zoo staff on whether they treat an animal that is displaying stereotypic behaviour.

Most participants from Institute 2 answered one answer ('yes'), and thus the likelihood of another participant from the same institute giving this answer is significant. In contrast, participants at Institutes 1 and 3 were more undecided on the answer.

Question 22.Rate the extent to which you think, in general, the following possible solutions contribute towards the treatment of stereotypic behaviours.

a. *Ignore it*

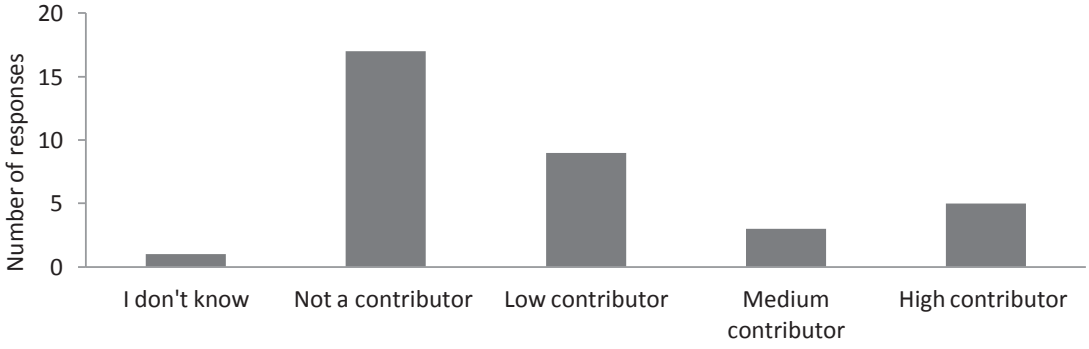


Figure 3.41 The perspectives of New Zealand zoo staff and the extent to which they think that ignoring stereotypic behaviour contributes to the treatment of it. The number of valid responses to this question was 35.

Most participants said that ignoring stereotypic behaviour is not a contributor when treating it. They secondly said it was a low contributor. There was no significant difference in the response to this question between zoo staff from different institutes, of different gender, or different levels of experience.

b. *Environmental enrichment*

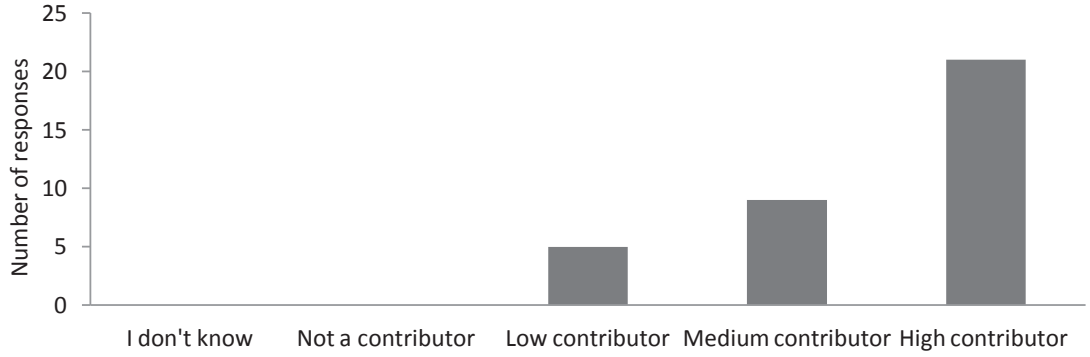


Figure 3.42 The perspectives of New Zealand zoo staff and the extent to which they think that environmental enrichment contributes towards the treatment of stereotypic behaviour. The number of valid responses to this question was 35.

Most participants said that environmental enrichment is a high contributor when treating stereotypic behaviour with medium being the second highest contributor followed by low. There was no significant difference in the response to this question between zoo staff from different institutes, of different gender, or different levels of experience.

c. *Behavioural enrichment*

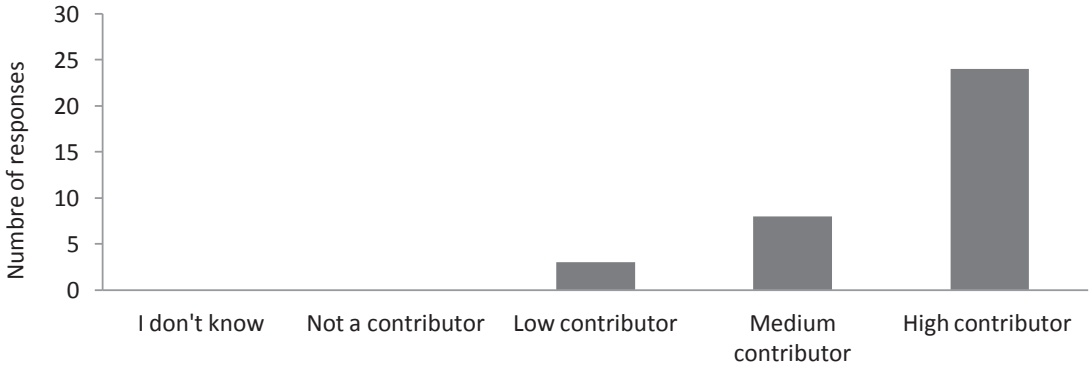


Figure 3.43 The perspectives of New Zealand zoo staff and the extent to which they think that behavioural enrichment contributes towards the treatment of stereotypic behaviour. The number of valid responses to this question was 35.

Most participants said that behavioural enrichment is a high contributor when treating stereotypic behaviour. There was a significant difference in the response to this question between keepers of different genders (χ^2=6.73, df=2, p=0.035) (Fig. 3.44). There was no significant difference in the response to this question between zoo staff from different institutes or of different levels of experience.

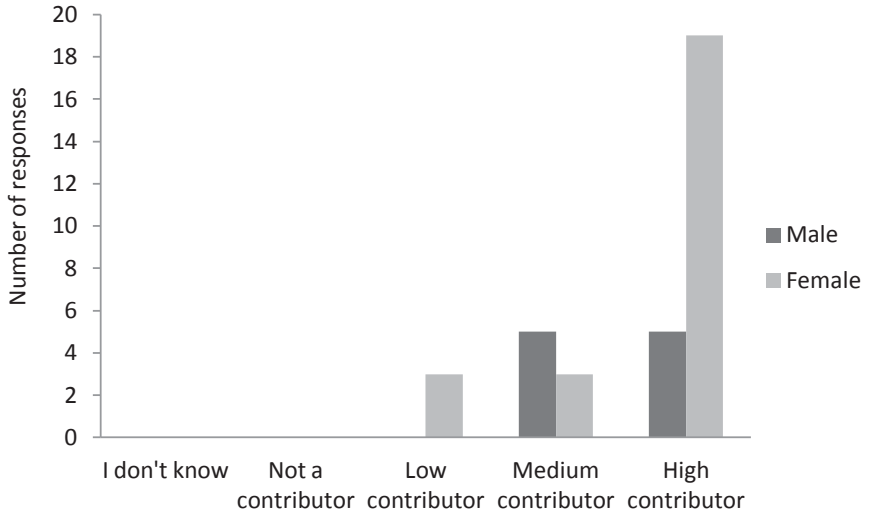


Figure 3.44 The difference between genders in the perspectives of New Zealand staff on the extent at which they think that behavioural enrichment is a contributor towards the treatment of stereotypic behaviour.

d. *Alter social interactions*

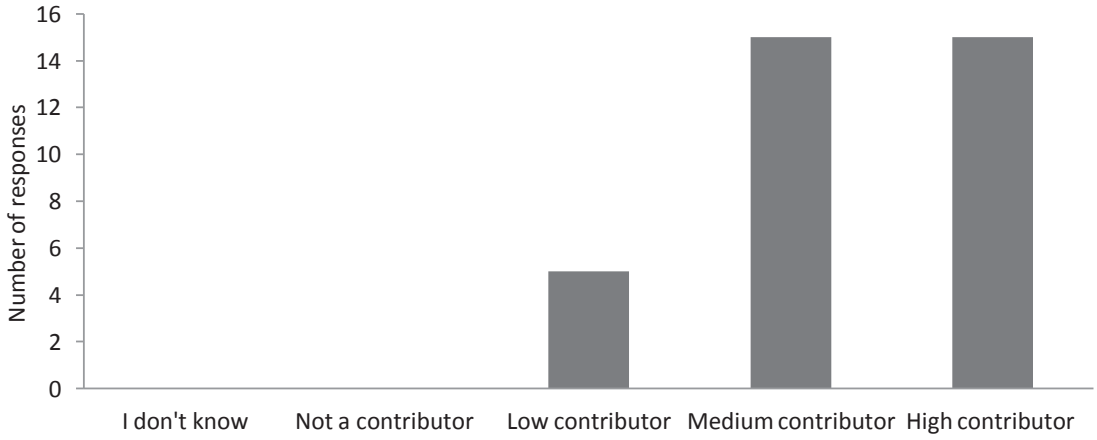


Figure 3.45 The perspectives of New Zealand zoo staff and the extent to which they think that altering social interactions contributes towards the treatment of stereotypic behaviour. The number of valid responses to this question was 35.

Participants primarily thought that altering social interactions was either a medium or a high contributor when treating stereotypic behaviour. There was not a significant difference to this question between zoo staff of different levels of experience, from different institutes, or of different gender.

e. *Medical therapy*

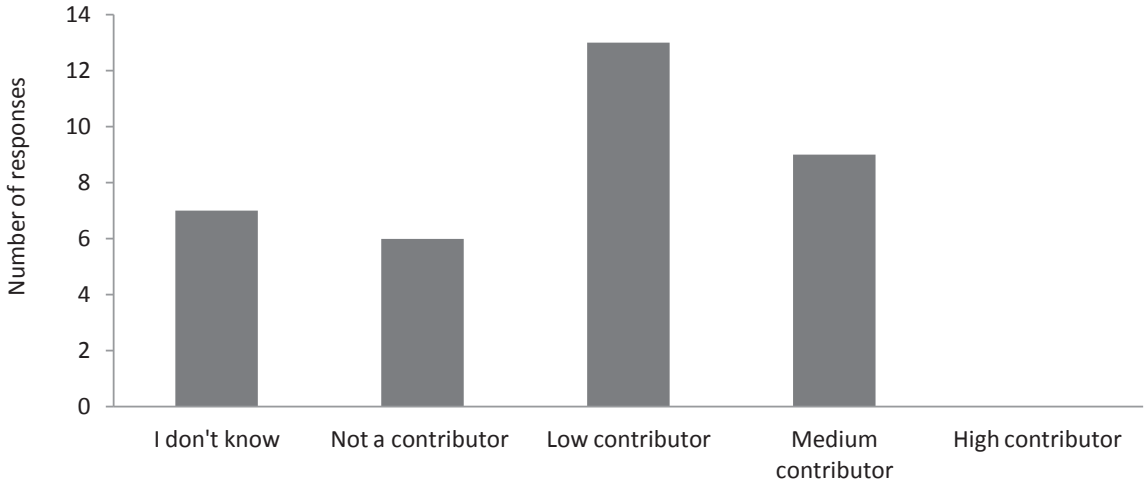


Figure 3.46 The perspectives of New Zealand zoo staff and the extent to which they think that medical therapy contributes towards the treatment of stereotypic behaviour. The number of valid responses to this question was 35.

Participants had mixed views about medical therapy being a treatment option for stereotypic behaviour. Most participants said it was a low contributor with the second highest portion saying it was a medium one. There were no significant differences in the response to this question between zoo staff of different levels of experience, from different institutes, or of different gender.

Question 23. How do you measure the success of your treatment of animals exhibiting stereotypic behaviour?

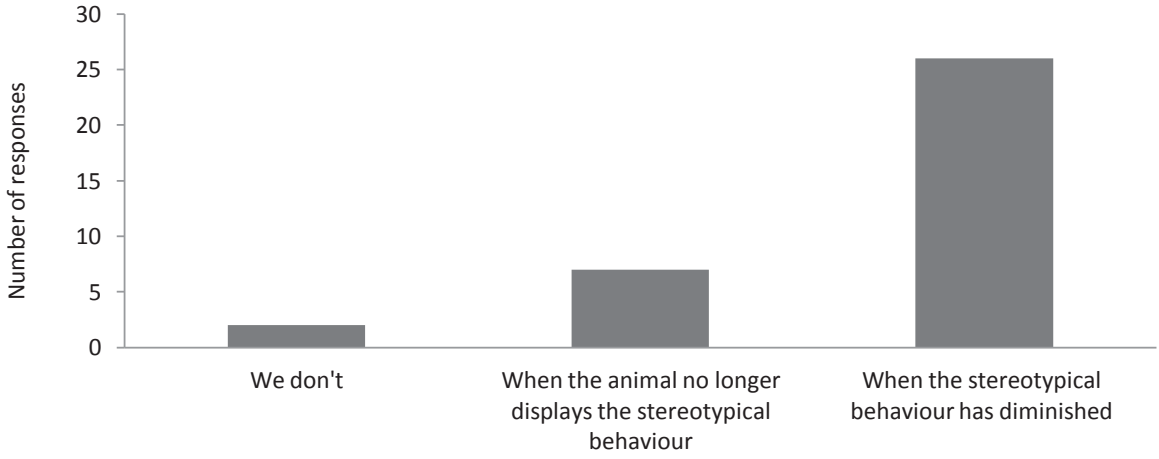


Figure 3.47 The perspectives of New Zealand zoo staff on how they measure the success of their treatment of animals exhibiting stereotypic behaviour. The number of valid responses to this question was 35.

Most participants said that they measure the success of treating animals displaying stereotypic behaviour when the behaviour has diminished. There was no significant difference in the response to this question between zoo staff from different institutes, of different gender, or different levels of experience.

Question 24. Stereotypic behaviour is often defined as "a series of movements of whole body parts of the animal's body which are repeated regularly and which serve no apparent function". Do you agree with this definition?

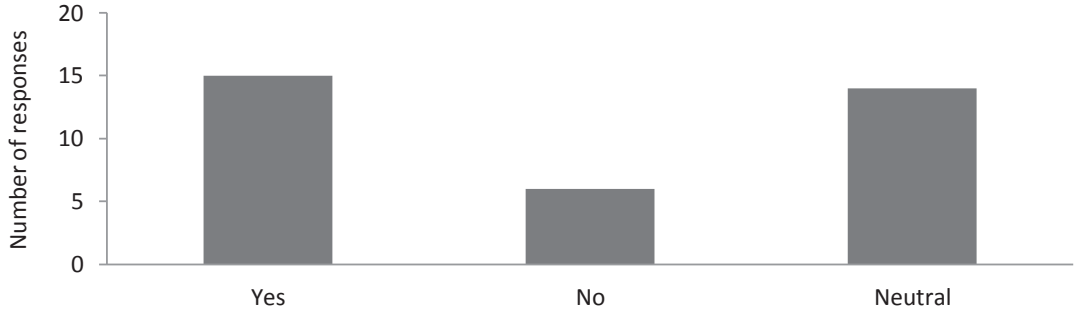


Figure 3.48 The perspectives of New Zealand zoo and whether they agree with the definition of stereotypic behaviour being *"a series of movements of whole body parts of the animal's body which are repeated regularly and which serve no apparent function".* The number of valid responses to this question was 35.

Participants were mostly either neutral or agreed with the definition provided about stereotypic behaviour. Only a small minority said that they did not agree with it. There was a significant difference (χ^2=12, df=4, p=0.014) in the response to this question between keepers from different institutes (Fig. 3.49). There was no significant difference in the response to this question between zoo staff of different genders or of different levels of experience.

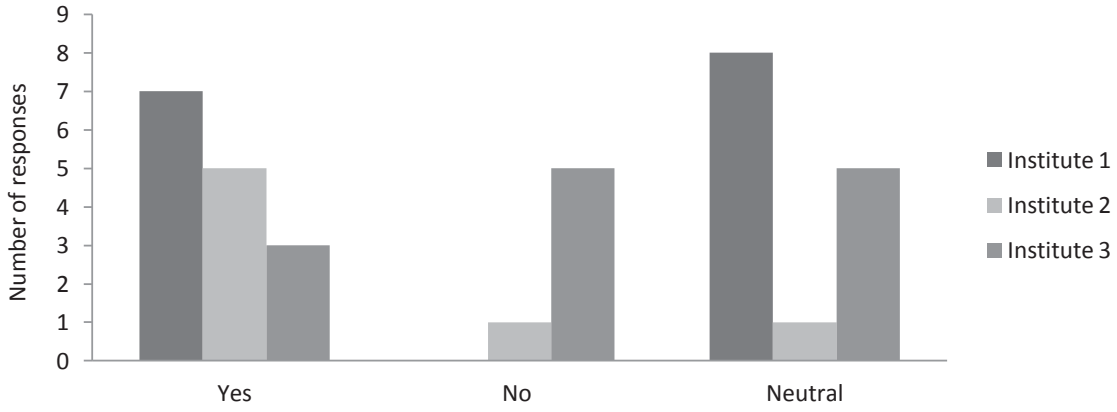


Figure 3.49 The difference between institutes in the perspectives of New Zealand zoo staff and whether they agree with the definition of stereotypic behaviour being *"a series of movements of whole body parts of the animal's body which are repeated regularly and which serve no apparent function".*

Most participants from Institute 2 selected primarily one answer ('yes') making their responses unimodal compared with the participants from Institutes 1 and 2 who had more varied answers.

3.5 Discussion

3.5.1 Questionnaire participants

The questionnaire was targeted at zoo staff who worked at three zoos (Hamilton, Auckland, and Wellington) in New Zealand's North Island. The aim was to collect and evaluate the currently held viewpoints and perspectives of zoo staff regarding stereotypic behaviour. For this reason, and although there may be some variation between participants, the results for staff who shared similar views, for some questions, were combined. Such questions included those about staff beliefs

concerning stereotypic behaviour versus an animal's or a person's perspective (Questions 16, 17, 19, and 20), and whether staff agreed about a proposed definition of stereotypic behaviour (Question 24).

Institute 1 had the highest number of respondents to the questionnaire, out of the three institutes, and mostly females and predominately zoo keepers participated. The age ranges of participants were fairly well represented but the younger age categories (18-25 and 26-35 years old) were most common. There were only small numbers of respondents who held senior roles in the zoo (curators and managerial positions) and few with over 30 years experience. Because the younger age categories were most common, the participants' years of experience mirrored this, with the "1-5 years experience" group having the largest number of respondents. Although participants at Institute 1 were mainly in the 1-5 years' or 6-10 years' experience groups, most had remained at Institute 1, spending most or all of their time in the captive animal industry at which they were currently employed. The implication here is that these participants at Institute 1 should be familiar with their institute and the institute's viewpoints, but would not have been exposed to the workings and viewpoints of other institutes.

When asked which mammals the participants at all three institutes currently provide care for, it was evident that they looked after an array of species of mammals. Monkeys and cats were the most common animals looked after by participants, closely followed by cattle and related species, and great apes. This variety is beneficial because the different animals will have potentially widely varying needs, are likely to display different types of stereotypic behaviours (if any), and would require different environmental enrichments to mitigate any stereotypic behaviours. Participants were asked if any of the species for which they were responsible displayed stereotypic behaviours. Although a large proportion said yes, there was a significant difference between institutes in response to this question. Institute 1's participants were split evenly, with half saying 'yes' and the other half 'no', in response to the question that none of the animals they currently care for display stereotypies.

The cats and great apes were most commonly reported to display stereotypic behaviours. The stereotypies were in the form of locomotion and self mutilation behaviours, respectively. These two categories of mammals (cats followed by great apes) were also reported as being the two most common to display stereotypies that have been seen overall by the participants throughout their careers thus far. Although birds were not the focus of this study, a number of participants reported seeing stereotypies in them, and they were the third-most common group of animals to have displayed a stereotypic behaviour in the participants' careers. Monkeys were the only type of animal that had all four stereotypic behaviour categories (locomotion, self mutilation, oral, repetitive body movements) associated with them.

3.5.2 Breakdown of questions and comparisons by gender, institute, and experience

The initial questions about which species commonly display stereotypies were followed by a number of questions regarding possible causes of stereotypies. The results showed a few significant differences between the answers to some of these questions and between zoo staff from different institutes, of different gender, and of difference levels of experience.

3.5.2.1 Gender

It was hypothesised that there may have been more significant differences between the questions relating to gender because, typically, females are seen to be more nurturing than males through a maternal instinct, a trait which is high in mammals (Kokko and Jennions, 2008). There were three responses that were significant with regard to gender: whether husbandry procedures contributed towards the development of stereotypic behaviour (Question 13i), whether participants thought stereotypic behaviour is undesirable from the public's perspective because it indicates distress and welfare issues (Question 20), and how behavioural enrichment contributes towards the treatment of stereotypies (Question 22c). A large proportion of male participants felt that husbandry procedures are not a contributing factor leading to the development of stereotypic behaviour; a number also indicated that they felt they were a low contributor. Only one participant indicated husbandry procedures were a high contributing factor and one responded with 'don't know'. In

contrast, a large proportion of female participants felt that husbandry procedures were a low contributing factor towards the development of stereotypic behaviour. Some female participants answered that they were not a high contributor, and two didn't know. These contrasting results possibly indicate that females tend to think that husbandry procedures could contribute towards the development of stereotypic behaviour, and thus they are conscious of the importance of such procedures. The male respondents, however, were more inclined to say husbandry procedures were not a contributing factor, possibly because they consider the animals have either been born and bred in captivity, or have lived in captivity for a very long time, and thus should be 'used to'/habituated to the husbandry procedures. When questioned about whether they think that stereotypies are undesirable behaviour from the public's perspective because stereotypies indicate a level of distress and underlying welfare issues, male participants usually agreed. However, female participants held a more varied response and although most also agreed, 'occasionally' and 'always' were high response categories as well. Only one female participant answered with 'never'. The findings from this question (Question 20) hence do not support the hypothesis that females are more nurturing than males regarding the statement that stereotypies are an undesirable behaviour from the public's perspective. The results from Question 13i indicated that male participants are less inclined to think that husbandry procedures could contribute to the development of stereotypies, because animals may have become habituated to them, but the low numbers of male participants mean I cannot conclude that it is because they are less nurturing than female participants. The response of female participants towards Question 22c, and how they rate behavioural enrichment towards the treatment of stereotypies, was high, i.e. they felt that the enrichment contributes towards the treatment of stereotypies. The males as a group were undecided. They felt enrichment was both a medium and high contributor towards the treatment of stereotypies. The responses to this question also indicate that males are just as conscious of stereotypies and the importance of their treatment as females.

3.5.2.2 Institutional differences

Out of the 24 survey questions, some of which were made up of multiple parts, there were seven questions where there were significantly different patterns of responses between the institutes. Responses to Question 8 (Fig. 3.9) showed that participants from Institute 1 were split evenly on whether any of the mammals they currently care for display stereotypic behaviours. This finding is arresting because half of the participants care for multiple species yet none was regarded as displaying stereotypies, but the other half of participants did regard the species as displaying such behaviours. These results suggest that zoo staff have markedly different perceptions regarding stereotypic behaviour in the animals under their care. The remaining questions that generated statistically significant responses related mainly to contrasts between the responses from staff at Institute 2 and those from staff at Institutes 1 and 3. Staff at Institute 2 gave answers that fell into a single or only two categories, whereas staff at Institutes 1 and 3 had more varied answers across more than two categories. This pattern indicates that there may be a degree of institutionalised thought that has helped to structure the mindset of the participants from Institute 2 (not necessarily in a negative way).

The pattern of responses relating to three particular questions (Questions 13j, 21, and 24) are worthy of more detailed discussion. Question 13j was investigating what the zoo staff thought about environmental enrichment and whether the lack of it, in general, contributed towards the development of stereotypic behaviour. Participants at Institute 1 and 3 felt that it was primarily a high contributor but answers were quite varied, whereas staff at Institute 2 felt it to be a medium contributor and this was the main (narrower) response provided. When it came to asking participants whether they think animals displaying stereotypies should be treated (Question 21), participants from Institute 1 and 3 responded with either ‘yes’ or ‘sometimes’ (assuming that ‘sometimes’ was selected depended on the circumstances the stereotypy was displayed). Institute 2 participants, however, firmly believed that if a stereotypy is displayed it should be treated.

In the introduction to the survey, the participants were provided with a definition of stereotypic behaviour, namely *"a series of movements of whole body parts of the animal's body which are repeated regularly and which serve no apparent function"*. The participants were asked if they agreed with the definition or not. As viewpoints have changed over the years, and because stereotypies can be hard to indentify, definitions have also changed but scientists and captive wildlife institutes still struggle with classifying certain behaviours as stereotypic. However, participants from Institute 2 primarily agreed with this definition; participants from Institute 1 either supported it or were undecided. Institute 3's participants were undecided and either did or did not agree or were neutral. The responses of staff at Institute 2 were unimodal, possibly illustrating again a pattern of institutionalised thought or training.

3.5.2.3 Institutionalised thought

Institutionalised thought or organisational culture refers to the development of ideas within a company/institute that are, generally, established by management and which are shaped to be incorporated and shared by staff or employees (Fard et al., 2009, Ahlgren and Tett, 2010). Such development is carried out by management in an attempt to accomplish certain goals or outcomes that are held by the company or institute. Or, according to Schein (1990) "culture (organizational) is widely understood as an instrument to be used by management to shape and control in some way the belief, understandings, and behaviours of individuals, and thus the organisation to reach specified goals". This managerial shaping or control could apply to the staff members at Institute 2 who tended to share the same viewpoint when questioned about stereotypic behaviours, environmental enrichment, and welfare issues associated with holding exotic species in captivity. Institute 2 may have a number of goals and desired outcomes and thus managerial input may have moulded the staff to their belief structures or company outcomes. Institutes 1 and 3 may also have similar or identical desires and outcomes to those of Institute 2, but the staff at Institutes 1 and 3 hold more varied beliefs. An alternative viewpoint is that staff at Institute 2 have been very well trained and have a more uniform understanding of animal husbandry and animal welfare than the staff at Institutes 1 and 3. It is not certain whether the uniform pattern on responses from institute 2 represents a planned

managerial approach to staff education or is simply a by-product of informal staff interaction. Although Institute 2 did have a number of significant results it is also important to note that they also had the lowest number of participants partake in the survey, and thus answers may be less likely to vary. Overall, the results indicate that the education and experience of zoo staff are varied because different attitudes were expressed by participants, primarily from Institutes 1 and 3, throughout the questionnaire, but the education of staff at Institute 2 on these topics may be more focussed.

3.5.3 Limitations of the survey and recommendations for future studies

The biggest problem with the survey was getting good participation rates. From my experience, people often view surveys as "time wasters" and an inconvenience, a view point which was also noted by Ryan and Saward (2004). Some participants started the survey but did not complete it, and in some cases respondents only got as far as the demographics section, or to a few questions from the end. Several of the questions were personal, i.e. how old participants were, or how many years they had been working in the industry, and, although the survey was anonymous, some participants did not disclose this sort of information. There was also the potential, and unavoidable, problem of participants not correctly reading the question or not thinking deeply about their answers. At the end of the survey, there was an option for participants to provide additional comments regarding the survey and to note any misunderstanding they found. Two participants commented that it was difficult to answer the questions "from an animal's perspective" (Questions 15-17), and from a general viewpoint regarding the topic of stereotypic behaviour, because each animal is an individual and thus responses could not be generalised. These comments also highlight the problems implicit in assigning anthropomorphic motives to animal behaviour, which is a particular problem recorded throughout the literature on stereotypic behaviour. It is further acknowledged that animal personality has strong effects on individual behaviour and each animal may react differently from others. However, the questions were framed to derive the attitudes of zoo staff when thinking in general from an animal's viewpoint concerning stereotypic behaviour. Most participants felt that stereotypic behaviour, from an animal's perspective, was caused

by underlying welfare issues. Most participants also felt stereotypic behaviour was undesirable, or held a neutral opinion, and only a few felt it was a desirable behaviour. This level of uncertainty, although not that high, was also seen when participants were provided with the following statement, *"I believe that stereotypic behaviour is a desirable behaviour because it is a good coping mechanism*", and were asked to answer to what extent they agreed with it, again "from an animal's perspective". The majority answered occasionally, but 'never', 'rarely', and 'usually' were also common answers. This range of responses may have been because participants found it difficult to answer the question from an animal's perspective generally, especially if they answered whilst thinking about a certain case of stereotypy they had seen in a specific individual animal.

Another participant commented that he/she was uncertain what the word "treat" was referring to in Question 21 – '*In general, do you treat an animal with stereotypic behaviour if it is being displayed?'* – as it could refer to medical treatment or where the animal was given a treat by being able to interact with a keeper, forage naturally, or perform natural behaviours. This question was formulated in a general sense: I wanted to know if participants would treat stereotypic behaviour by providing whatever an animal needed to alleviate the behaviour.

The term "medical therapy" also prompted clarification when it was provided as an option for the treatment of stereotypic behaviour in Question 22: '*Rate the extent to which you think, in general, the following possible solutions contribute towards the treatment of stereotypic behaviours – medical therapy'.* Medical therapy refers to the provision of drugs and other forms of medication used to alleviate some forms of stereotypic behaviour. There was a significant response to this question by zoo staff with different levels of experience.

Further points that were also made by participants were that animals, such as chimpanzees, can learn behaviours (e.g. hair picking) from older animals that were kept in inadequate conditions in the past, thus making these behaviours very hard to eliminate. Anticipatory pacing prior to feeding in captive felids was also mentioned as being a difficult behaviour to eliminate because, if the felids were not being fed on a

schedule, then simply the arrival and presence of zoo staff could elicit this pacing behaviour.

From my experience, designing surveys is very time consuming and the surveys are often evaluated numerous times during their development to ensure the questions are not only clearly understandable but also serve the investigator's purpose. This preparation is undertaken to enable answers to the questions, desired by the researcher, to be provided in not only the clearest but most objective way. Unnecessary or poorly worded questions are a waste of time for both the researcher and participant. However, there comes a point when evaluation has to stop and for a questionnaire to be distributed to the target audience. As found in this study, however, there were still a number of misunderstandings regarding some of the questions. Although some questions may have been misunderstood by participants, and a number of them did not complete the survey, the survey I feel was generally well designed. However, to improve response rate, I would be inclined to offer incentives to participants (e.g. provision of petrol/supermarket vouchers) in the future. Having more time to construct the survey and promote its importance would also be beneficial. The questionnaire results do provide some very interesting insights and definitely help to gain an understanding about zoo staffs' attitudes to stereotypic behaviour and the effects of enrichment in captive zoo mammals.

3.6 Conclusions

A significant number of New Zealand zoo staff surveyed indicated that they currently care for a number of animals that display stereotypic behaviours. Of the species currently cared for in the three institutes, cats, great apes, and giraffe and okapi, were the most common animals displaying stereotypic behaviours. Stereotypic locomotion behaviours were the most prominent.

Most participants felt that there are multiple underlying causes to the development of stereotypic behaviours, such as the absence of retreat space or the lack of environmental or structural enrichment. The majority of responders also felt essentially neutral in that stereotypic behaviour was neither desirable nor undesirable from an animal's perspective. Occasionally, stereotypic behaviour was seen as

beneficial as ‘a coping mechanism’ but respondents usually inferred that such behaviour indicates that there are underlying causal welfare issues. From a member of the public’s perspective, most participants indicated stereotypic behaviour to be undesirable and most often it was never seen as being a good indicator that the animals were occupied, and that it indicates underlying welfare issues. Most participants from Institute 2 said ‘yes’ to the question that animals displaying stereotypies should be treated whereas staff from Institutes 1 and 3 said either ‘yes’ or ‘sometimes’. Viewpoints were fairly similar when asked about some specific treatment options for stereotypies, and methods such as using environmental or behavioural enrichment as a treatment option were regarded as highly favourable. Other treatment methods, such as ‘ignore it’ (i.e. the stereotypy), were not seen as an option by any participant.

Most participants indicated that they felt stereotypies were indicators of underlying welfare issues and that they should be treated. Nevertheless, the viewpoints of staff differed between institutes. A pattern observed in response to a number of the questions was that participants from one institute (Institute 2) shared very similar or identical viewpoints compared to the more varied responses from the participants from the other two institutes (1 and 3). This pattern indicates that there could be a level of institutionalised thought or organisational culture that has influenced staff at this institute.

Chapter 4

The prevalence of stereotypic behaviours displayed by eight species of captive mammals kept at three New Zealand zoos

"The greatness of a nation and its moral progress can be judged by the way its animals are treated"

Mohandas Gandhi 1869-1948

4.1 Introduction

A well documented problem in holding captive animals is stereotypic behaviour (Mason, 1991, Vickery and Mason, 2005, Hogan and Tribe, 2007). Stereotypic behaviour refers to repetitive behaviours, such as pacing, hair pulling, body rocking, which are thought to develop when living conditions are inadequate (Mason, 1991, Dawkins, 2004, Mason and Latham, 2004). These inadequate living conditions refer to situations resulting in boredom, lack of mental stimuli, stress, unnatural or an un-stimulating environment that lead to frustrated animals displaying stereotypies (Garner et al., 2003, Hogan and Tribe, 2007).

Although inadequate living conditions and underlying welfare issues are thought to be the main causes of stereotypic behaviour, they are not well understood (Vickery and Mason, 2005). This is partly because it is difficult to distinguish other behaviours, such as anticipatory feeding behaviour (AFB), which may be classed as stereotypic, from genuine stereotypic behaviours. AFB occurs when animals pace prior to feeding time in anticipation of being fed. This pacing by zoo animals could be a mimic of natural feeding patterns, so that a carnivore, for example, paces as a way to mimic hunting for food (Carlstead, 1996). To obtain a better understanding of some stereotypies in captivity, and to determine whether or not they are normal behaviours, requires an understanding of wild behaviour. It has been shown that species housed in captivity have a much higher occurrence rate of stereotypic behaviours than their wild counterparts (Mason, 1991, Rees, 2004, Vickery and Mason, 2005, Hogan and Tribe, 2007, Miller et al., 2011).

Developing an understanding of behaviour expressed in captivity by different species, and of the husbandry requirements for each of the species in captivity, is also important. Although numerous species have been kept in captivity for thousands of years (Kisling, 2001), gaps in knowledge remain regarding the behavioural husbandry of many species (Melfi and Hosey, 2011). Different animals also behave differently in captivity because not all species cope well in confinement. For example, polar bears (*Ursus maritimus*) (Bertram, 2004, Mason, 2006) and giraffes (*Giraffa camelopardalis*) are thought to not cope as well as ring-tailed lemurs (*Lemur catta*) in captivity (Mason, 2010). The genetic make-up of the animals, their cognitive abilities, and previous

experiences all contribute to their current behaviour and ability to cope in captivity (Swaisgood, 2007, Hosey et al., 2009). Consequently, behavioural husbandry and the causes of stereotypies in individual animals and numerous species worldwide are key areas for research. Furthermore, at least 10,000 of the ca. 600,000 captive wild mammals and birds kept worldwide display stereotypic behaviours (Mason et al., 2007, Swaisgood, 2007). It is important to recognise that stereotypies develop over time and that they do not just appear 'overnight' (Mason, 1993). Because it is likely animals will always be kept in captivity, optimising the captive conditions of the animals, and assuring their welfare is not compromised, are important tasks faced by most captive wildlife institutes. Hence, finding solutions for these stereotypic behaviours by investigating the causes and how to alleviate them is essential for the long-term welfare of captive animals.

One of the best ways to understand the different behaviours of captive animals, and what possible causes of stereotypies could be, is to observe the daily activities and behaviours displayed by the animals in a controlled manner. These observations should be carried out over a number of days and, at periodic intervals throughout the day to obtain an understanding of an animal's behavioural activities. Observing animals in their normal captive environment is also important because it reduces any unnecessary stress that would arise by moving them to a more easily assessable viewing area away from their normal conditions. Any stereotypic behaviours (if present) are more likely to be manifested over a number of days of observation.

Eight species of mammals were selected to be observed for the presence and frequency of stereotypic behaviour across three New Zealand captive wildlife institutes. I assessed a mixture of species that were either social or solitary and are either herbivores or carnivores/omnivores. I aimed to look at these factors and see how they might contribute to the presence and frequency of stereotypic behaviours.

4.2 Methodology

4.2.1 Study area and subjects

Three captive wildlife institutes, located throughout New Zealand's North Island, were used in this study. They are (1) Hamilton Zoo, (2) Auckland Zoo, and the (3) Wellington Zoo. However, institutes will not be identified in this study. Institutes 1, 2, and 3 do not always refer to the same institute for results relating to the eight species. These institutes were selected because they are the three largest zoos in New Zealand, and thus care for a larger number and a more diverse array of species than smaller zoos or game parks.

Eight species were selected to be observed for stereotypic behaviours at each of the three institutes. They were: (1) Sumatran tiger (*Panthera tigris sumatrae*), (2) giraffe (*Giraffa camelopardalis*), (3) southern white rhinoceros (*Ceratotherium simum simum*), (4) Asian small-clawed otter (*Aonyx cinerea*), (5) chimpanzee (*Pan troglodytes)* (6) plains or Grant's zebra (*Equus burchelli bohmi*) (7) meerkat (*Suricata suricatta*), and (8) African wild dog (*Lycaon pictus*). These species were selected because they are housed in at least two, or more, of the three captive wildlife institutes. They were also selected to obtain a mixture of solitary versus social species, as well as herbivores versus carnivores/omnivores, and species that have previously been recorded to express stereotypic behaviours (Table 4.1). No nocturnal species were selected because of the viewing restrictions.

Table 4.1 Indicating if the eight species observed are either social or solitary animals, what their dietary type is, and whether they have known stereotypic behaviours

Species	Social or solitary	Dietary type	Known stereotypic behaviour
Sumatran tiger	Solitary	Carnivore	Yes[1]
Giraffe	Social	Herbivore	Yes[1,2,3]
Southern white rhinoceros	Both – males solitary and females can form small herds with their offspring	Herbivore	Yes[2,9]
Asian small-clawed otter	Social – small groups	Omnivore	Yes[1,4,6]
Chimpanzee	Social	Omnivore	Yes[3,4,5,7,8]
Zebra	Social	Herbivore	Yes[1,2,3]
Meerkat	Social	Omnivore	No
African wild dog	Social	Carnivore	Yes[1]

[1] Pacing/pattern swimming, [2]Oral SB's (e.g. licking inedible objects, crib biting), [3]Head shaking/tossing, [4]Hair picking, [5]Coprophagy, [6]Begging, [7]Self mutilation (biting), [8]Body rocking, [9]Excessive horn rubbing on objects

4.2.2 Observations

Each of the eight study species was observed, at each institute, for a period of 40 minutes every day for four days. In order to match observation times at each of the three institutes, the eight species were randomly assigned a number and four different observational times (Table 4.2). These times remained consistent at each institute. Observing the same species at the same time over different days enabled me to obtain comparable data. No observations were carried out before 10 am to reduce the amount of staff and animal interactions that occur because of the daily husbandry duties. Some flexibility had to be employed, however, because there are afternoon feeding times and other human-animal interactions, such as 'face-to-face' (behind-the-scenes public interaction) occurring on a daily basis. No observations were made between the times of 1210–1300 hr because of the increased human-animal encounters occurring during this hour. Observations finished at 1640 hr each day because some of the animals are shut indoors at night and these closing routines are generally carried out from 1630 hr onwards prior to the institutes' closing time.

Table 4.2 Time and species observation allocation time.

Time	Day 1	Day 2	Day 3	Day 4
10 – 10.40 am	1 meerkat	4 otter	8 tiger	6 chimpanzee
10.45 – 11.25 am	2 wild dog	5 giraffe	7 rhinoceros	3 zebra
11.30 - 12.10 pm	3 zebra	7 rhinoceros	6 chimpanzee	1 meerkat
←		Lunch Break		→
1 – 1.40 pm	4 otter	8 tiger	5 giraffe	2 wild dog
1.45 – 2.25 pm	5 giraffe	1 meerkat	4 otter	8 tiger
2.30 – 3.10 pm	6 chimpanzee	2 wild dog	3 zebra	7 rhinoceros
3.15 – 3.55 pm	7 rhinoceros	3 zebra	2 wild dog	4 otter
4.00 – 4.40 pm	8 tiger	6 chimpanzee	1 meerkat	5 giraffe

Observation times were selected for each species to avoid as much human-animal interaction as possible, and hence certain species were not observed when members of the public were “getting up close” and feeding the animals at officially endorsed “encounters”. The animals were observed from the outside of their enclosures and their behaviours and activities were recorded as they occurred. The behaviour(s) being displayed, the number of individuals displaying them, and the duration (seconds or minutes where appropriate) were also continuously recorded throughout each entire observation time. By recording the duration that each behaviour was displayed, the type of behaviour, and the number of individuals displaying it, I was able to develop a breakdown of the number of minutes each species spent displaying specified behaviours. Because each species was treated as a whole group, then if the majority of the group was displaying one particular behaviour, e.g. meerkats digging and scratching versus one individual on ‘look out’, the number of seconds (making up minutes, the main time units used for duration) was assigned predominantly in favour of the animals digging and scratching, with a lesser value being giving to the one individual on ‘look out’ duty.

However, prior to any observations being carried out, general behaviour tables were formed as a base-line of commonly-seen behaviours (including known stereotypic behaviours) to enable comparison of the expected behaviours relating to each species and the actual behaviours. As the behaviours were displayed, I assigned them into the categories I had compiled prior to making the observations, and I reassigned some behaviours as needed (Tables 4.3-4.10). These tables were developed to help classify the behaviours and to separate behaviours if more than one behaviour occurred (e.g. an animal walking and eating simultaneously). In this situation, the circumstances dictated the category I used. For example, if a giraffe was standing still without masticating, the behaviour was recorded as 'standing still'; but if the giraffe was also masticating, I recorded it as "eating". When it came to assigning behaviours as being stereotypic, the literature of known stereotypic behaviours was used as a guide but I also recorded behaviours that I observed to be repetitive for noticeable durations of time. Any other behaviours that were unexpected, or which were unusual, or other significant information such as zoo personnel arriving, were also noted. These other behaviours were assigned into categories relevant to their nature in the species-specific behavioural tables.

4.3 Data analysis

For each of the eight species, a description of the behavioural categories, how each category is manifested, and pictures illustrating the behaviours, are reported below (Tables 4.3–4.10, Figs 4.1a–4.8e). From the observations, the proportion of time the animals were observed performing each behaviour was manually calculated and averaged for each relevant species; the time the animals spent displaying stereotypic behaviours during each forty-minute observation period over the four days was also assessed. The behaviours as assigned were recorded in minutes using the method outlined in section 4.2. The statistics programme SPSS version 20 (IBM) was used to conduct a one-way ANOVA. This one-way ANOVA was used to compare the time each species spent displaying behaviours over the forty-minute observation periods for four days. Any significant differences between species at different institutes and the behaviour they displayed are reported.

Table 4.3 Description of the behaviours displayed by the meerkats at all three captive wildlife institutes – all four days of observations combined

Look out duty (Fig. 4.1a)	Limited movement and either sitting or standing on hind limbs whist looking periodically in all directions and staying in one spot/vantage point.
Locomotion (Fig. 4.1b)	Running, walking, or climbing around enclosure without digging, stopping, or any interaction with another individual.
Digging/scratching (Fig. 4.1c)	Digging or scratching in substrate (comprises of soil, bark, gravel, sand) or at logs, walking, sniffing and stopping to dig. Freshly pulled grass was given to meerkats to dig through.
Social play (Fig. 4.1d)	Meerkats run together or chase each other, play fighting or biting, wrestling (rough and tumble) with each other, huddling.
Mating (Fig. 4.1e)	Males mounting female (assuming it is the males that are mounting the females)
Attentive to indoor sleeping area (Fig. 4.1f)	Meerkats go inside or stick their heads into or out of tunnels that lead to sleeping area.
Human interaction (Fig. 4.1g)	Running around or climbing on zoo personnel in enclosure, running up to enclosure fences when keeper goes past. Standing up and acknowledging members of the public when looking into or going past enclosure. Looking at members of the public.
Resting (includes sunbathing) (Fig. 4.1h)	Sitting or lying outstretched (on back and front) on ground, leaning against objects in or on walls of enclosure, sunbathing. There are heat lamps that can be seen in part of the animals' indoor area – some animals sat under them.
Eating (Fig. 4.1i)	Eating, chewing insects they have found or food (day-old chicks, vegetables –e.g. pumpkin, carrot) that has been given to them by zoo staff.
Social interaction (Fig. 4.1j)	Approaches another individual(s) and sniffs, greets/acknowledge, approaches them without playing or huddling together, grooming each other.
Solitary behaviours (Fig. 4.1k)	Grooming, urinating, defecating, scratching
Other – harassing other species (Fig. 4.1l)	The meerkats at Institute 3 share their enclosure with African crested porcupines which they harassed – stole food from.
Other	Meerkats were provided on Day 2 of observations with enrichment toys (plastic containers and logs with holes in filled will treats) animals periodically played with and scratched at throughout observation period – was classed as a solitary behaviour.

Figure 4.1a Meerkat on ‘Look out’ duty

Figure 4.1b Meerkat running – locomotion

Figure 4.1c Meerkat digging a hole

Figure 4.1d Two meerkats play fighting

Figure 4.1e Two meerkats mating

Figure 4.1f Meerkat sticking head out of tunnel to indoor area

Figure 4.1g Meerkats interacting with a zoo staff member

Figure 4.1h Meerkat sunbathing

Figure 4.1i Young meerkat eating

Figure 4.1j Two meerkats grooming each other

Figure 4.1k Meerkat grooming itself

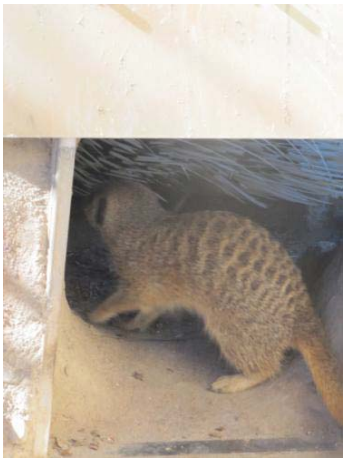


Figure 4.1l Meerkat harassing porcupine

Table 4.4 Description of the behaviours displayed by the African wild dogs at two captive wildlife institutes - all four days of observations combined

Look out – standing and staring (Fig. 4.2a)	Standing and staring and looking in a particular direction when there is no sign of any zoo staff.
Human interaction (Fig. 4.2b)	Following (alertness) zoo staff when they go past enclosure, looking alert and in direction of zoo staff. Running to fence line where zoo staff are.
Resting (includes sleeping) (Fig. 4.2c)	Lying down anywhere (excluding designated sleeping areas i.e. dens or huts) in grass with either head up or sleeping.
Locomotion (excludes pacing) (Fig. 4.2d)	Walking or running to other areas of enclosure as a pack without sniffing, or pacing – no set pattern of movement.
Solitary behaviours (Fig. 4.2e)	Grooming, walking about sniffing, defecating, urinating.
Social play (Fig. 4.2f)	Dogs chasing, jumping up at each other, play fighting.
Social interaction (Fig. 4.2g)	Greeting, grooming, nuzzling each other.
Eating (Fig. 4.2h)	Dogs eating food that has been given to them, chewing on bones.
Attentive to sleeping area/dens (Fig. 4.2i)	Walking/running down to or waiting outside tunnels to dens or sleeping in huts.
Pacing (Figs 4.2j & 4.2k)	Institute 1 – Pacing back fence line of their enclosure as a pack and down the left hand side. If stand and stare they look straight out towards public or towards doors that lead to their night quarters. Institute 2 - Pacing the front area of their enclosure mostly as a pack, odd occasion just a number of individuals will pace the area whilst the other stood still and stared in to front left hand corner.

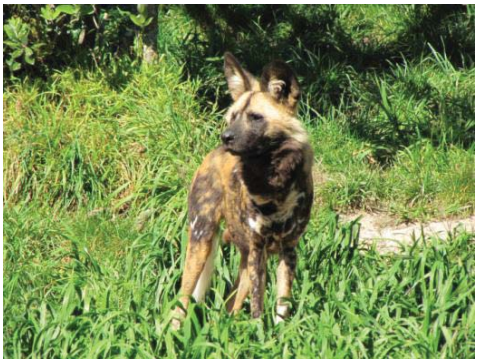


Figure 4.2a African wild dog – look out

Figure 4.2b Two African wild dogs looking at zoo staff

Figure 4.2c African wild dogs sleeping in sun

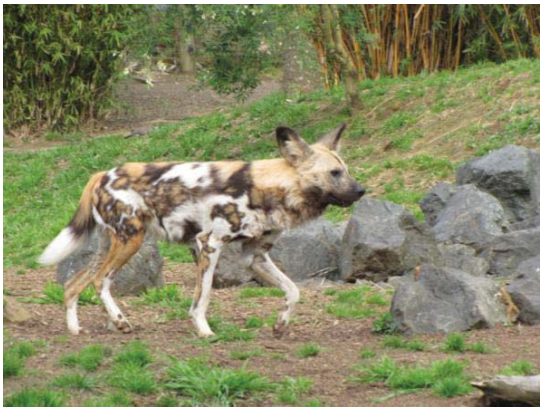


Figure 4.2d African wild dog walking

Figure 4.2e African wild dog scratching

Figure 4.2f Two dogs play fighting

Figure 4.2g Two dogs greeting each other

Figure 4.2h African wild dog chewing on a bone

Figure 4.2i African wild dog looking down tunnel to den

Figure 4.2j African wild dogs pacing the front fence of their enclosure

Figure 4.2k African wild dogs pacing back fence of their enclosure

Table 4.5 Description of the behaviours displayed by the zebras at two captive wildlife institutes - all four days of observations combined

Look out/standing still (Fig. 4.3a)	Animals standing and staring without masticating or looking a people/zoo staff.
Locomotion (Fig. 4.3b)	Walking or running without sniffing, grazing
Eating (Fig. 4.3c)	Grazing, masticating, eating hay or grass. Not much grass in enclosure so animals could only graze if fed hay or it chews on little grass that is left in enclosure. Drinking at water stations.
Social interaction (Fig. 4.3d)	Approaching another individual, nuzzling
Solitary behaviours (Fig. 4.3e)	Rolling on back (dust bathing/itching)
Human interaction (Fig. 4.3f)	Watching zoo staff, walking over to where staff is or following keeper when placing food in enclosure.
Resting (Fig. 4.3g)	Lying down without grazing or dust bathing/itching.
Aggression to other species	Running at/chasing or biting other species kept in same enclosure – springbok.
Stereotypic behaviour (Fig. 4.3h)	Licking fence posts, some head tossed and coprophagy occurred - zebra ate their own faeces not any of the other species kept in same enclosure.

Figure 4.3a Zebra standing

Figure 4.3b Zebra and calf walking

Figure 4.3c Zebra grazing

Figure 4.3d Social interactions

Figure 4.3e Zebra rolling around on back

Figure 4.3f Zebra following zoo staff when putting out food

Figure 4.3g Zebra resting

Figure 4.3h Coprophagy by zebra

Table 4.6 Description of the behaviours displayed by the otters at two captive wildlife institutes - all four days of observations combined

Attentive to indoor sleeping area (Fig. 4.4a)	Otters going into or looking in sleeping dens, hanging around back gate to another off-display sleeping area.
Solitary behaviours (Fig. 4.4b)	Grooming, scratching, collecting nest building material (bamboo shoots), playing in water – not swimming but flips, turns, dives, sniffing.
Human interaction (Fig. 4.4c)	Following or running up to fence when a member of the public or zoo staff approaches – not begging behaviour.
Locomotion (Fig. 4.4d)	Running or walking around enclosure but not following or running at zoo staff or members of the public. Swimming.
Social play (Fig. 4.4e)	Chasing, following each other, play fighting.
Social interaction (excludes play) (Fig. 4.4f)	Grooming, greeting, nuzzling.
Resting (includes sunbathing and sleeping) (Fig. 4.4g)	Sleeping/lying down in enclosure but not in dens or sleeping areas, sunbathing.
Eating (Fig. 4.4h)	Eating, chewing, masticating food that is thrown or left in enclosure.
Stereotypic behaviour – circling (Fig. 4.4i)	One otter at one institute periodically turns in a 360 degree circle when either running or swimming.
Stereotypic behaviour – begging (Fig. 4.4j)	At Institute 2 on Days 1 and 4, prior to feeding (~1 hr) otters will run towards any member of the public or zoo staff that approaches or looks over enclosure fence, they squeak, stand on their hind quarters and perform begging type behaviours until keepers arrived to feed them.

Figure 4.4a Otters in den

Figure 4.4b Otter scratching

Figure 4.4c Otter swimming

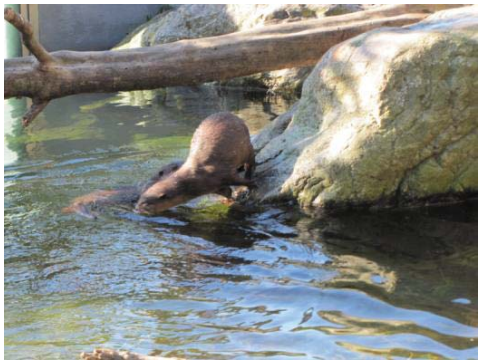


Figure 4.4d Otters playing in water

Figure 4.4e Otters grooming each other

Figure 4.4f Otter resting in sun

Figure 4.4g Otter eating

Figure 4.4h Otter circling whist swimming

Figure 4.4i Otters squeaking and begging at fence

Table 4.7 Description of the behaviours displayed by the giraffes at three captive wildlife institutes - all four days of observations combined

Attentive to sleeping area (Fig. 4.5a)	Waiting outside gate to sleeping area
Eating (Fig. 4.5b)	Eating, masticating food that is in their enclosure or has been fed to them. Drinking
Solitary behaviour (Fig. 4.5c)	Grooming, sniffing, scratching, flehmen
Human interaction (Fig. 4.5d)	Eye-to-eye encounters – i.e. public feeding giraffes, keepers feeding. Walking over to a staff member or member of the public
Locomotion (Fig. 4.5e)	Walking around enclosure without masticating
Standing still (Fig. 4.5f)	Standing and looking around without masticating, licking, grooming etc
Social aggression (Fig. 4.5g)	Biting, head swinging/hitting another giraffe with horns
Social interaction (Fig. 4.5h)	Nuzzling, greeting each other, drinking/licking another giraffe's urine – no fighting
Resting (Fig. 4.5i)	Sitting down
Off display	Giraffes are being kept off display and cannot be seen
Stereotypic behaviour – oral (Fig. 4.5j)	Licking, chewing, biting inedible objects such as fence post, wall, bars of gates etc
Stereotypic behaviour – pacing (Fig. 4.5k)	Pacing in front of the sleeping area – backwards and forwards along same path.

Figure 4.5a Giraffes attentive to their sleeping area

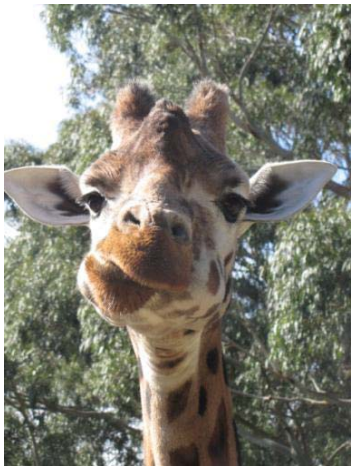


Figure 4.5b Giraffe mid mastication

Figure 4.5c Giraffe scratching side of head on fence

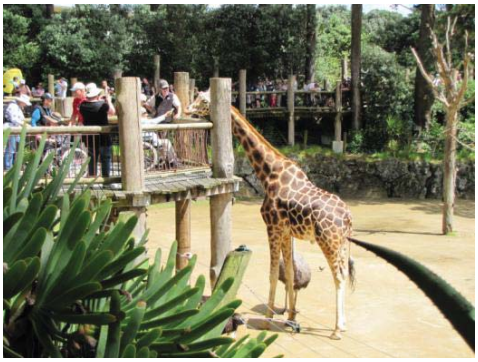


Figure 4.5d Giraffe being fed by members of the public

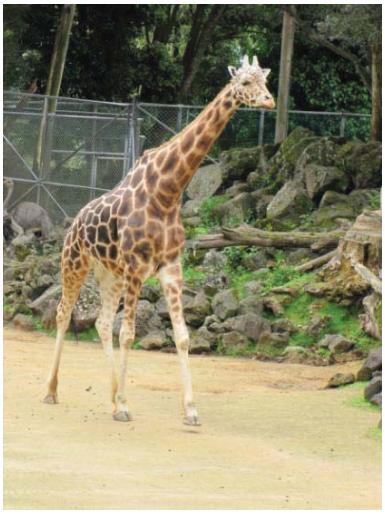


Figure 4.5e Giraffe walking

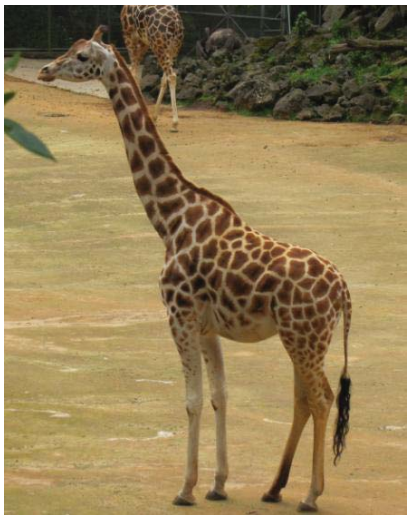


Figure 4.5f Giraffe standing still

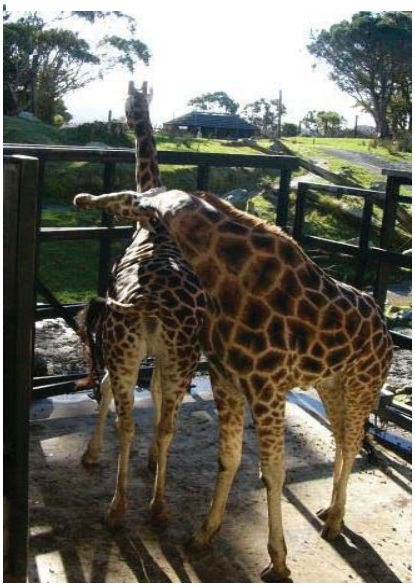


Figure 4.5g Male giraffe hitting female giraffe with horns

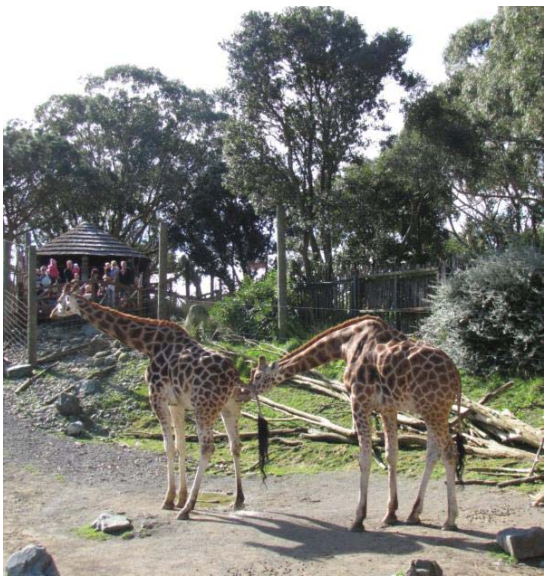


Figure 4.5h Giraffe licking urine of other giraffe

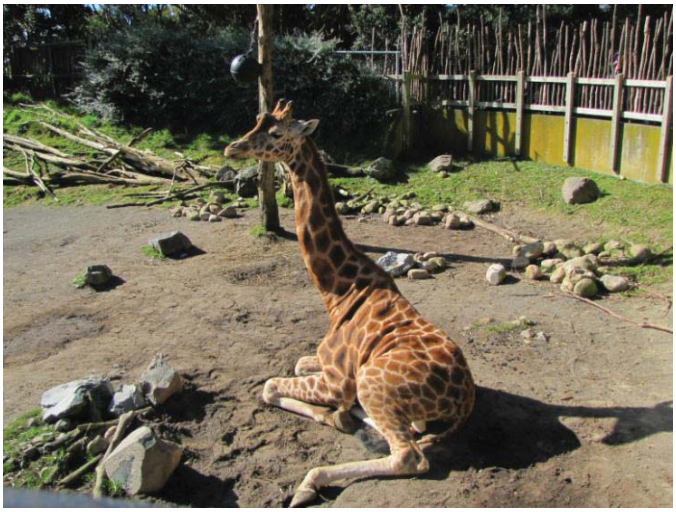


Figure 4.5i Giraffe resting

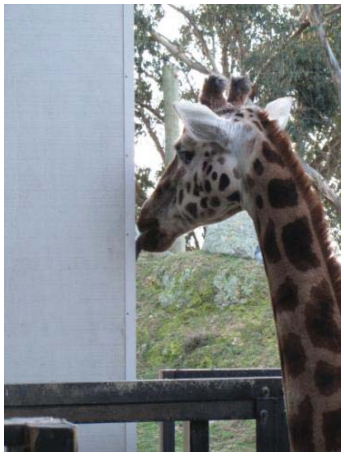


Figure 4.5j Giraffe licking wall

Figure 4.5k Giraffes all pacing in a loop around sleeping quarters prior to feeding

Table 4.8 Description of the behaviours displayed by the chimpanzees at three captive wildlife institutes – all four days of observations combined

Attentive to indoor area	Sitting by door that leads to night quarters. Looking through windows to indoor area.
Locomotion (Fig. 4.6a)	Walking or running without stopping and picking grass/eating, swinging on ropes
Resting (Fig. 4.6b)	Sleeping in enclosure and not in sleeping area, lying down, sitting quietly
Eating (Fig. 4.6c)	Eating, masticating food in enclosure or given to them by zoo staff, drinking
Human interaction (Fig. 4.6d)	Being fed if there is a talk, watching zoo staff as they go past.
Solitary behaviour (Fig. 4.6e)	Grooming, males playing with their genitals, youngest playing by themselves – 'roly poly', building nests
Social play (Fig. 4.6f)	Chasing each other, baby playing with mum
Social aggression (Fig. 4.6g)	Biting, hitting, chasing, hair pulling, screeching aggressively, shaking bars, kicking or hitting doors/walls
Social interaction (excludes play) (Fig. 4.6h)	Grooming, cuddling, greeting, moving to different areas of the enclosure as a group, sniffing each other's bottoms
Watching T.V. –One institute only (Fig. 4.6i)	Solitary kept chimp at one institute only.
Stereotypic behaviour – coprophagy (Fig. 4.6j)	Eating their own faeces
Stereotypic behaviour – head shake	Shaking head from side to side either continuously or every couple of seconds
Stereotypic behaviour – Hair pick	Picking at their own hair and pulling it out

Figure. 4.6a Chimp swinging on ropes

Figure 4.6b chimp resting

Figure 4.6c Chimp eating

Figure 4.6d Chimps waiting to catch food from keeper

Figure 4.6e Chimp building a nest

Figure 4.6f Young chimps playing

Figure 4.6g Chimp with wound (circled) – aggression.

Figure 4.6h Social grooming

Figure 4.6i Solitary housed chimp watching TV

Figure 4.6j Chimp eating faeces off wall

Table 4.9 Description of the behaviours displayed by the rhinoceroses at two captive wildlife institutes - all four days of observations combined

Standing still (Fig. 4.7a)	Standing, no chewing – looking at nothing in particular
Resting (Fig. 4.7b)	Lying down in enclosure with head looking up or down
Eating (Fig. 4.7c)	Eating or masticating food given to them, drinking
Solitary behaviour (Fig. 4.7d)	Sniffing, defecating, urinating
Human interaction (Fig. 4.7e)	Looking at keeper or people
Social interaction (Fig. 4.7f)	Greeting each other, nuzzling
Locomotion (Fig. 4.7g)	Walking around enclosure
Attentive to indoor area (Fig. 4.7h)	One institute only – waiting by gate to go to night quarters
Social aggression	Charging at another individual, fighting with horns

Figure 4.7a Rhino standing still

Figure 4.7b Rhinos resting

Figure 4.7c Rhinos eating

Figure 4.7d Rhino sniffing faeces

Figure 4.7e Rhinos following keeper on other side of fence

Figure 4.7f Two rhinos socially interacting

Figure 4.7g Rhino walking

Figure 4.7h Attentive to gate to indoor area

Table 4.10 Description of the behaviours displayed by the tigers at three captive wildlife institutes - all four days of observations combined

Locomotion (Fig. 4.8a)	Walking around enclosure – no set route or repetitiveness, no sniffing, scenting, flehmen
Solitary behaviour (Fig. 4.8b)	Sniffing, scenting, grooming, flehmen
Eating (Fig. 4.8c)	Eating food, drinking
Resting (Fig. 4.8d)	Lying down with head up or down in enclosure
Attentive to indoor area	Waiting outside door to night quarters
Social interaction	Nuzzling, greeting each other, grooming
Off display	Animals are being kept off display or cannot be seen
Human interaction	Watching or following a member of the public or zoo staff– tiger talks (staff informing public about tigers)
Stereotypic behaviour – pacing (Fig. 4.8e)	Pacing a set route periodically and repetitively backwards and forwards.

Figure 4.8a Tiger walking

Figure 4.8b Tiger flehmen

Figure 4.8c Tiger drinking

Figure 4.8d Tiger sleeping

Figure 4.8e Tiger pacing fence

4.4 Results

From carrying out observations, the quantitative data were analysed and graphs were constructed to illustrate the number of minutes each of the eight species spent displaying different behaviours at the respective institutes. Comparison between each of the institutes, species and the behaviours they displayed are graphically provided below along with the proportion of time some species spent displaying stereotypic behaviours (Figs. 4.9-4.22). Any significant differences between behaviours displayed by each species at different institutes were also analysed and provided below.

Meerkats

There were no stereotypic behaviours displayed by any mob of meerkats or any significant differences between the frequency of behaviours displayed at different institutes (Fig. 4.9)

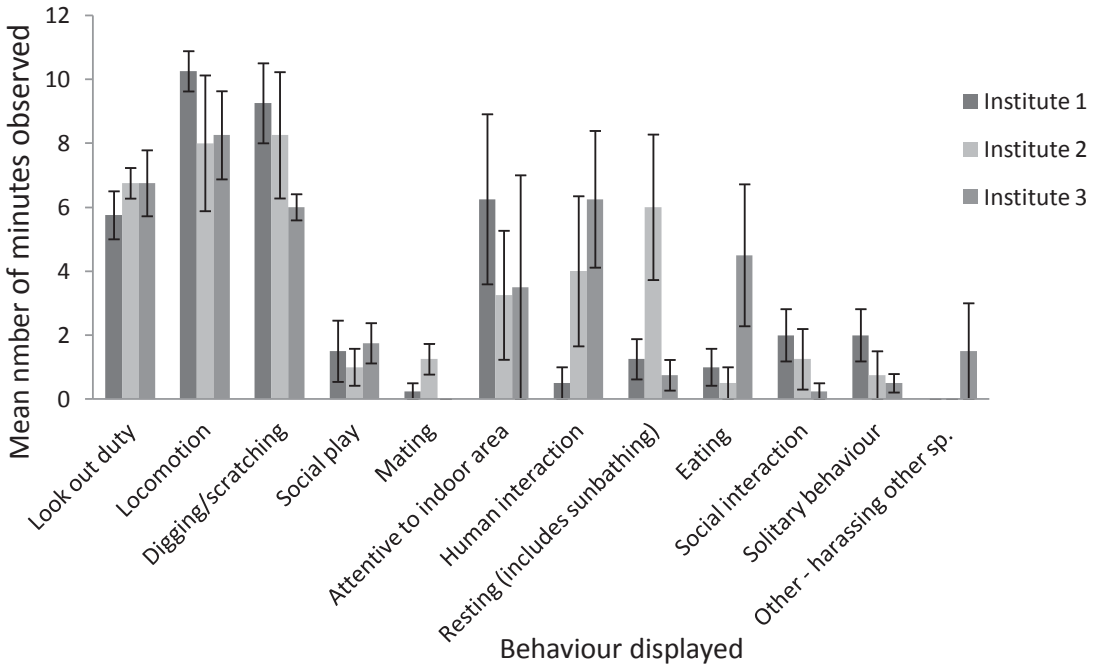


Figure 4.9 The mean number of minutes the meerkats at three captive wildlife institutes spent displaying behaviours. Mean time for all four observation days for each institute. The error bars represent one standard error.

African wild dog

There were no significant differences between the frequencies of behaviours displayed by packs of African wild dogs at two different institutes (Fig. 4.10).

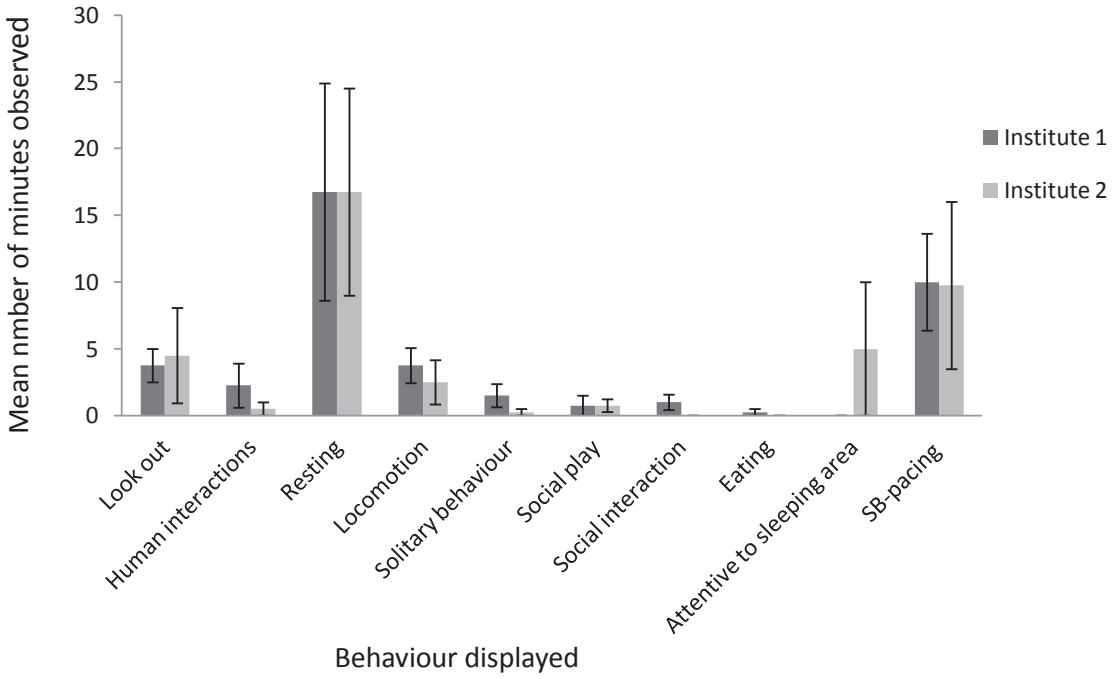


Figure 4.10 The mean number of minutes the African wild dogs at two captive wildlife institutes spent displaying different behaviours. Mean time for all four observation days for each institute combined. Error bars represent one standard error.

Pacing was displayed 25% of the time observed and was the only stereotypic behaviour displayed by the AWDs at both institutes. There was marked daily variation in the frequency of pacing observed (Fig. 4.11), with AWDs pacing more on feed days than starve days (Appendix 2.1).

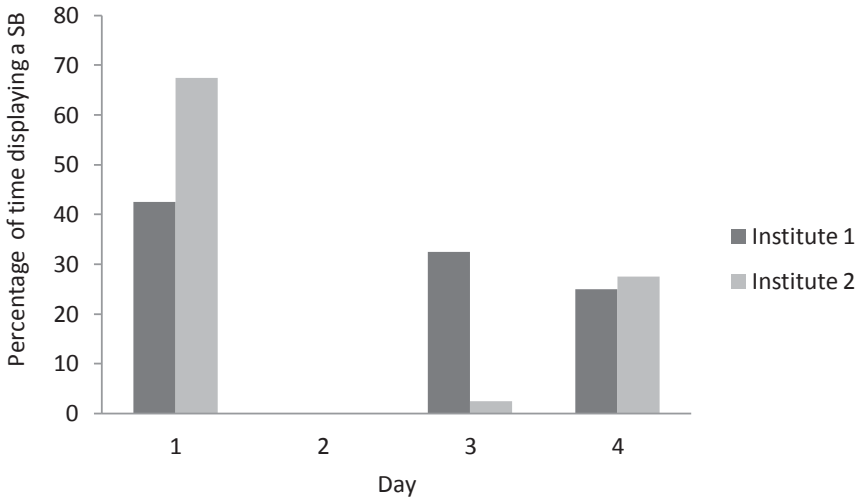


Figure 4.11 The percentage of time the African wild dogs spent displaying stereotypic behaviours at two captive wildlife institutes. Days 1 and 4 were 'starve days' at institute 1 and Days 2 and 3 were' starve days' at Institute 2.

Zebra

There was a significant difference in the frequency of "look out" ($F_{1,6}$ =20.5, P=0.004), "locomotion" ($F_{1,6}$ =24.8, P=0.003), and eating ($F_{1,6}$ =43.6, P=0.001) behaviours displayed between the herds of zebras at the two institutes (Fig. 4.12).

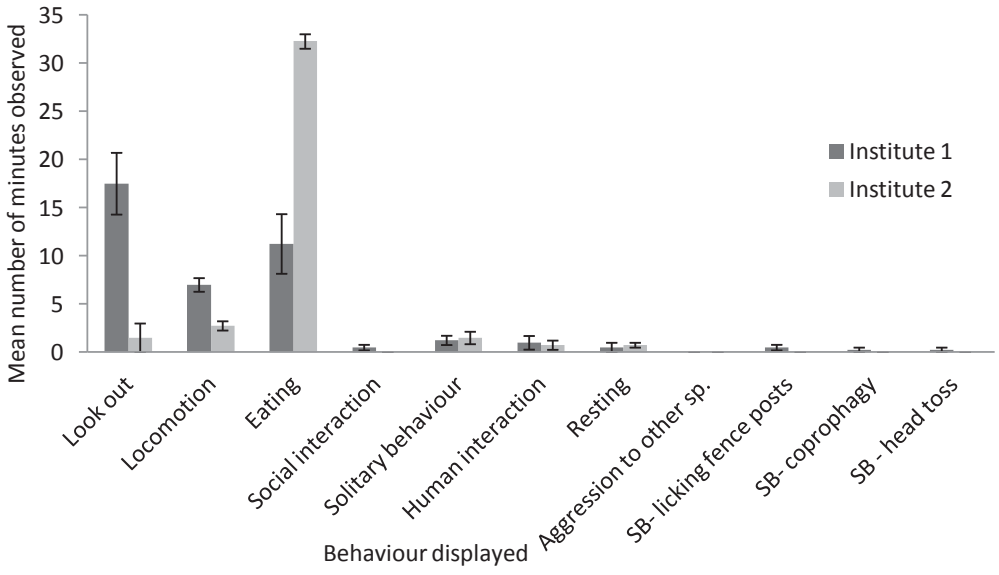


Figure 4.12 The mean number of minutes the zebras at two captive wildlife institutes spent displaying different behaviours. Mean time for all four observation days for each institute combined. Error bars represent one standard error.

Only Institute 1's zebras displayed stereotypic behaviours, which occurred 2.5% of the time observed, and manifested as licking fence posts, head tossing, and coprophagy (Appendix 2.2). Again there were differences in the daily frequency of stereotypic behaviours observed (Fig. 4.13).

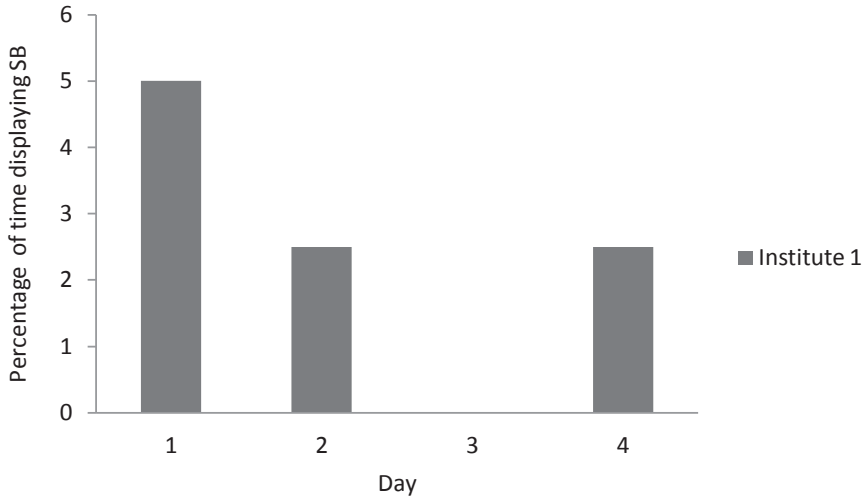


Figure 4.13 The percentage of time the zebras spent displaying stereotypic behaviours at one captive wildlife institute.

Otters

The was a significant difference in the frequency of "circling" ($F_{1,6}$ =6.82, P=0.04) behaviour between these two institute's otters (Appendix 2.3). Although 'circling' was only seen at Institute 1 and was only performed by one individual and 'begging' at Institute 2, only 'circling' was significant (Fig. 4.14).

Figure 4.14 The mean number of minutes the otters at two captive wildlife institutes spent displaying different behaviours. Mean time for all four observation days for each institute combined. Error bars represent one standard error.

The stereotypic behaviours observed in the otters included circling and begging. Circling was displayed for 3% of total time observed at Institute 1 and begging was displayed for 20% of total time observed at Institute 2 (Fig. 4.15).

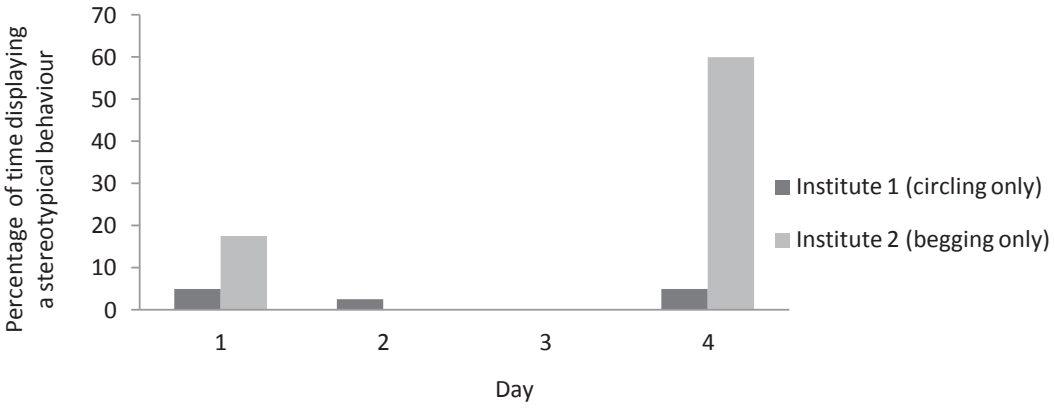


Figure 4.15 The percentage of time the otters spent displaying stereotypic behaviours at two captive wildlife institutes.

Giraffes

Stereotypic behaviours were displayed at all three institutes but there were no significant differences between the frequencies of stereotypic or other behaviours displayed at the different institutes (Fig. 4.16).

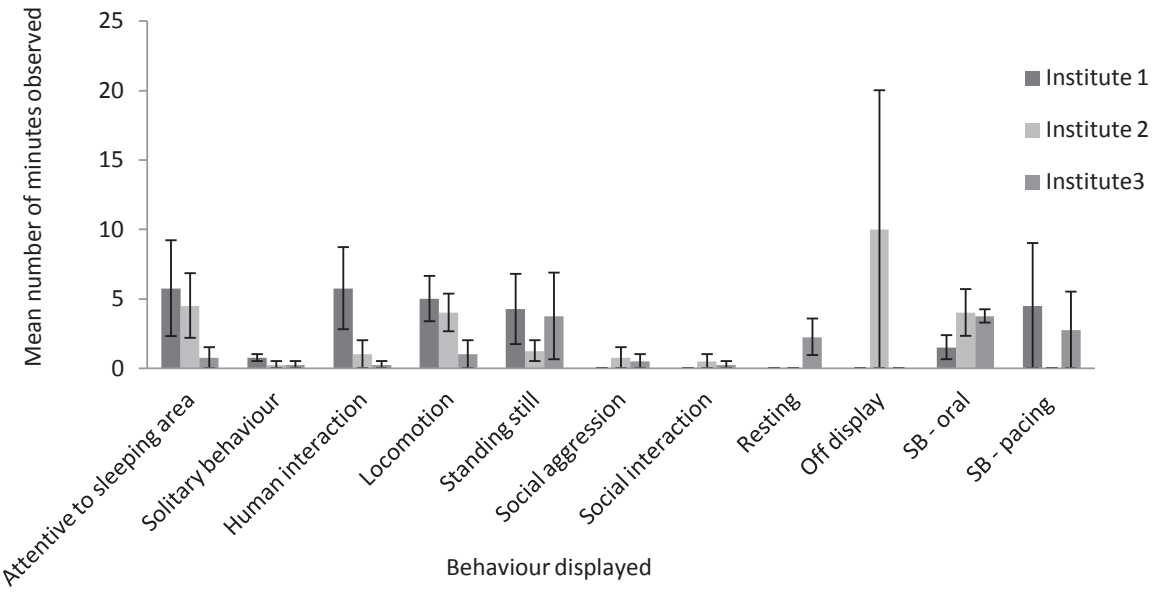


Figure 4.16 The mean number of minutes the giraffes at three captive wildlife institutes spent displaying different behaviours. Mean time for all four observation days for each institute combined. Error bars represent one standard error.

Oral stereotypic behaviours comprising of licking inedible objects were seen at all three institutes (4% at Institute 1, 10% at Institute 2, and 9.4% for Institute 3 respectively) of the total time observed (Appendix 2.4 and 2.5). Pacing was seen at two institutes and was displayed 11% at Institute 1 and 7% at institute 3 of the total time observed (Appendix 2.5 and 2.6). There were differences in the daily frequency of stereotypic behaviours observed (Fig. 4.17).

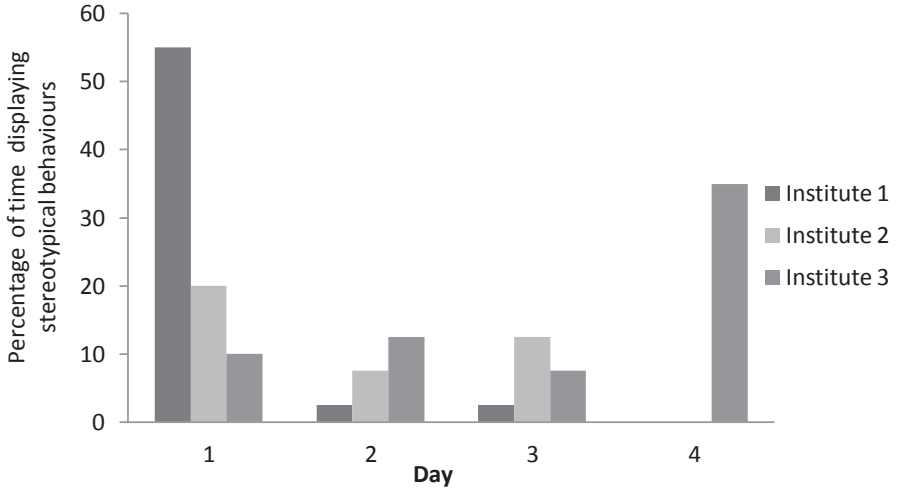


Figure 4.17 The percentage of time the giraffes spent displaying stereotypic behaviours at three captive wildlife institutes.

Chimpanzees

Stereotypic behaviours were displayed by both institutes' troops of chimpanzees but there were no significant differences between the institutes in the frequencies of stereotypic or other behaviours displayed (Fig. 4.18).

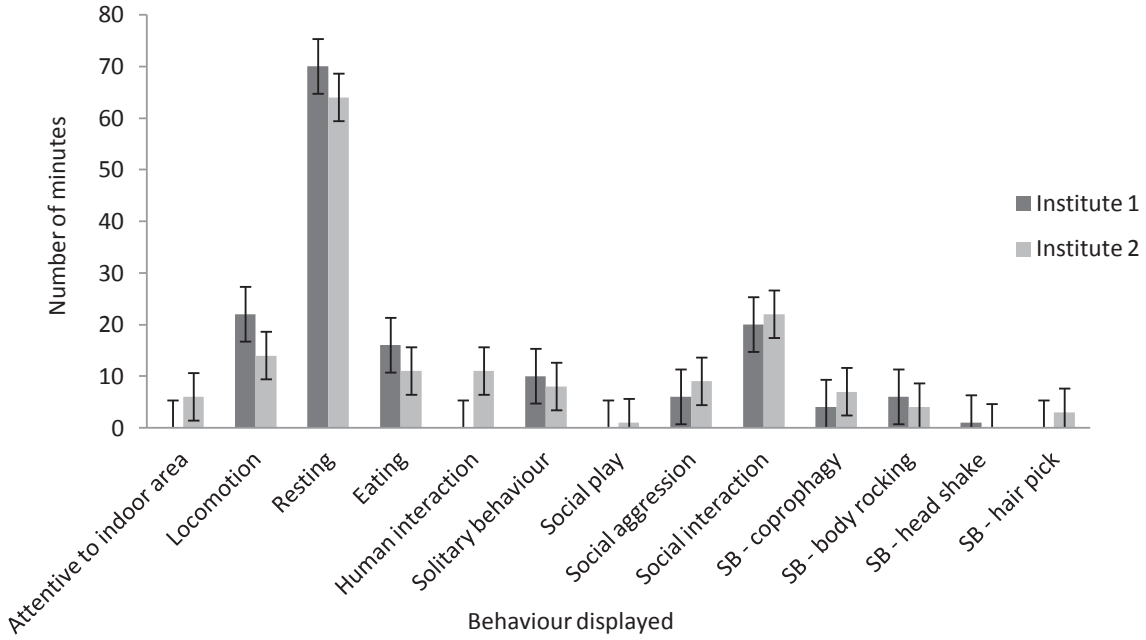


Figure 4.18 The mean number of minutes the chimpanzees at two captive wildlife institutes spent displaying different behaviours. Mean time for all four observation days for each institute combined. Error bars represent one standard error.

Stereotypic behaviours, including coprophagy, body rocking, head shaking, and hair picking, were displayed at both captive wildlife institutes (Appendix 2.7 and 2.8). Stereotypic behaviours were displayed for 7% of the total time observed at Institute 1 and for 9% of the total time observed at Institute 2. Chimpanzees at Institute 1 expressed stereotypic behaviours on all four observation days (Fig. 4.19).

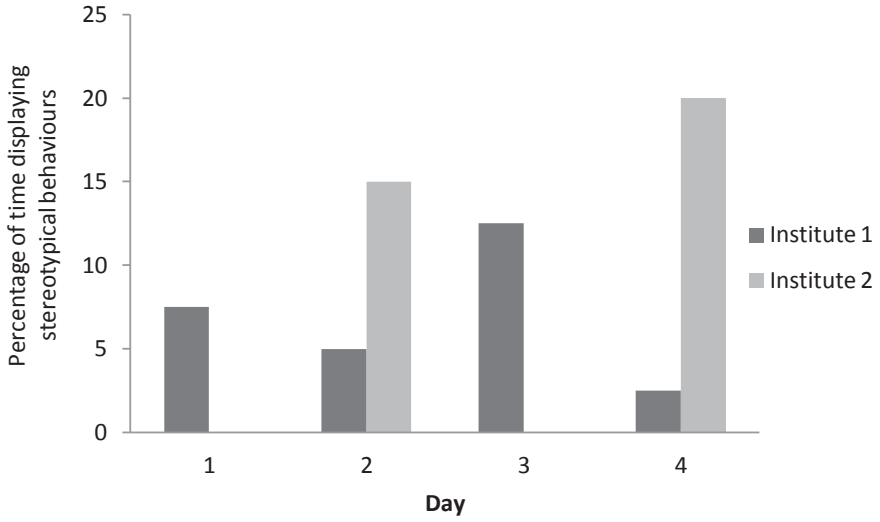


Figure 4.19 The percentage of time the chimpanzees spent displaying stereotypic behaviours at two captive wildlife institutes.

Rhinoceros

There was a significant difference between the frequency of eating ($F_{1,6}$ =13.5, P=0.01) behaviour displayed by the herds of rhinoceroses at two different institutes, which may reflect grazing opportunities. No stereotypic behaviours were displayed by either herd of rhinoceros at each institute (Fig. 4.20).

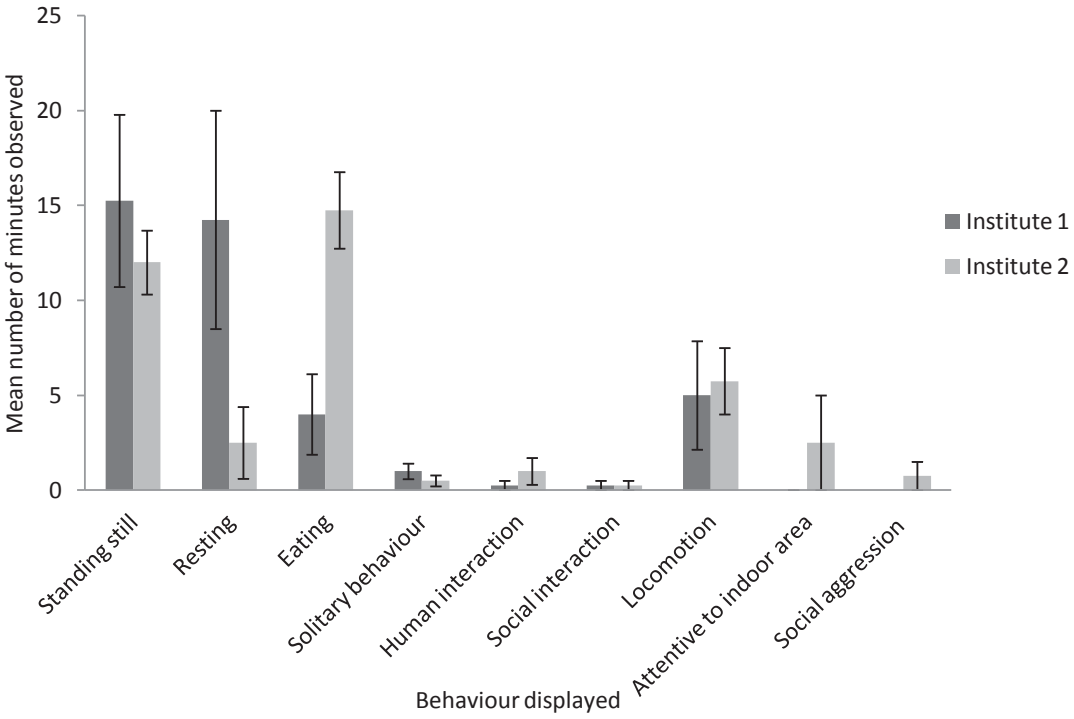


Figure 4.20 The mean number of minutes the rhinoceroses at two captive wildlife institutes spent displaying behaviours. Mean time for all four observation days for each institute combined. The error bars represent one standard error.

Tiger

There was a significant difference in the frequency of locomotion ($F_{2,9}$ =4.4, P=0.046) behaviour between the three institute's tigers (Fig. 4.21). However, the post hoc tests (Tukey) were unable to confirm a significant difference between Institutes 1 and 2 (P=0.063).

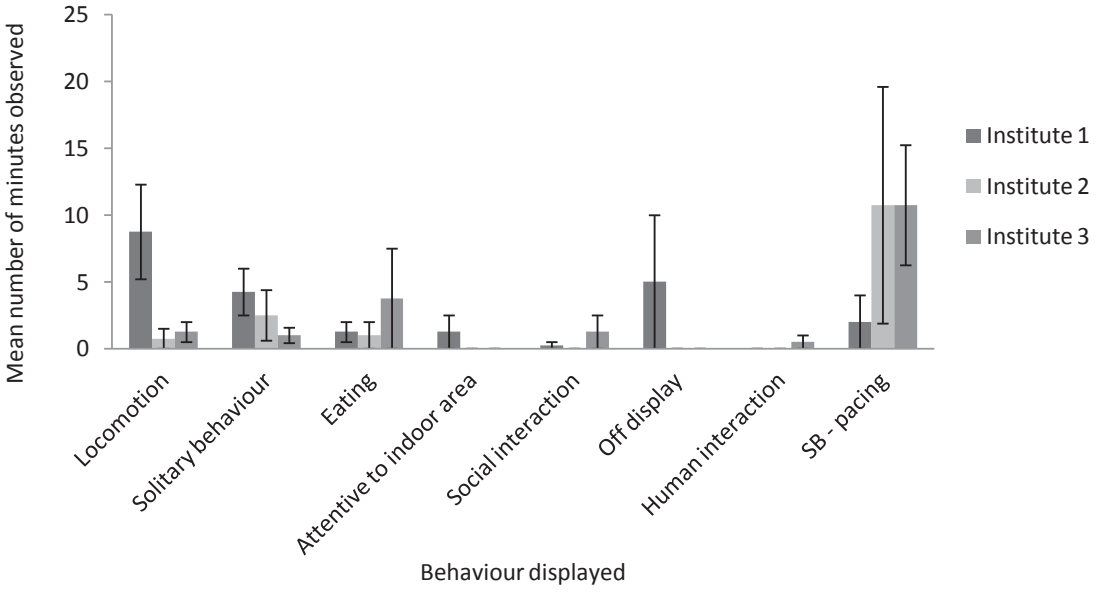


Figure 4.21 The mean number of minutes the tigers at three captive wildlife institutes spent displaying behaviours. Mean time for all four observation days for each institute. Error bars represent one standard error.

Stereotypic behaviour, consisting of pacing, was displayed at all three captive wildlife institutes (Appendix 2.9). There was daily variation in the frequency of this stereotypic behaviour observed with pacing being displayed for 5% of the total time observed at Institute 1, and 27% of the total time observed at Institutes 2 and 3 (Fig. 4.22).

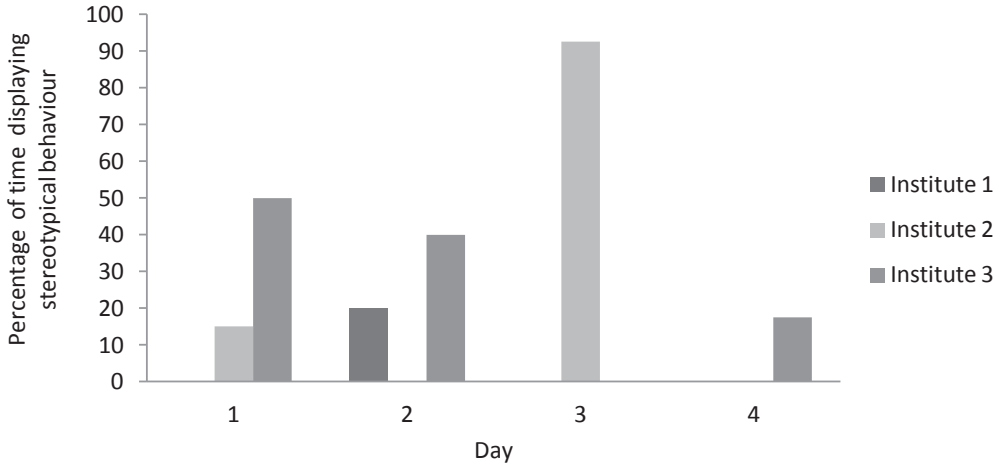


Figure 4.22 The percentage of time the tigers spent displaying stereotypic behaviours at three captive wildlife institutes. At Institutes 1 and 2, Day 2 was a starve day and Days 1, 3, & 4 were feed days and at Institute 3 Day 3 was a starve day and Days 1, 2, & 4 were feed days.

4.5 Discussion

4.5.1 Types of stereotypic behaviours encountered

Some species cope better in captivity than others as they are less prone to behavioural problems such as stereotypies (Bertram, 2004, Clubb and Mason, 2007, Mason, 2010). From my observations of the eight target species, it became evident the meerkats, *Suricata suricatta*, appear to be better suited for captivity than the chimps which displayed the most variable stereotypic behaviours. Although most of the species observed (six out of eight) did display stereotypic behaviours, it does not necessarily follow that these behaviours are necessarily good indicators of current welfare issues because history and past events, along with other underlying issues, may also be causal factors (Bassett and Buchanan-Smith, 2007, Swaisgood, 2007). In my study, the two species displaying the highest prevalence of stereotypic behaviour were the African wild dogs and the Sumatran tigers. Both showed only one stereotypy, pacing. However, it is possible that the pacing is anticipatory behaviour prior to feeding and arguably therefore not strictly stereotypic.

4.5.1.1 Pacing – anticipatory or stereotypic?

The African wild dogs (AWDs), the tigers, and the giraffes all paced in this study. The pacing may be an anticipatory behaviour prior to feeding time, or a stereotypic behaviour resulting from underlying causes such as enclosure design. Pacing was displayed by the AWDs on three out of the four observation days at both institutes under study. However, the AWDs were fed prior to the allocated observation time on day 2 at Institute 1 when no pacing was observed because the dogs were resting. Because the allocated observation time (1430–1510) on this day did not coincide with feeding time, then any potential display of anticipatory pacing prior to the feeding was missed. Days 1 and 4 were 'starve' days at Institute 1, and Days 2 and 3 were 'starve' days at Institute 2. These 'starve' days are employed by zoo management to ensure the dogs are not overfed, and to mimic more natural feeding patterns, because AWDs do not generally eat every day in the wild. Pacing was more prevalent on feed days rather than starve days, a pattern which corresponds to anticipatory feeding behaviours that can develop in animals in captivity (Kistler et al., 2009). It arises

because the animals are anticipating the routine delivery of food and become restless. However, a degree of pacing was also seen on starve days at Institute 1, thus suggesting that pacing may be a stereotypic behaviour related to other underlying causes rather than just the anticipation of feeding. The differences in the proportion of time the dog packs at each institute spent pacing were generally related to the observations falling on a 'starve' *versus* 'feed' day, i.e. the dogs paced more on feed days than starve days. Also, although this 'starve' *versus* 'feed' day is an interesting distinction, the sample size is too low to carry out any meaningful statistical analyses on it but, it would provide an interesting future research area. Neither pack of AWDs was interested in members of the public and individuals were only interested in zoo staff and zoo vehicles on feed days demonstrating an ability by the AWDs to discriminate between the two groups of people. This strong connection with only zoo staff indicates that the dogs have learnt to relate the staff and associated noises with the arrival of food, a trait that was well studied and documented by Pavlov with salivating dogs and ringing bells (Tully, 2003).

The tigers paced at all three captive wildlife institutes, with those at Institute 1 pacing considerably less than the tigers at Institutes 2 and 3 which paced for a similar length of time. However, the tigers at Institute 1 walked more than those at the other two institutes, but the walking was not in a repetitive pattern in a specific part of the enclosure. The male tigers were predominantly the ones pacing, with the female at Institute 3 pacing for a short duration before being let into the night sleeping quarters for feeding. The female at Institute 2 also paced for a short duration on Day 3 of the observation period prior to feeding. The tigers at Institute 2 alternate between being inside and outside with each other, and whilst outside the male tiger paced the fence line on Day 3 considerably more than on Day 1. Other than boredom and coping mechanisms, another possible reason for the pacing behaviour, as mentioned previously, is in anticipation of feeding time. The tigers, like the AWDs, have feed days and starve days to mimic natural feeding behaviours. This alternation can therefore influence the amount of pacing displayed. Day 3 was a starve day for Institute 3's tigers and no pacing occurred on this day compared to Days 1, 2, and 4, which were feed days when pacing was exhibited. Day 2 was Institute 2's starve day and no pacing was

exhibited on this day and was exhibited on Days 1 and 3 which were feed days. Day 4 was also a feed day, at Institute 2, but no pacing was exhibited. Unlike the tigers at Institute 2 and 3, who paced primarily on feed days only, the tigers at Institute 1 paced on Day 2 which was their starve day. It was not for a long duration, compared to the pacing exhibited by tigers at Institutes 2 and 3, and it did not occur on any other observation day, which were all feed days. Again, as shown for the AWDs, although the 'starve' *versus* 'feed' day is an interesting distinction, the sample size for further statistical analyses is too low.

Anticipatory feeding behaviours, such as pacing, are thought to occur because the animals are trying to mimic natural hunting behaviours where they would normally walk to locate and hunt prey (Shyne and Block, 2010). This behaviour (pacing prior to feeding) is not an uncommon behaviour displayed by captive AWDs although very little literature has been published on AWDS in captivity (Shyne and Block, 2010). Anticipatory feeding behaviours also occur in felids, pigs, sheep, and poultry (Shyne and Block, 2010). A study that examined anticipatory feeding behaviour and pacing in leopards concluded that they paced when there were increased levels of zoo keeper activity, e.g. cleaning their on- and off-exhibit enclosures (Mallapur and Chellam, 2002). Prior to feeding, they displayed signs of anxiety and restlessness as well as pacing, but this pacing, prior to food, was no different to the stereotypic pacing seen throughout the day (Mallapur and Chellam, 2002). Tigers, like many felids, are renowned for stereotypicly pacing and captive wildlife institutes try to mimic natural feeding patterns by not feeding them every day, as mentioned previously. However, pacing increased in some felid species (lions (*Panthera leo*), cheetah (*Acinonyx jubatus*), jaguar (*Panthera onca*), and leopard (*Panthera pardus*)), on non-feed days as the animals were looking for food (Szokalski et al., 2012). Pre-feeding anticipation has also been reported in other species, such as capuchin monkeys (*Cebus paella*). They have been found to increase their levels of grooming prior to food, potentially as a way of decreasing stress levels and social conflicts (di Sorrentino et al., 2010).

Pacing that is not linked to anticipatory behaviour (such as prior to feeding) can also occur. There are accounts of pacing in captive animals, commonly in felids, which is associated with barren or unstimulating enclosures. This lack of stimuli has been

suggested to result in bored and frustrated animals that develop stereotypic behaviours, such as pacing, as a means of coping with their barren environment and giving them something to do (Skibiel et al., 2007). It is a particular problem for species that have large home ranges as they are unable to cover the same quantity of ground in captivity as they do in the wild (Szokalski et al., 2012). This is thought to be the cause of pacing displayed by giraffes in captivity as they generally forage and feed for ~60% of their day and have home ranges that can be between 282 km^2 (du Toit, 1990) and 1950 km^2 for giraffe bulls (Fennessy, 2009). Unlike herbivores, carnivores cannot graze from one food source to another, and instead have to hunt (Bashaw et al., 2001). Although pacing prior to food can be a sign of anticipatory feeding behaviour and may also be a mimic of hunting behaviour, this stereotypic pacing can be displayed at other times of the day and not prior to food. Mallapur and Chellam (2002) concluded that stereotypic pacing seen in leopards (*Panthera pardus*) was not caused by food anticipation but by the lack of stimuli in their enclosure. Pacing was also displayed by tigers when they were housed in enclosures adjacent to another tiger that they could see or smell, and especially evident if a male is housed next to a female (Bashaw et al., 2001).

As occurred with the tigers and the AWDs, the giraffes paced at Institutes 1 and 3. The giraffes at Institute 3 all paced in the late afternoon prior to them being let into their night quarters for dinner. Again, this could be a form of anticipatory behaviour as it was not seen at any other time of day. More observations would be beneficial for helping to isolate this possible cause for their pacing. However, the pacing that was observed at Institute 1 occurred throughout the day and was only displayed by the male giraffe. He was also very attentive to the indoor area and it was assumed that he was attentive and pacing because of the arrival of a new female giraffe that was still in quarantine. Observations should be carried out again to test this hypothesis once the female giraffe has been introduced to the herd.

In conclusion, the pacing displayed by the AWDs primarily occurred on feeding days when the dogs showed increased alertness and attentiveness to zoo staff generally, and to the direction from which the zoo staff approached to feed the animals. This attention to the direction zoo staff came from, and the dogs' increased

alertness, are documented behaviours of anticipatory feeding (Montaudouin and Le Pape, 2004). Thus, the pacing seen by these animals is most probably a food anticipatory behaviour. The pacing displayed by the giraffes at Institute 3 was also probably an anticipatory behaviour as they are only fed four times throughout the day, a shorter duration than they would experience in the wild. The behaviour was also displayed prior to their evening feed before being let inside for the night. However, more observations should be carried out to test this hypothesis as they were only observed once during late afternoon (1600-1640) and this was the only time pacing occurred. As shown by the AWDs, the tigers primarily paced on feed days rather than starve days which also indicates the pacing was because of food anticipation. The only exception was the pacing at Institute 1 which occurred on a starve day rather than a feed day. Even though it was displayed for a short duration, reasons for this pacing should be investigated further.

4.5.1.2 Begging – stereotypic behaviour or conditioned response?

Begging was only displayed by the otters at one institute and it may be a conditioned response to food – a different food anticipatory behaviour to pacing, or a stereotypic behaviour. Instead of locomotive behaviours, the otters at Institute 2 spent a large portion of their time "begging" from zoo staff and from members of the public when it was close to feeding time. This behaviour involved the otters running backward and forward to any person (public or zoo staff) who walked past, or who stood and looked into their enclosure. The otters would squeak and stand on their hind quarters and display the begging behaviours similar to that seen in pet dogs. This behaviour was displayed predominantly on Day 4 of observation (time 1515–1555) prior to the otters' dinner and settling down for the night. Such begging behaviour is not uncommon and it has been recorded in other captive Asian short-clawed otters.

Gothard (2007) hypothesised that the begging behaviour was either the result of boredom, or inadequate nutrition (hunger) and/or a feeding pattern that does not take into account the otters' natural foraging behaviour. Gothard (2007) discussed the purpose of 'contrafreeloading' and how some animals are motivated to "work" for their food because it is more natural and provides them with a mental stimulus

(Chapter 2). If animals are not given a chance to forage, or are not provided with mental stimuli, begging and other forms of stereotypic behaviours can develop. Alongside this potential cause of the begging behaviour, inadequate nutrition or an inappropriate feeding regime can also contribute by not meeting the metabolic needs of the animal because otters have a high metabolism and need feeding often. If not fed frequently enough, or if fed inadequate amounts of food, otters become hungry and hence may turn to stereotypic behaviours in an attempt to locate or acquire food (Gothard, 2007). Gothard (2007) concluded that hunger was the prime cause of the begging stereotypic behaviour, with boredom and lack of stimuli also being contributing factors.

Suggestions to alleviate the begging behaviour have been to provide the otters with enrichment so they could feel they had some control over their environment and also to establish a feeding regime that the animals could predict. A feeding regime that allows the animals to self-feed may also be possible. If the otters are able to predict feeding time by having pre-feeding cues, they are able to relax and engage in other behaviours rather than becoming stressed over obtaining sufficient food and performing stereotypic behaviours (Gothard, 2007). These two suggestions are valid and should be trialled to attempt to alleviate the begging behaviour displayed by the otters at Institute 2. Nevertheless, members of the public (based on personal observations) seem to enjoy their "interaction" with the begging otters.

4.5.1.3 Circling – stereotypic behaviour, playing, or neurological disorder

Circling was only displayed at Institute 1, and there by one otter. The otter performed this circling behaviour whilst walking and swimming. It covered a 360-degree circle whilst moving on land or in the water sporadically. This behaviour was the only significant difference found between that of the otters of Institutes 1 and 2 on the basis of statistical analysis. Although the begging behaviour was also only seen at one institute (Institute 2), it was not significant because it was only displayed on two of the four observation days compared with the circling behaviour which was displayed for a short duration, time wise, but which was witnessed on three out of the four observation days.

Reasons for circling behaviours could firstly be a stereotypic behaviour resulting from underlying welfare issues. Circling is a common stereotypic behaviour displayed by captive sea mammals, such as seals, and is generally the result of inadequate captive living conditions, e.g. barren and boring (Grindrod and Cleaver, 2001). Environmental enrichment has been used successfully to alleviate stereotypic circling in common captive seals (*Phoca vitulina*) by providing them with novel devices that encourage natural foraging and feeding behaviours (Grindrod and Cleaver, 2001). Circling behaviour in seals is similar to pacing, but it occurs in water and results in the seals swimming in a circular pattern around their tank. The behaviour of the otters was slightly different: it occurred sporadically when they were running or swimming. Very little research has been carried out on captive otters, but Morabito and Bashaw (2012) have concluded that the most common stereotypic behaviours seen in captive otters were locomotion behaviours.

This circling could also be a form of play that the otter is engaging in but there is no evidence to support this hypothesis and only one otter engaged in it. Another possible explanation is that this behaviour is a symptom of a neurological disorder. Neurological disorders that cause circling behaviour have been extensively studied in rats (Palomero-Gallaghera et al., 2007, Loscher, 2010, Gerlach et al., 2011, Stiles et al., 2012) but I was unable to find any literature relating to otters. Cerebral or brain asymmetry can cause circling behaviour in rats – it refers to a disconnection between the two hemispheres of the brain (Palomero-Gallaghera et al., 2007, Loscher, 2010). For example, dopamine is a neurotransmitter that aids locomotion in the brain (Salvatore et al., 2009) and if an imbalance occurs between the dopamine systems in the forebrain, especially in the striatum, this circling behaviour can occur. The animals can also favour a particular side to turn when circling and generally is in the direction away from the brain's hemisphere that has higher striatal dopaminergic transmission (Loscher, 2010). The otter that circled whilst swimming and running/walking always turned to its right and completed a 360 degree circle before continuing to swim or walk. Similarly, if a disease or defect is affecting the animal's inner ear or vestibular system, circling can also occur because this is the balance centre of the brain (Palomero-Gallaghera et al., 2007, Loscher, 2010). Brain tumours can also cause

circling behaviours in animals (Choi et al., 2012), along with brain lesions (Lindemann et al., 2001). In order to obtain a more accurate diagnosis on why this circling was observed in the otter, more observations would have to be carried out as well as examining the animal's history and when this circling behaviour was first noticed. Computed tomographic and nuclear magnetic resonance scans to assess the animal's brain function to see if there are neurological disorders could also be carried out.

4.5.1.4 Coprophagy – stereotypic behaviour or dietary issues?

Coprophagy refers to the eating of faeces and is common in some species of mammals, for example rabbits (*Oryctolagus cuniculus*). Rabbits produce both hard and soft faeces and have been found to consume both for different reasons (Soave and Brand, 1991, Hirakawa, 2001). They consume the soft faeces, which they produce at night, because they are high in microbial proteins and vitamins. Hard faecal pellets produced during the day by the rabbits contain a lot of waste material but by re-ingesting hard-to-digest particles promotes food digestibility (Hirakawa, 2001). Dogs, foals, other rodents such as mice and guinea pigs, and also nonhuman primates have all been reported as engaging in coprophagy (Soave and Brand, 1991). Coprophagy was performed by the chimpanzees and by one of the herds of zebras that were observed. I am firstly going to address and discuss coprophagy in chimpanzees in relation to the literature and then zebras to look at the causes of this in these captive mammals, and then examine whether the behaviour is a natural one, as it is in rabbits, or stereotypic.

Coprophagy was performed by both troops of chimpanzees and by a solitary housed chimpanzee that is kept at the third institute studied. However, this solitary chimp is an elderly female (57 years old) with numerous health problems (asthma and type 2 diabetes). Because of these health conditions, and her solitary housing, this chimp was ultimately excluded from the observational data and statistical analysis because her behaviours would have biased the results of the study of the other two troops of chimpanzees. But she still performed coprophagy and the reasons why remain relevant to the other troops and will be discussed.

The reasons why chimpanzees display stereotypic behaviours are not entirely understood and it is often suggested to be due to a lack of mental stimuli for these

highly intelligent socially complex animals (Birkett and Newton-Fisher, 2011). However, another possible cause of coprophagy may be that it is a behaviour learnt by younger chimps from older generations that were kept in poorer captive conditions (Krief et al., 2004, Sakamaki, 2010). It has also been hypothesised that coprophagy can be due to the animals, in captivity, being nutrient deficient, stressed, bored, hungry, or sick (Krief et al., 2004, Sakamaki, 2010). Soave and Brand (1991) have reported that primates, such as prosimians (*Lepilemurs*) eat their faeces as a way to gain bacteria and fatty acids. They also reported that rhesus monkeys (*Macaca mulatta*) would consume their faeces in order to obtain vitamins such as B-12 (Soave and Brand, 1991). Conversely, coprophagy is a debated stereotypic behaviour because it has been observed in wild chimpanzee (Krief et al., 2004, Bertolani and Pruetz, 2011) and bonobos (*Pan paniscus*) (Sakamaki, 2010) as well as in captive animals. Wild chimpanzees are thought to re-ingest and hence sort through their faeces in order to obtain seeds (which have softened and thus become more digestible), nutrients, and food items that were not ingested initially. Krift *et al.* (2004) concluded that coprophagy was a dietary behaviour rather than a stress-related one, but more observations in the wild need to be carried out to substantiate this finding. Similarly, bonobos were observed ingesting and sorting through faeces containing seeds and other undigested items, and Sakamaki (2010) reached the same conclusions as those of Krift *et al*. (2004). More wild observations and investigations of the nutrient content of faeces were also recommended (Sakamaki, 2010). Bertolani & Pruetz (2011) also observed wild chimpanzees sorting through their faeces for undigested items. The captive chimpanzees may be consuming their faeces to obtain missed nutrients, such as seeds, but no “sorting” was witnessed as the observed chimpanzees tended to eat freshly excreted faeces caught in their hands. They were also seen manipulating the faeces around their mouth with their tongue and lips prior to consuming them, or smearing faeces onto walls and other surfaces to consume from these surface. Based on my observations, I suggest that the coprophagy seen in this study is most consistent with a stereotypic behaviour. Further investigations into the composition and nutrient value of the faeces in the captive chimpanzees, together with more observations, should be carried out to help improve understanding of this behaviour.

With regard to the zebras, only the individuals in the herd kept at Institute 1 were seen eating faeces of their own species. I was unsure if individuals consumed their own excrement because it was not consumed fresh, but it was evident that zebras consumed zebra-derived faeces, not the faeces of other species housed in the same enclosure. The main difference between the two herds of zebras observed was that the animals at Institute 1 were inclined to stand around ("look out") and walk more than the animals did at Institute 2, which spent a larger proportion of their time eating. This finding may be related to differences in the enclosures at each Institute. The enclosure at Institute 2 is grassed which allows the animals to graze and feed between specific feed times. In comparison, the enclosure at Institute 1 has very little grass and the animals thus rely more heavily on zoo staff to feed them. Coprophagy, common in rodents as mentioned previously, has been recorded for domestic horse foals (*Equus ferus caballus*) up to about 19 weeks of age which eat, primarily, the faeces of their mothers. It is thought that foals eat such faeces to help establish bacterial flora in their gut, or if they are deficient in nutrients (Crowell-Davis and Houpt, 1985). Marinier and Alexander (1995) concluded that coprophagy of the faeces of their mothers by foals was a way for them to learn what foods to select and graze on. Coprophagy is not often seen in adult horses, but if they are fed low protein diets, it can occur (Marcella, 1988, Soave and Brand, 1991). Horses and zebras are grazing and browsing herbivores that spend a large proportion of their day feeding. In the wild, free ranging horses can spend up to 18 hours a day feeding. However, when bought into a captive situation, there are restrictions on their foraging behaviour which compromises their welfare and can lead to behavioural problems (Thorne et al., 2005). Their welfare can be affected as they have to rely on being fed by humans and thus spend more time inactive. The animals can become hungry and bored and may result in them eating their straw bedding, if housed in a stable, and performing stereotypic behaviours such as head weaving. In relation to my study, such boredom and hunger could have been experienced by the zebras at Institute 1, thus leading to them engaging in coprophagy because they are unable to feed continuously like their wild counterparts. This conclusion is supported by the differences seen in feeding duration for the two herds of zebras at both institutes that can be attributed to the grazing pasture available at Institute 2 but not at Institute 1. Further observations and

monitoring of the feed intake, as well as potential nutrient deficiencies, should be carried out for the zebras at Institute 1 to establish if either boredom and hunger or nutrient deficient were the causes for their coprophagy.

4.5.1.5 Body rocking

Unlike other behaviours, rocking is a clearly defined stereotypic behaviour with a high correlation to welfare, and was one of the more prominent stereotypies displayed by the chimpanzees. As with other stereotypic behaviours, body rocking is often attributed to boredom, underlying welfare issues, and the stress of confinement (Birkett and Newton-Fisher, 2011). One study that evaluated the effects of the provision of puzzle feeders on self injurious behaviours and rocking in rhesus monkeys found that the puzzle feeders reduced body rocking but not self injurious behaviours (Novak et al., 1998). This finding supports the suggestion that unstimulating environments can lead to the development of some stereotypic behaviours such as rocking (Spijkerman et al., 1994). Novak *et al*. (1998) also concluded that individually housed primates are more susceptible to stereotypic behaviours than those kept within a group. Body rocking was displayed by both troops of chimpanzees evaluated in my study, and by the old, individual female chimpanzee kept on her own at the third institute studied.

Another cause of body rocking (along with environments that lack stimuli) in captive chimpanzees is the effect of the early rearing environment and conditions in which they are brought up (Nash et al., 1999). Nash *et al*. (1999) concluded that young chimps raised by mothers that had been kept in barren environments learnt this behaviour which indicates a level of social learning. Although not all of the chimpanzees in the troops I studied were born in New Zealand, they may have been raised by individuals that were kept in a barren environment and hence learnt this behaviour. Subsequently, chimpanzees that are born in the institutes today may learn these behaviours from their mothers, or from other members of the troop, despite contemporary conditions being much better than those endured by the older chimpanzees. Chimpanzees hand-reared by humans tend to show less stereotypic rocking than chimpanzee-raised individuals (Nash et al., 1999). The histories of the

chimpanzees studied would have to be investigated, as well as the conditions under which they were raised, to ascertain if these were additional contributing factors leading to the body rocking behaviour.

Although some animals such as bonobos use body rocking as a form of communication, chimpanzees evidently rock for three main reasons: (1) courtship, (2) frustration, and (3) aggression (Kuroda, 1984). At both Institutes 1 and 2, chimpanzees exhibited body rocking prior to aggressive outbursts. This is consistent with the findings of Kuroda (1984). In addition, rocking was displayed by individuals who were just sitting and looking around. In these cases, rocking may be a sign of frustration or self-stimulation. Other causes for the development of body rocking in chimpanzees are as a response to fearful objects, such as noisy toys, the introduction and merging of new individuals to the group, or frustrated social circumstances (Spijkerman et al., 1994). Spijkerman *et al*. (1994) noted that body rocking can be a 'comforting' coping mechanism (anxiolytic). They concluded also that the lack of stimuli, and the stress and anxiety arising from an inability to change their environment, lead to frustration and body rocking. The troop of chimpanzees housed at Institute 2 was divided during the observation period, and individuals were housed adjacently but not all together. This partial separation may have contributed to the occurrence of body rocking. Further research into the coping mechanisms of captive chimpanzees in dealing with life in captivity, and why they might be displaying these stereotypic behaviours (for example, body rocking), should be investigated. More observations and documentation of the past histories of all of the animals, as well as their daily activities, would be beneficial in helping understand the life of captive chimpanzees.

4.5.1.6 Hair picking (Trichotillomania)

Hair picking was only observed in the chimpanzees at Institute 2 although all individuals had signs of hair loss, most probably because of hair picking. Hair picking occurred when the chimpanzees were still in their night quarters and before they were let outside for the day. A number of individuals pulled their hair. Prominent in this action was a male chimpanzee with a fresh wound on the back of his neck. Aggressive behaviour by some chimps was seen during this observation period also.

Grooming and social grooming are common behaviours in both wild and captive chimpanzees but hair picking occurs when they are kept in captivity (Reinhardt, 2005). Other species of primates, dogs, cats, rodents including mice and guinea pigs, and humans, have all been reported to pick or pull hair when in confinement. Unlike humans, who have been classed as having a mental disorder when pulling/picking hair, it is identified as a behavioural disorder because of psychological stress in chimpanzees and other animals (Reinhardt, 2005). In most species, individuals often ingest the hair after it has been pulled. Hair pulling or picking in humans is generally self inflicted, and occurs when the person is depressed, frustrated, bored, under stress or anxious. In non-human primates, however, hair pulling is not only self inflicted but can also occur socially or by the action of another individual (Reinhardt, 2005, Hosey and Skyner, 2007). Pulling out another individual's hair can be a form of aggression as it can hurt and rhesus macaques have been seen teeth baring/grinning and moving away in discomfort from the offender. Hair pulling has also been seen where overcrowded enclosures result in a lack of social space or shelter, or where animals are socially distressed. Solitary housed individuals that are depressed, bored or lonely can also hair pick (Reinhardt, 2005, Hosey and Skyner, 2007). Over grooming can occur also in this situation. Frequent hair pulling can lead to bald patches forming, also known as alopecia, in both humans and non-human primates (Reinhardt, 2005). Hair pulling decreases in primates when enrichment or environmental stimuli are provided but does not eliminate it (Reinhardt, 2005).

The chimpanzee that displayed the most hair pulling in my study was a male that had a fresh wound on the back of his neck (noted above). The hair pulling could therefore have been a sign of social distress arising from a fight, and the aggressive screeching also evident during the same observation period as the hair picking would tend to support this idea. Social distress may have also been the cause for the other individuals that were seen hair picking. The only hair picking seen was self inflicted.

4.5.1.7 Head shaking

Head shaking was seen in one herd of zebras at Institute 1 and by both troops of chimpanzees kept at Institutes 1 and 2. However, it was most commonly seen in the

solitary housed old female chimpanzee at the third institute studied. As mentioned previously, she was not included in the results, but reasons why she may be displaying this behaviour are discussed along with those pertaining to the chimpanzees at Institute 1. The troop of chimpanzees at Institute 1 was split into two groups (they are normally all housed together) during the observation period for an unknown reason. This separation may have contributed to this stereotypic behaviour. The chimpanzees would shake their heads from side to side, whereas the head shaking that was observed in the herd of zebras, at Institute 1, was a head-toss up and down. Possible causes for this behaviour for each species will be discussed below.

Head shaking occurs in black-handed spider monkeys (*Ateles geoffroyi*) and is expressed primarily by juveniles as a form of communication during play (Pellis and Pellis, 2011). However, shaking can also be expressed by all ages of black-handed spider monkeys prior to copulation or when greeting another individual (Pellis and Pellis, 2011). For chimpanzees, like hair picking and body rocking, head shaking is suggested to be due to stress, anxiety or frustration from being in confinement (Birkett and Newton-Fisher, 2011). The shaking reflects the detrimental effect of confinement on the animal's welfare as it is a sign that the mental health of the animal is compromised and should be alleviated. The animals may be experiencing these detrimental effects because of boredom and the lack of stimuli in their environment, and shake their heads as a coping mechanism. The frustration of being unable to control their environment, social stress, being solitarily housed or being separated too early from their mothers, can also result in this behaviour occurring (Brune et al., 2004, Birkett and Newton-Fisher, 2011). It has been suggested that chimpanzees should be afforded psychiatric help, in the form of anxiolytic medication, as humans do because environmental enrichment cannot successfully alleviate the presence of these abnormal or stereotypic behaviours (Brune et al., 2004, Bourgeois et al., 2007). Medical causes of head shaking include ear infections (Adkesson et al., 2009) and vestibular disease (Kim et al., 2012).

Other causes for the development of stereotypic behaviours, such as head shaking, also include exposure to people because chimps and other species are frequently observed by unfamiliar people, they are restricted by their enclosure and

the size of it, and feeding routines and mating partners are out of their control (Hosey, 2005). In my study, the two main factors, as mentioned previously, seem to have been the solitary confinement (hence boredom) of the old female at Institute 3, and the stress arising from the separation of the chimpanzee troop at Institute 1 into two groups, the members of which are normally together.

Head tossing was seen in one herd of zebras at Institute 1 and it has been seen in domestic horses in a number of circumstances. Provision of a low forage diet can lead to the development of stereotypic behaviours in horses as the lack of food can result in the animals becoming bored and hungry (Thorne et al., 2005). Domestic horses can spend up to 18 hours of their day grazing but when confined to stalls, or kept in captivity like their zebra cousins, they have to rely on being fed and thus become bored and hungry very easily (Thorne et al., 2005). Horses have been reported to perform stereotypic behaviours in such conditions as a mechanism for coping with this environment. However, head shaking or tossing have also been reported as normal behaviours in horses to enable flies to be kept away, not necessarily a sign of frustration from being kept in captivity (Cook, 1992).

There was no hay in the enclosure when the zebra was seen to be head tossing and so hunger or boredom may have been the reason for the animal to perform this behaviour. Alternatively, or in addition, this head tossing behaviour may have arisen as the result of a male zebra trying to mate with a number of the individuals just after the head tossing occurred. This could have been a response by the females to feeling harassed by the male. The tossing in this case was only displayed briefly in relation to the total time observed and so its significance is uncertain.

4.5.1.8 Oral stereotypies – licking inedible objects

Both the giraffes, at all three captive wildlife institutes, and zebras at Institute 1, licked inedible objects. These objects included fence posts, bars or gates, and walls. Such oral stereotypies by giraffes are displayed in captive wildlife institutes all over the world (Bashaw et al., 2001, Tarou et al., 2003). Very little research has been published regarding licking stereotypic behaviours by zebras, but similar causes for these oral

stereotypies in giraffes have been seen in horses and will be discussed in relation to zebras.

Oral stereotypies are thought to develop in captivity between feed periods when the giraffes have nothing on which to graze, whereas in the wild they browse for 50-70% of their day (Baxter and Plowman, 2001). Similarly, horses graze for up to 75% of their day (18 hours/day) (Thorne et al., 2005) and so when kept in captive conditions they have to wait between feeds as do zebras, because they do not have unlimited access to grass. These species of animals are thought to perform oral stereotypies because of boredom arising between feeds, and hunger (Baxter and Plowman, 2001, Thorne et al., 2005, Fernandez et al., 2008). Efforts to decrease the occurrence of these oral stereotypies in giraffes have involved the introduction of high-fibre food that the animals spend a longer time breaking down, thus keeping them occupied. Other methods involve enrichment devices to increase tongue manipulation. This increase in tongue manipulation draws out the feeding period and thus decreases the amount of time available to perform oral stereotypies (Baxter and Plowman, 2001, Fernandez et al., 2008). It has been successful in decreasing the frequency of the stereotypic behaviour occurring but has not completely eradicated it.

The oral stereotypies seen in the giraffes at all three captive wildlife institutes in my study occurred when there was no food present, i.e. they had consumed it all and were waiting for their next feed. Thus, boredom and possibly hunger seem to be a probable cause of their oral stereotypies. This conclusion is reinforced by observations of the zebras: those at Institute 1 did not have a continual supply of grass/food and performed oral stereotypies, whereas the zebras at Institute 2, with a continual supply, did not perform licking behaviours. These differences suggest strongly that the amount of time spent grazing contributed inversely to the occurrence of oral stereotypies. Further observations would have to be carried out on both species, as well as enrichment trials, to ascertain whether boredom or hunger is the main cause for oral stereotypies.

4.5.2 Meerkats and rhinoceroses

No stereotypic behaviours were displayed by the meerkats or rhinoceroses which may indicate that these species are better suited for life in captivity than the other six species observed. The behaviours displayed by the mobs of meerkats were consistent with between institutes and the animals seemed content with their environment. Although the meerkats spent a considerable amount of time on "look out" this behaviour was not deemed to be stereotypic as it is displayed to a high degree in the wild also. The behaviours displayed by the rhinos at both institutes were fairly consistent with each other, with there only being a significant difference between eating behaviour. If stereotypic behaviours are a good indicator of welfare, then this finding also demonstrates that even though meerkats are a lot smaller than rhinos, a good quality of life in captivity for both small and large animals is possible. Although meerkats are social animals, other species observed that are social, such as the giraffes, chimpanzees, African wild dogs, and zebra, still performed stereotypies. In my study, it was not significant if animals were herbivores or carnivores, or were social or solitary animals, they all had the potential to display stereotypic behaviours in captivity for whatever reason.

4.5.3 Observation methodology

The methods used in this study to observe the eight captive species of mammals were generally adequate in determining whether stereotypic behaviours were present, but some limitations became evident. Although only forty minutes per day were allocated for observing each species, it was thought that if a stereotypic behaviour was present it would be displayed and seen within this time frame. However, although stereotypic behaviours were witnessed for some of the eight species, in some cases such behaviours occurred only at a particular time of the day. This factor made it difficult to (*i*) acquire an accurate account of the duration of stereotypic behaviours on a day-to-day basis, and (*ii*) determine which type of stereotypy is more prevalent, for example, coprophagy or body rocking by chimpanzees. Therefore, it would be more beneficial to observe individual species for a set number of days to document the occurrence of stereotypies at more times than I

was able to observe in my study. This expansion of the observation times to cover the whole day, and even possibly night observations, would allow the entire daily behaviour of the captive mammals to be better understood because the impact of environmental factors, such as the weather and confinement, could be assessed against the 'standard' behavioural patterns. A second important limitation arising from the use of the 40-minute observation period is that immediately prior- and post-observation behaviours are missed. These gaps may be crucial in establishing the reasons for some behaviour, such as the type and duration of anticipatory pacing behaviour of animals prior to feeding.

Other factors may also have an effect on observational data and hence their interpretation. For example, a new female giraffe was acquired by one of the institutions. The arrival of this giraffe meant that the institute's only male giraffe was preoccupied as he spent a proportion of his time pacing the fence line of his enclosure by the quarantine area holding the female giraffe. Because of events such as this, which can be unavoidable, undertaking observations for a longer period would likely help indicate what may be causing a stereotypic behaviour if it is present.

Even though life in captivity is generally routine (especially husbandry procedures and daily activities), some animals are thought to develop stereotypies because they cannot control their environment (Meehan and Mench, 2007). To ensure the conditions in which the captive animals are being kept is maintained to the best possible standard, it is therefore important and beneficial for the long-term welfare of the animals to carry out observations such as described in this chapter, on a regular basis. Such observations allow unwanted behaviour, such as stereotypic behaviour, to be identified as well as enabling any changes in behaviour displayed by the animals to be monitored over time. However, because of the busy daily schedules of zoo staff, it can often be challenging to observe the animals in an 'undisturbed' environment after their husbandry requirements have been met. Thus, the observations I undertook, will hopefully provide zoo staff with insightful information about the current behavioural patterns being carried out by the animals under their care. The observational data are useful from the point of view of being essentially objective because they were acquired by me as an "outsider" with no prior knowledge

of the animals individually. However, it is still important for zoo staff to carry out regular observations of the animals to ensure that their behaviour is not out of character, and such deviations from normal behaviour would not normally be identifiable by a stranger.

4.6 Conclusion

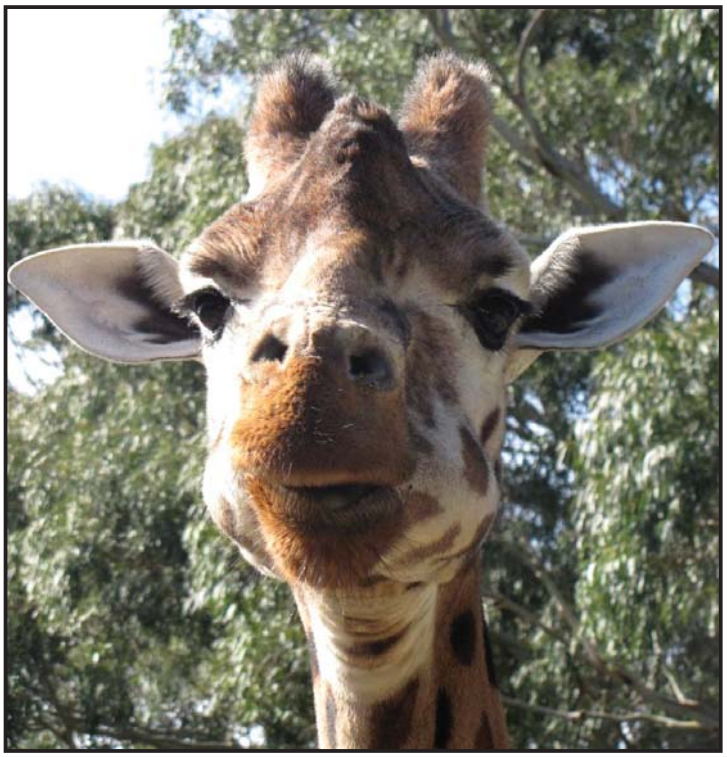
From the observational study of eight species of captive mammals kept at three New Zealand captive wildlife institutes, six of the species displayed stereotypic behaviours. Eight different types of stereotypic behaviours were seen: pacing, begging, circling, body rocking, hair picking, head shaking, licking inedible objects, and coprophagy. Because of limitations in the observational methodology, I was unable to determine the definitive cause of these stereotypies, but some possibilities have been discussed with regard to each species based on the observations and the literature. Not all species are suited to life in captivity and some express a higher degree of stereotypic behaviour than others. From my observations, I concluded that meerkats and rhinoceroses at the respective captive wildlife institutes displayed no signs of stereotypic behaviour, the only significant difference in behaviour being in the eating behaviour of the rhinoceroses. In comparison, the other six species – chimpanzee, AWD, tiger, otter, giraffe, and zebra – were all seen displaying stereotypic behaviour of varying frequency and severity.

To obtain a more accurate account of the prevalence of stereotypic behaviours for each of the eight species, increasing observations over a longer period should be carried out. Such studies will help get a better understanding of the daily behaviours and habits of the animals and may provide insight to some unanswered questions. Investigating their past history and experiences would also be important as it may help explain why some of the behaviours were seen. For example, the chimpanzees might pick at their hair because older generations did it when they were housed in inadequate conditions, and so this unwanted behaviour has been passed onto future generations, i.e. the transmission perpetration of an abnormal behaviour unrelated to proximate cause.

Trialling enrichment programmes that have been developed to target the different types of stereotypic behaviours, seen both in this study and others, and their association with the different species, would also be beneficial for the long-term welfare of the animals. Other than carrying out further observations and implementing purposefully designed enrichment programmes, efforts should be increased to understand how animal species, not just mammals, cope with life in captivity. Even though considerable research has already been carried out, there are still gaps in knowledge not only regarding the husbandry of some species in captivity but also their welfare.

Chapter 5

The effect of short-term enrichment on stereotypic behaviours in three captive mammals: African wild dog (*Lycaon pictus*), chimpanzee (*Pan troglodytes*), and giraffe (*Giraffa camelopardalis*)



"Keep fighting for animals by making compassionate, cruelty-free choices every day and encouraging those around you to do the same"

Bea Arthur 1922 – 2009

5.1 Introduction

Stereotypic behaviours occur in animals that are kept in captivity and are primarily caused by their confinement and the conditions under which they are kept. 'Stereotypic' refers to the nature of these displayed behaviours as repetitive in appearance and often seem pointless (Mason, 1991, Vickery and Mason, 2005, Hogan and Tribe, 2007). Stereotypic behaviours include pacing, body rocking, licking inedible objects, and self mutilation. A number of underlying welfare issues associated with confinement cause the animals to display stereotypic behaviour, and include boredom, stress, and lack of stimulation (both mentally and environmentally) that result in frustration because the animals are unable to control their environmental, e.g. when to eat, who to mate with (Slater, 1999, Gregory, 2004, Fraser and Weary, 2005, Shyne, 2006). Thus the development of stereotypic behaviours may be the animal's way of coping with unsuitable conditions (Gregory, 2004). These stereotypic behaviours develop over time – they do not appear abruptly – and their cause should be investigated to avoid compromising the welfare of the animal (Mason, 1993).

Not all species cope equally in captivity and some are more prone to stereotypic behaviours than others. For example, polar bears (*Ursus maritimus*) (Bertram, 2004, Mason, 2006) and giraffes (*Giraffa camelopardalis)* do not cope as well as ring-tailed lemurs (*Lemur catta*) in captivity (Mason, 2010). Although stereotypies are generally thought to be a result of underlying welfare issues, other factors such as: past conditions, age, sex, and learnt behaviours from confinement with older generations of animals can also result in the development of them. By making good observations of behaviour we can quantify the type and frequency of stereotypies. We might not be able to determine the case from this, especially with chronic stereotypic behaviour, but it does allow us to assess the efficiency of changes to the environment or other treatments.

The most common method applied to prevent or alleviate stereotypic behaviours (or both) is using environmental enrichment. Environmental enrichment is designed to provide the animals with some form of stimulation. Animals in captivity are restricted and cannot perform the same activities, at their discretion, such as foraging or hunting for food, as they can in the wild. The ultimate goal of

environmental enrichment is to improve the 'quality of life' of the animals by meeting their physiological and psychological needs (Kuczaj et al., 2002).

Environmental enrichment can be provided in a number of different forms which target different needs of the animal. The five different types of environmental enrichment tactics used by captive wildlife institutes are as follows.

(1) **Food enrichment**, which aims to simulate more natural feeding conditions such as encouraging the animals to forage or work for their food by providing (for example) whole carcasses.

(2) **Sensory enrichment** in the form of odours, auditory or visual cues, for instance, that are designed to stimulate one or more of the senses of the animals.

(3) **Physical enrichment** by providing artificial structures that can continuously be altered to encourage the animals to be physically active.

(4) **Social enrichment** by having exhibits of mixed species, or by housing more than one animal, if socially viable, or via human interaction.

(5) **Cognitive enrichment** is designed to mentally stimulate the animals by providing problems such as puzzle feeders or by hiding food items in objects that require the use of tools to obtain them.

Of these five different enrichment methods, food enrichment is probable the most common and most affordable form of enrichment.

Three species of captive mammals with identified stereotypic behavioural problems (Chapter 4) are the African wild dog (AWD) (*Lycaon pictus*), chimpanzee, and giraffe. These species were the subjects in my study, which was undertaken to determine if short-term environmental enrichment could alleviate the stereotypies displayed by these species. The study also aimed to increase knowledge about these three species and especially the AWDs and giraffe as there is very little research concerning their husbandry, the prevalence of stereotypic behaviour, and environmental enrichment tactics.

Captive AWDs have been reported to perform stereotypic pacing. However, enrichment methods in the form of training (Shyne and Block, 2010), using odours, boomer balls, and hidden food (Price, 2010), have been successful only in increasing other behaviours, such as locomotion. They have had no effect on the stereotypic behaviour. With regard to giraffes, enrichment programmes have been established to decrease the amount of oral stereotypies that occur in captivity, namely licking inedible objects such as walls, posts, and fences, and pacing. The occurrences of these oral stereotypies are attributed to the boredom, hunger, and lack of food to browse during captivity because giraffes in the wild spend ~ 50-70% of their day feeding (Baxter and Plowman, 2001). Consequently, giraffes in confinement have to wait for their periodic feeds throughout the day which leads to these stereotypies developing. Enrichment methods have focussed on trying to occupy their long prehensile tongues by providing them with more complex feeding devices (Fernandez et al., 2008) and with high fibre diets (Baxter and Plowman, 2001) to encourage a higher degree of mastication. High fibre diets and more complex feeders were successful in decreasing the occurrence of stereotypic behaviours but the problem remained nonetheless. Spraying chemicals such as bitterants onto problem licking areas has also been trialled (Tarou et al., 2003). The chemical sprays were not successful in alleviating oral stereotypies because the animals found new areas to lick.

It is also important that chimpanzees have enrichment programmes as they display a number of different stereotypies which include coprophagy, body rocking, hair picking, and head shaking. Enrichment methods trialled in previous studies include providing televisions to watch (Brent and Stone, 1996, Bloomsmith and Lambeth, 2000), a range of toys, and complex feeding devices that required the animals to work for their food and use their cognitive abilities to solve problems (Clark, 2011). Although many enrichment programmes have been trialled with chimpanzees, stereotypies are still prevalent. Along with the AWD and giraffe, chimpanzees still require a great deal of research to meet husbandry, behavioural, physical, and psychological needs and ensure their welfare is not further compromised. Environmental enrichment cannot be expected to eradicate stereotypic behaviour, if other psychological or physiological needs are not met. They can, however, reduce the frequency and severity of them.

Although environmental enrichment is beneficial for captive animals, a number of safety issues have to be addressed prior to its introduction to an animal's enclosure (Hare et al., 2007). These safety precautions are to ensure the animals are in no danger of choking, getting tangled in devices, breaking teeth, claws, or bones, being poisoned, stressed or scared, or becoming aggressive or distressed because of the enrichment (Hare et al., 2007). Safety of staff and members of the public should also be evaluated before the introduction of enrichment to avoid situations such as enrichment devices being thrown out of enclosures and hitting someone. Lastly, animals will habituate over time to the enrichment and so the continual introduction of new devices will be needed to ensure the long-term welfare of the animals is met and provided for (Anderson et al., 2010).

The aim of the study was to test the effectiveness of short term environmental enrichment devices on the expression of stereotypic behaviour on a selected group of species.

5.2 Methodology

Three species, African wild dog, chimpanzee, and giraffe, were selected for the short-term enrichment trials. They were selected based on their prior history of displaying stereotypic behaviours (Chapter 4) and because of their easy accessibility. Each species' enrichment trial lasted four days and was carried out over three consecutive weeks (23rd May – 9th June 2012), with each species being the main focus for one week. To assess the effectiveness of short-term environmental enrichment, the animals were observed for one day prior to any enrichment being introduced. During this observation period (Day 1), all behaviours the animals displayed were recorded throughout the day. However, although individual behaviours were noted when possible, each species was treated instead as a whole, i.e. behaviour recorded for whole pack, troop, or herd. By recording behaviours displayed throughout the day allows the frequency of minutes to be calculated for each behaviour. These behaviours were separated into a number of major categories which included locomotive, social interaction, solitary or stereotypic behaviours (Tables 5.1 – 5.3 in Section 5.4). This process was repeated for each species.

Following the observations on Day 1, there were two days of enrichment. These enrichment trials differed slightly between each species but all encompassed food-based, physical, sensory, and cognitive enrichment methods (Hosey et al., 2009). As for Day 1 observation, the behaviours and activities of each of the species were recorded regularly throughout the day. These enabled the overall frequency (in minutes) that each species spent displaying different behaviours to be calculated. As well, the amount of time the animals spent interacting with the enrichment was documented. Further details on the enrichment methods for each species will be outlined in subsequent sections of this chapter.

Day 4 was a repeat of Day 1. No enrichment was provided (all enrichment devices were removed either at the end of Day 3 or at the start of Day 4) for the animals and their daily behaviours were recorded. This procedure enabled comparisons to be made, between the days, to assess the amount of time the animals spent displaying behaviours, and in particular stereotypic behaviours. The effectiveness of short term enrichment was assessed by comparing the frequency of stereotypic behaviours displayed prior, during, and post enrichment.

All four days of observations, including the two enrichment trial days, were carried out at Wellington Zoo, New Zealand. They were conducted during normal working and opening hours of the zoo (0930–1700 hours) and were managed around the relevant zoo staff timetables and commitments. All of the enrichment toys/devices were approved by Massey University's Animal Ethics Committee (MUAEC) (Protocol number 12/37), as well as by the Wellington Zoo. The enrichment devices they approved were selected by the MUAEC and the Wellington Zoo from a list of ideas and options I presented to them. Not all items were novel to the animals, e.g. the giraffes have previously used a boomer ball (filled with lucerne) sporadically. I also used devices that I found from extensive research (e.g. fire hose ball), attempting to make the enrichment situation different and more interesting for the animals. Before my study, the most recent usages in the zoos of enrichment items, and the nature of those enrichment devices, have not been documented systematically, unfortunately.

5.2.1 Observations

5.2.1.1 African wild dog (*Lycaon pictus*)

5.2.1.1.1 Subjects and habitat

There were five African wild dogs at the Wellington Zoo, three males and two females. They are kept in two grassed-hill enclosures (Figs 5.1-5.2). The dogs were moved from one side of the enclosure to the other when fed. The dogs were fed three times a week. The gap between each feed constitutes a starve day which helped to mimic normal feeding behaviours in the wild when the pack would not successfully make a kill. Days 1 and 3 of the trial were starve days which generally result in the dogs being less active and resting more as they are satisfied from eating the previous day. Days 2 and 4 were feed days (Day 2 was a smaller feed consisting of whole rabbits and offal, and Day 4 was a bigger feed of offal and a goat hind limbs). Feed days may result in the animals being less interested in the enrichment as they appear to anticipate food as shown by pacing their fence line.

Figure 5.1 Right hand side of African wild dogs' enclosure

Figure 5.2 Left hand side of African wild dogs' enclosure and enrichment toy (arrow)

5.2.1.1.2 Enrichment toys

One enrichment toy was provided for the dogs which consisted of a buoy, ~20 cm in diameter, attached via a D-shackle onto a metal ring which was secured onto 25 mm thick sisal rope (Fig. 5.3). The sisal rope was knotted at both ends and was about 1 m long. The buoy had seven holes drilled into it. Six were drilled around the base of the buoy to allow blood to drip out and one larger one (~ size of 10-cent piece) was drilled near the top to allow better access. On the first day of enrichment (Day 2), the buoy was filled with some rabbit blood and a small amount of beef mince inside and on top (outside the buoy). On the second enrichment day (Day 3), the buoy was filled with horse's blood and, again, some beef mince. The adding of blood was to encourage three senses: (i) sensory enrichment because the blood would stimulate the dogs' olfactory senses, (ii) physical enrichment because the toy was novel and the dogs were able to manipulate it, and (iii) cognitive because it was hung off the ground on a post. The beef mince provided a small amount of food-based enrichment but the main purpose was physical and sensory stimulation with cognitive and food-based enrichment being secondary.

Figure 5.3 African wild dogs' enrichment toy

The toy was hung from a post at 1020 hr on the first day of enrichment in a position where dogs would be able pull it down (Fig. 5.4). At the end of the day the dogs were moved to their other enclosure adjacent to where the enrichment toy was so it could safely be refilled with blood and beef mince and hung back up the following day. However, because of busy zoo staff schedules, the dogs were not let back into the enrichment enclosure until 1530 hr the following day, the second day of enrichment. Therefore, observations taken on this day of enrichment were invalid. The toy was taken down early on Day 4 when the dogs were moved back into their adjacent enclosure prior to being fed later on that day.

Figure 5.4 Enrichment toy hanging up from post (arrow)

5.2.1.2 Chimpanzees (*Pan troglodytes*)

5.2.1.2.1 Subjects and habitat

There are 12 chimpanzees kept at Wellington Zoo ranging in age from 1.5 to 35 years old. They are confined to quarters at night, but each morning they have the option of going outside to their outdoor enclosure. This outdoor grass-covered enclosure consists of a rock cave with under-floor heating, a pond with a small water-fall, and a jungle gym structure (Fig. 5.5). They are fed four times a day with a diet that consists primarily of fresh fruit and vegetables but are also fed cooked chicken, chimpanzee pellets, and other sources of protein and carbohydrates. In order to stimulate as many members of the troop as possible, four enrichment toys were provided for the chimpanzees and were located in their outdoor enclosure. They were put up both days prior to the chimps being let out for the day and were removed early on Day 4 of the trial.

Figure 5.5 Outdoor chimpanzee enclosure

5.2.1.2.2 Enrichment toys

Three of the four toys were buoys ~ 20 cm in diameter that were attached either via Dee shackles and chain to the jungle gym or with rope (Fig. 5.6). Two of them had six smaller holes drilled into them and one had only two holes. The two with the smaller holes contained ~ 30 live mealworms (*Tenebrio molitor*), provided on the first day of enrichment (Day 2), and the buoy with only two holes was filled with black currant syrup and water, which was frozen the night prior to its deployment. The fourth buoy was attached via 25 mm-thick sisal rope and had a diameter of ~ 60 cm (Fig. 5.6). This larger buoy also had six holes, and it was filled with ~ 440 g of whole peanuts in their shells.

Because of low mealworm stocks and the successfulness of the black currant ice block, on the second day of enrichment (Day 3 of the trial), two black currant ice blocks were made instead of one. The other smaller buoy was refilled with ~ 40 live mealworms and the larger buoy with another ~440 g of whole peanuts in shells.

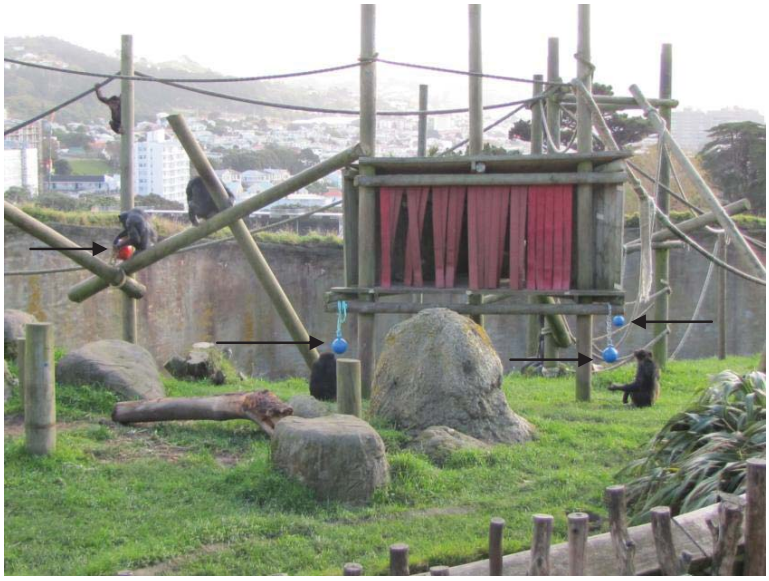


Figure 5.6 Chimpanzees and location of enrichment toys (arrows)

By providing the chimps with a variety of different food items (live mealworms, whole peanuts, and black currant ice blocks) in the buoys, the animals were stimulated not only through cognitive enrichment by working out how to extract some of the items, but also through sensory enrichment. Sensory enrichment was provided from

the odours each item produced but which were not clearly visible. The food-filled buoys also provided a form of food enrichment, but it should be noted that these food items are treat foods only and should not be considered as a nutritionally stable part of their daily diet. Lastly, the chimps were stimulated by the physical enrichment because they were able to manipulate them.

5.2.1.3 Giraffes (*Giraffa camelopardalis*)

5.2.1.3.1 Subjects and habitat

Three giraffes, two females (mother, Tisa, 21 years old) and daughter (Zahara, 8 years old and who was born at the zoo) and one male (Seun, a 5 year old pure Rothschild giraffe born at Orana Park in Christchurch, New Zealand), are housed at Wellington Zoo. As for the chimpanzees, the giraffes are confined to quarters at night and let out to their outdoor area early each day if the weather permits (Fig. 5.7). On days 1 and 2 of the trial, the giraffes were confined to their indoor quarters because of bad weather but were outside on days 3 and 4. They are fed a diet of lucerne hay, silage, carrots, apples, giraffe pellets, and a wide variety of browse (small tree branches) four times a day.

Figure 5.7 Giraffes and the outdoor area

Figure 5.8 Giraffes near their indoor quarters

5.2.1.3.2 Enrichment toys

Three different enrichment toys were provided for the giraffes which were set out at the beginning of the first day of enrichment (Day 2), and were brought down early on Day 4. The toys consisted of two buoys (one smaller, ~20 cm in diameter, and a larger one, ~ 60 cm in diameter), and a fire-hose ball (Fig. 5.9). The fire-hose ball (completely novel to the animals) was hung up via chain and the two buoys with rope.

Figure 5.9 Fire hose ball. The design is courtesy of the Honolulu Zoo website.

The smaller buoy had two holes drilled into it and fresh carrot juice inserted. The buoy and juice was frozen each night prior to the enrichment trial days. The second and larger buoy had two considerably larger holes (~ 10cm in diameter) drilled into it. It was filled with giraffe pellets, carrots, and apples that made up part of one of their normal daily feeds. On the first day of enrichment (Day 2) the fire-hose ball had bits of carrot pulp left over from the juicing squeezed under the hose folds, and on Day 3 was stuffed with silage. The buoys were hung off bars that the giraffes could access from either inside or outside their housing structure (Fig. 5.10). These toys, as in the other cases, were to provide the animals with several forms of enrichment including (i) food enrichment, (ii) physical enrichment, (iii) sensory enrichment with odours especially in the form of carrot juice, and (iv) cognitive enrichment. They were also aimed at increasing the amount of time the giraffes spent feeding as well as increasing tongue manipulation.

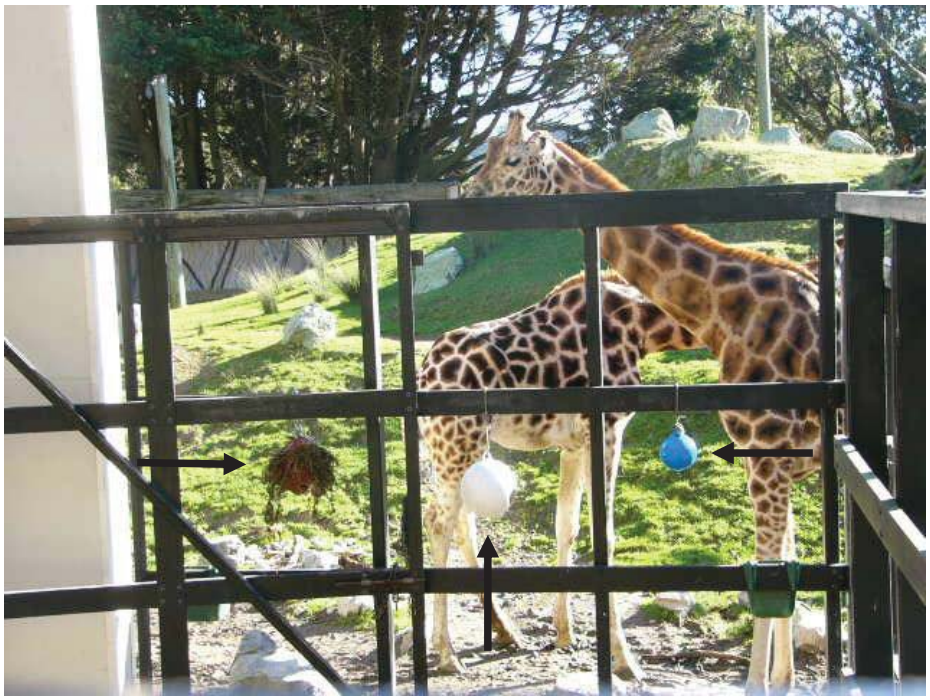


Figure 5.10 Enrichment toys (arrows) and giraffes

5.2.2 Behavioural data and analysis

Behaviours displayed throughout each day by the animals were recorded and categorised into a number of major categories (Tables 5.1, 5.2, and 5.3). The amount of time the animals spent displaying these behaviours was calculated manually from the observational data that was recorded throughout every day by the researcher. The data was analysed and graphed using Windows Excel 2010.

Table 5.1 Description of behaviours of the Wellington Zoo African wild dogs – all four days of observations combined

Attentive to sleeping area/dens	Going down or waiting outside tunnels to dens or sleeping in huts.
Look out – standing and staring	Standing and staring and looking in a particular direction when there is no sign of any zoo staff.
Locomotion (excludes pacing)	Walking or running to other areas of enclosure as a pack without sniffing, or pacing.
Social greeting (except play)	Greeting, grooming.
Social play	Dogs chasing, jumping up at each other, play fighting.
Solitary behaviour	Grooming, walking about sniffing.
Resting (includes sleeping)	Lying down anywhere in grass, or dens/tunnels with either head up or sleeping.
Human interaction	Following (alertness) zoo staff when they go past enclosure, looking alert and in direction of zoo staff. Running to fence line to where zoo staff are.
Eating	Dogs eating food.
Stereotypic behaviour	Pacing an area continuously (at least three or more times along same path) – was primarily front area of their enclosure mostly as a pack, odd occasion just a number of individuals will pace the area whilst the other stood still and stared into front left hand corner. Second most common spot to pace was along left hand side fence line of both enclosures.
Engaging with enrichment	Dogs sniffing, chewing, licking, dragging, rubbing on or paying any attention to the enrichment toy provided.

Table 5.2. Description of behaviours of the Wellington Zoo chimpanzees – all four days of observations combined.

Eating	Eating, masticating food in enclosure or given to them by zoo staff, drinking.
Locomotion	Walking or running without stopping and grazing, swinging.
Social interaction (excludes play)	Grooming, cuddling, greeting, moving to different areas of the enclosure as a group, sniffing one another's bottoms.
Social play	Chasing each other, baby playing with mum.
Solitary behaviour	Grooming, males playing with their genitals (especially early morning), youngest playing by themselves – roly-poly.
Social aggression	Biting, hitting, chasing, pulling at hair, screeching aggressively.
Resting	Sleeping in enclosure and not in indoor sleeping area, lying down, sitting quietly
Vocalisations	Screeching, hooting – general chatter not aggressive, howling.
Human interaction	During the daily talk are fed, watching, waiting for zoo staff – holding out hands when being fed by keepers.
Stereotypic behaviour	Coprophagy and body rocking. No hair pulling was seen but evidence that it occurs is visible.
Engaging in enrichment	Chimps holding, touching, sniffing, manipulating enrichment toys, licking, poking sticks into, shaking, swinging off, bashing. Any interest shown at the toys in regard to looking to manipulating in every way possible.

Table 5.3. Description of behaviours of the Wellington Zoo giraffes – all four days of observations combined.

Attentive to sleeping area	Going inside or waiting outside sleeping area or bedroom if they are locked in inside area but not allowed in some areas.
Eating	Eating, biting, masticating food that is in their enclosure or has been fed to them. Drinking.
Standing still	Standing and looking without masticating, licking, grooming etc.
Locomotion	Walking around enclosure without masticating.
Resting	Lying down.
Human interaction	Eye-to-eye encounters – i.e. public feeding giraffes, keepers feeding.
Social interaction	Nuzzling, licking urine of other giraffes, greeting each other but no fighting – biting, head swinging.
Social aggression	Biting, hitting other giraffe with horns.
Solitary behaviour	Grooming, sniffing/flehmen.
Social harassment	Male following either female, sniffing their bottoms, trying to mount them, hounding them but not aggressively or nicely as for social interaction.
Stereotypic behaviour	Licking or biting bars or inedible objects, pacing around specific areas continuously – showing signs of restlessness. Day 4 giraffes' paced area outside sleeping quarters – prior being let into sleeping area for the night and for dinner.
Engaging in enrichment	Giraffes sniffing, nudging, investigating enrichment toys. Feeding from them, licking the carrot juice ice block via the holes. Tongue manipulation into any of the holes.

The total proportion of time the animals spent displaying stereotypic behaviours over the four days was manually calculated for each species. Also manually calculated was the proportion of time the animals spent engaging with the environmental enrichment devices that were provided.

5.3 Results

5.3.1 African wild dog

The African wild dogs (AWD) paced considerably more on feed days than on starve days when they were more inclined to rest. This behaviour made the experiment somewhat challenging because it was hard to compare each day's behaviour with the enrichment because it was carried out over starve (Days 1 and 3) and feed (Days 2 and 4) days. Although other behaviours were fairly consistent over the four days (Fig. 5.11), the difference in pacing and resting over the days was noticeable. This is one variable that has to be taken into consideration. Also, because of the lateness of the enrichment toy being put in for the dogs on Day 2 of enrichment, its short-term efficacy with respect to mitigating stereotypic behaviours cannot be made. However, the dogs did spend a considerable amount of their day engaging with the enrichment on Day 1 of the enrichment trial. All of the dogs would periodically sniff, chew, play, drag, rub, and tug the toy provided throughout the day (Figs. 5.12-5.16) (Appendix 3.1 and 3.2).

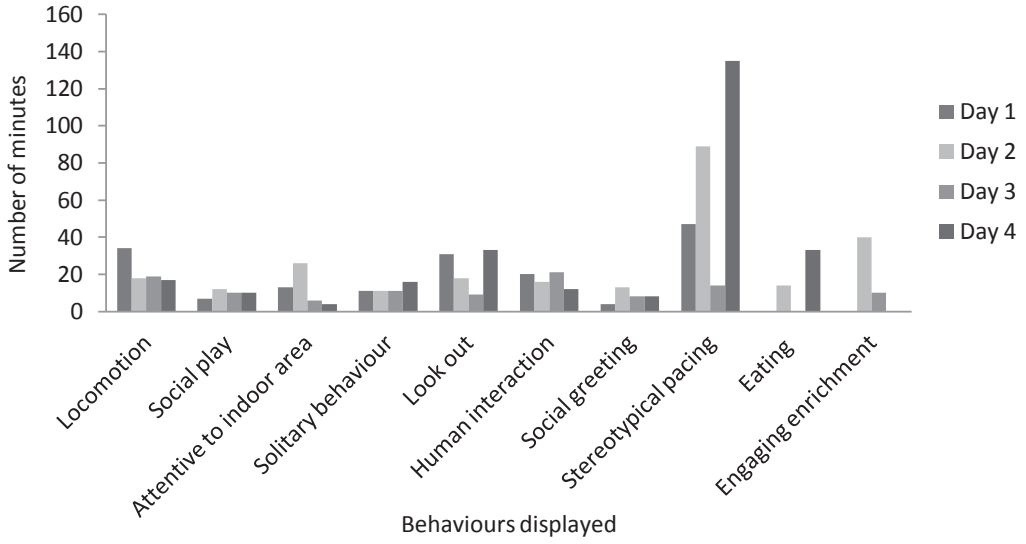


Figure 5.11. A comparison of the amount of time the African wild dogs spent displaying behaviours over the four day trial. Note: Resting was removed from graph because it comprised a large proportion (Day 1 268, Day 2 178, Day 3 327, and Day 4 167 minutes) of the dogs' day, making other behaviours hard to read. Total number of minutes observed each day = 435 mins.

Figure 5.12 African wild dog sniffing blood in buoy

Figure 5.13 African wild dog dragging enrichment toy

Figure 5.14 African wild dogs engaging with enrichment toy

Figure 5.15 African wild dog playing with enrichment toy

Figure 5.16 Two African wild dogs engaging with enrichment toy

The African wild dogs displayed stereotypic behaviours on all four days of the trial with it being more prominent on Days 2 and 4 which were also feed days (Table 5.4). Due to the lateness of the enrichment being introduced to the African wild dogs on Day 3 the percentage of enrichment time on Day 3 cannot be compared to Day 2 fairly.

Table 5.4 Total proportion of time the African wild dogs spent displaying stereotypic behaviours and engaging with the enrichment over four days (Total time = 1,740 mins – 435 mins per day). Days 2 and 4 were feed days and Days 1 and 3 were starve days. The greyscale rows in the table represent starve days.

Day	Stereotypic behaviours (%)	Engaging with enrichment (%)
1	10.8	-
2	20.5	9.2
3	3.2	2.3
4	31	-

5.3.2 Chimpanzees

The chimps spent a considerable amount of time with the enrichment toys on both enrichment trial days (Days 2 and 3, 18.6% and 17.6% of total observation time, respectively) (Appendix 3.3, 3.4, and 3.5). However, this enrichment did not have a drastic effect on reducing the frequency of any particular behaviour that was displayed on the two observational days before and after enrichment (Fig. 5.17). Although behaviours were relatively consistent across all trial days, the behaviours on Day 1 (other than resting and coprophagy) were higher (in terms of time spent) than on any other day. In comparison, on the days in which enrichment was provided, the chimps spent less time playing socially, vocalising, and engaged in less locomotion, human interaction, and coprophagy. Instead, the chimps engaged with the enrichment. On Day 4, the chimps spent the largest proportion of their day resting. This period of resting was considerably higher than that recorded for any other day; it may have been a result of the weather being cloudier and windier than that experienced on the other trial days. Although no hair picking/pulling was observed during this trial, there are signs (bald patches on all chimpanzees) that it is a chronic stereotypic behaviour problem in the troop. As all observations were carried out when the chimpanzees were in their outdoor enclosure during the day, none were carried out when they were contained inside and also during the night. This may be when this particular stereotypic behaviour may occur.

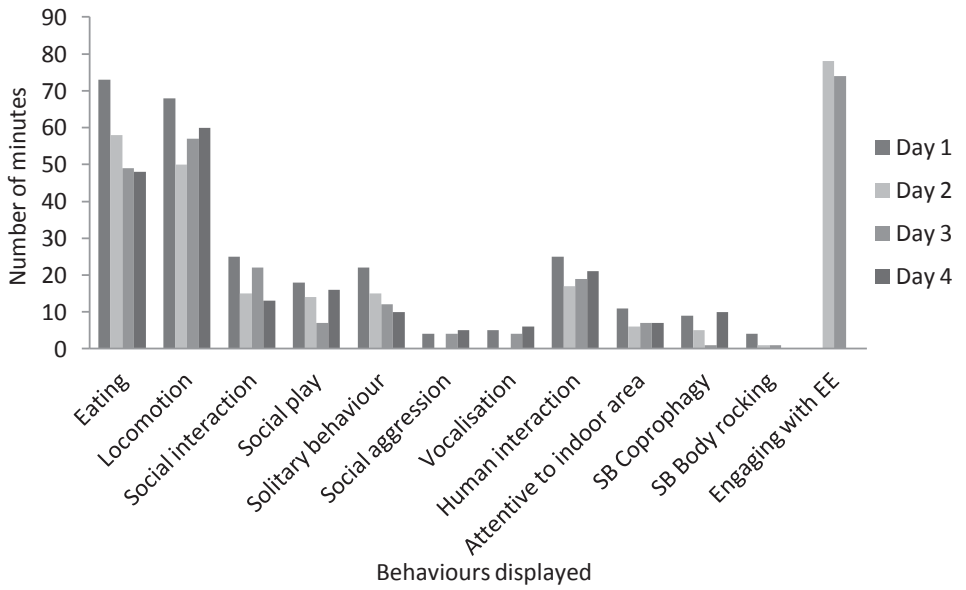


Figure 5.17 A comparison of the amount of time the chimpanzees spent displaying behaviours over the four day trial. Note: Resting was removed from graph due to it taking up a large proportion (Day 1 156, Day 2 161, Day 3 163, and Day 4 224 minutes) of the chimp's day and making other behaviours hard to read. Total number of minutes observed each day = 420 mins, i.e. less than for AWD.

The chimpanzees spent a considerable amount of time engaging with the enrichment devices (Figs 5.18 – 5.25) (Table 5.5) on days two and three of the trial and although they displayed stereotypic behaviours, the total proportion of time was low (Table 5.5)

Table 5.5 Total proportion of time the chimpanzees spent displaying stereotypic behaviours and engaging with the enrichment over four days (1,680 mins – 420 mins per day).

Day	Stereotypic behaviours (%)	Engaging with enrichment (%)
1	3.1	-
2	1.4	18.6
3	0.47	17.6
4	2.4	-

Figure 5.18 Young chimp and enrichment toy

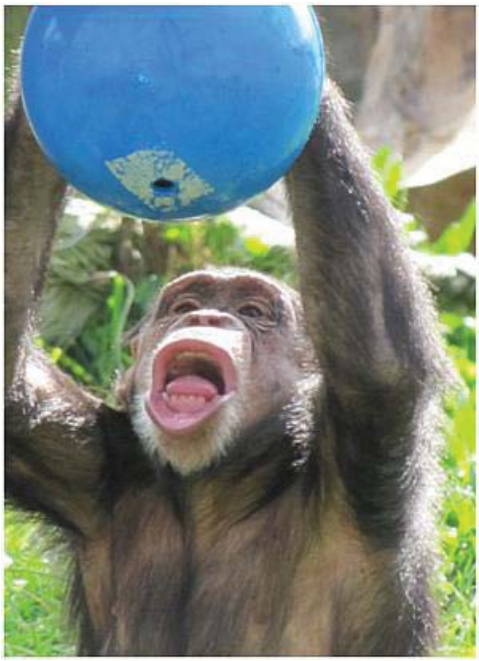


Figure 5.19 Young chimp and enrichment toy

Figure 5.20 Adult chimp with enrichment ice block

Figure 5.21 Two chimps investigating enrichment toy

Figure 5.22 Adult chimp trying to get peanut out of enrichment toy

Figure 5.23 Adult chimp getting out mealworms

Figure 5.24 Young chimp swinging on enrichment toy

Figure 5.25 Four chimps with the four enrichment toys

5.3.3 Giraffes

The behaviours displayed by all of the giraffes were fairly consistent over the four-day trial (Fig. 5.26). The only behaviour that was substantially different with respect to the length of display time was 'social harassment'. This 'harassment' behaviour was initially displayed on day 1 for 90 minutes but decreased to 34 minutes on Day 2 and 13 minutes on Day 3 to nothing on Day 4. On Days 1 and 2 the giraffes were confined to their indoor quarters, and therefore it was more difficult for them to move away from the herd or a problem individual, which may have generated this 'harassment' behaviour. Social aggression was also high on Days 1 and 2 compared with that on Days 3 and 4. In comparison, solitary behaviour was more prevalent on Days 3 and 4, when the giraffes were in their outdoor area, compared to such behaviour on Days 1 and 2. However, anticipatory pacing occurred on Days 3 and 4 only. Such pacing occurs on the perimeter of the giraffes' indoor enclosure before they are let in for the night, and before they are fed.

The giraffes spent only a small portion of the enrichment days with the toys provided (Appendix . The only difference between days with and without enrichment was time spent eating/masticating. This behaviour was lower on days with enrichment. No oral stereotypies were witnessed on Day 2, or head shaking on Day 1 of the four day trial.

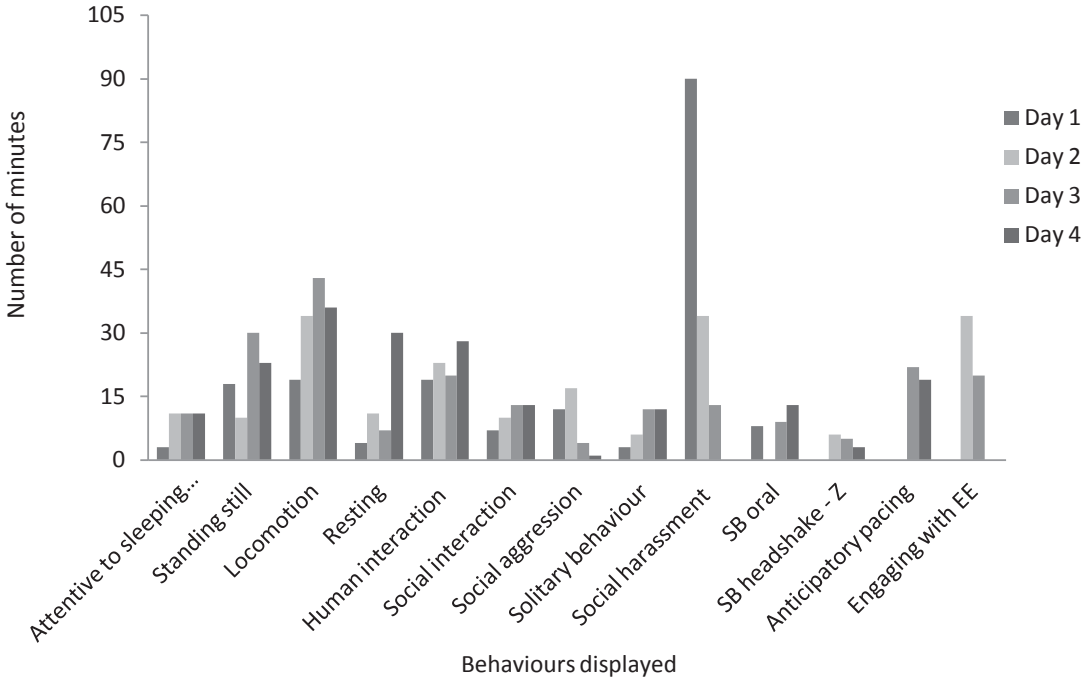


Figure 5.26 A comparison of the amount of time the giraffes spent displaying behaviours of the four day trial. Giraffes spent much of the day eating and this behaviour is not included on the graph. Giraffes spent 237 (Day 1), 224 (Day 2), 211 (Day 3), and 231 (Day 4) minutes eating. Total number of minutes observed each day = 420 mins.

Stereotypic behaviours were displayed on all four days of the trial and more so on Days 3 and 4 (Table 5.6). The proportion of time the giraffes spent engaging with the enrichment was higher on the first day it was introduced than the second (Table 5.6) (Figs. 5.27 – 5.30).

Table 5.6 Total proportion of time the giraffes spent displaying stereotypic behaviours and engaging with the enrichment over four days (Total time observed 1,680 mins – 420 mins per day). The rows in greyscale represent when the giraffes were confined inside.

Day	Stereotypic behaviours (%)	Engaging with enrichment (%)
1	1.9	-
2	1.42	8.1
3	8.75	4.76
4	8.3	-

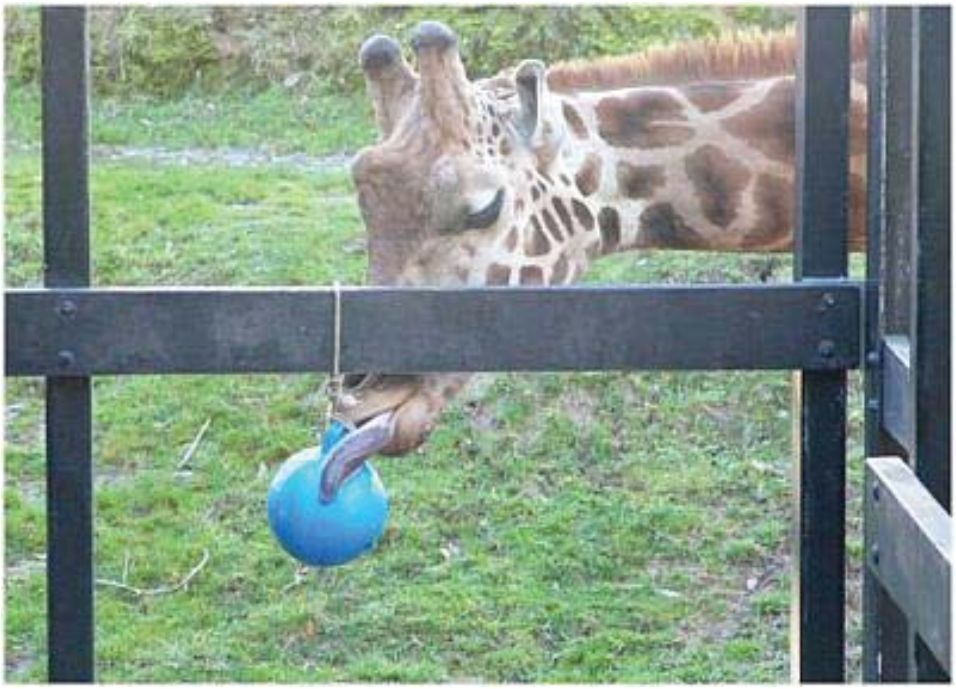


Figure 5.27 Giraffe licking carrot juice ice block

Figure 5.28 Giraffe sniffing fire hose ball

Figure 5.29 Giraffe investigating fire hose ball

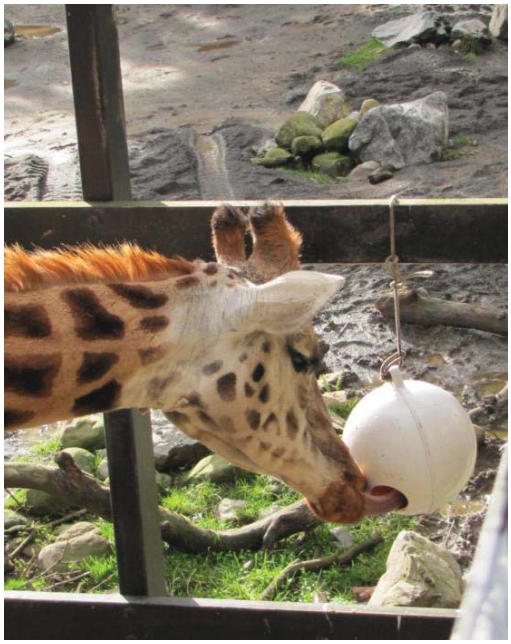


Figure 5.30 Giraffe feeding from enrichment toy

5.4 Discussion

5.4.1 Methodology

The methods used to test the effectiveness of short-term environmental enrichment devices on the expression of stereotypic behaviours by African wild dogs (AWDs), chimpanzees, and giraffes, were largely adequate. By initially establishing the frequency and duration of stereotypic behaviours, via observations, prior to the introduction and after the removal of environmental enrichment, I could assess the efficacy of the environmental enrichment trial by reference to the behaviours on the control days. Each trial lasted four days for each species, and pre- and post-environmental enrichment observations were carried out on Days 1 and 4. These pre- and post- environmental enrichment observations indicated a level of stereotypic behaviour.

A number of variables may have been assessed better if more observations had been undertaken over a longer period, but most of these variables, such as weather conditions, were uncontrollable, and managed as best as possible. For example, on the first two days of the giraffes' trial, it was too wet for them to be let into their day-time enclosure and so they were confined to their much smaller night-time quarters. Another variable, the alternation of feed days and starve days for the African wild dogs, resulted in the elevated occurrence of pacing on feed days. Due to unavailability of zoo staff, the enrichment device was not given to the dogs until late afternoon on Day 3 of the trial. This was uncontrollable by the researcher. Consequently, the conditions on the four trial/environmental enrichment days were not identical because of differences in weather conditions, housing, feeding regimes, husbandry procedures, and availability of zoo staff. Further details regarding these issues, and others that were encountered for each of the three species, will be discussed below (sections 5.4.2.1-5.4.2.3).

5.4.2 Case studies

5.4.2.1 African wild dogs

Carrying out observations prior to the introduction of enrichment allowed the daily 'routine' behaviours of the AWDs to be assessed. This assessment was to establish an understanding of how much time the animals spent engaging in different behaviours and, in particular, stereotypic behaviours. The time spent displaying a stereotypic behaviour could then be compared against the behaviours on two enrichment days and on the post-enrichment day to see if the enrichment had any effect on the length of time stereotypies were displayed. Pacing was the only stereotypic behaviour displayed by the AWDs and the enrichment did not have any effect on the proportion of time this behaviour was displayed. Although the pacing could be anticipatory behaviour because it coincides with the AWD feeding days, pacing also occurred on starve days thus indicating that some of the pacing could be classed as stereotypic behaviour. It may also be that the AWDs failed to recognise starve vs. feed days. Although research on AWDs with regard to stereotypic pacing behaviour is generally lacking worldwide (Price, 2010), some investigations have concluded that most pacing displayed is stereotypic and that training procedures or enrichment are beneficial for the long-term welfare of the animals. Anticipatory feeding behaviours, such as pacing, can result in pacing be more prevalent on feed days rather than starve days and arises because the animals are anticipating food and become restless. Anticipatory feeding behaviours, such as pacing, are hypothesised to occur because the animals are trying to mimic natural hunting behaviours where they would normally walk to locate and hunt prey. This behaviour (pacing prior to feeding) is not an uncommon behaviour displayed by captive AWDs although very little literature has been published on AWDS in captivity (Shyne and Block, 2010).

Because the AWDs have feed days and starve days, their behaviours differ markedly with respect the time spent pacing and resting on these two days. For example, in my study, the dogs' pacing behaviour was considerable higher on feed days than on starve days. They displayed little to no pacing on starve days as they were generally resting and were full and still digesting food from the day prior. This finding

could indicate that the dogs have learnt this feeding routine and therefore do not pace as much on starve days. They do, however, interact with humans for a similar amount of time on all four days, with a little bit more on starve days.

Although pacing was present on each of the four trial days, all of the AWDs did engage with the enrichment and spent a considerable amount of time with it throughout Day 2 (first day of enrichment) of the trial. Even though pacing was still present and was not affected by the presence of the enrichment device it indicates that the behaviour is driven by food and feeding. It indicates that the animals are anticipating food and are getting restless which could be their way of mimicking a hunt in the wild, as mentioned previously (Shyne and Block, 2010). When the dogs engaged with the enrichment device and after it was pulled down off the post to which it was attached, they periodically, throughout the day, dragged it around, rolled and rubbed their necks on it, played 'tug-of-war' and investigated it by sniffing, nuzzling, and chewing. If two of more dogs at a time were not engaging with it, others would approach the device after the others had left and the dogs shared it amongst themselves. On Day 2 of enrichment (Day 3 of the trial), the toy was not given to the dogs until 1530 pm in the afternoon because of the busy schedule of the zoo staff and therefore it cannot be used as a comparison day because the dogs only had 1.5 hours of observational time left. They did, however, engage with the toy shortly after they received it and displayed a similar behaviour as before, rolling and rubbing it and carrying it around. This late introduction of the enrichment device on Day 2 was unfortunate and in future more consistency should be carried out if possible.

For AWDs, there have been past trials using boomer balls, blood scents, and food items hidden in sandpits which have not been successful in alleviating stereotypic pacing but increased other behaviours such as locomotion and sniffing (Price, 2010). Price (2010) also concluded that some forms of enrichment were more successful in others. For example, hiding food in sandpits promoted more natural behaviours than that arising from the use of boomer balls, which was probably because of no hidden food providing sensory or instinctive behaviours (Price, 2010). The provision of training for husbandry purposes, e.g. health checks, by getting the AWDs to stand on

scales in a crate for food rewards, has, however, been successful in reducing stereotypic pacing (Shyne and Block, 2010).

In comparison, the enrichment in my study was successful in stimulating the AWDs but did not decrease the amount of stereotypic pacing. It would be beneficial and interesting to trial this project again but on more days. For example, the enrichment programme could be extended to allow a better comparison of the dogs' reactions to the device on starve versus feed days. The trial, however, was only for a short period and we might expect that with a longer trial the dogs would soon become habituated to the device. An eight day trial, for instance, would provide more observation days, and thus might give a better insight to the successfulness of the enrichment. Price (2010) found that although the AWDs were easy to distract with enrichment devices, they look interest fairly readily. She suggested that closer observations on time and habituation to enrichment devices by AWDs should be considered. Because AWD numbers are dwindling (there are approximately 3,000-5,500 left in the wild), and are classed as endangered by the International Union for the Conservation of Nature (IUCN, 2012), efforts to save them are imperative. The lack of research concerning the welfare of AWDs in captivity provides the perfect incentive for further research.

5.4.2.2 Chimpanzees

The chimpanzees responded well to the enrichment that was provided to try to alleviate the two stereotypic behaviours, coprophagy and body rocking, that they displayed. The enrichment devices did not completely eliminate the stereotypic behaviours but the frequency of those behaviours was lessened on the days (Days 2 and 3) the enrichment was provided. Coprophagy increased on Day 4 after the enrichment was removed. This increase in coprophagy was higher than that on the days with enrichment, and slightly higher than on day 1 prior to any enrichment being provided.

On Day 1, when no enrichment was provided, the chimpanzees spent more time eating, socially playing and intermingling, interacting with humans, being more attentive to the indoor area, and performing solitary, locomotive, and stereotypic

behaviours. In comparison with the amount of time spent displaying these behaviours on Day 1, the chimpanzees spent less time displaying these types of behaviours on Days 2 and 3 and instead engaged (nearly 20% of their day) with the enrichment devices. This result is similar to that from other studies in that enrichment was able to occupy the animals but did not ultimately change their daily behaviours (Bloomsmith and Lambeth, 2000).

Although not all of the chimpanzees could be individually identified, most of the chimpanzees were seen spending time investigating the enrichment devices throughout the days. Most of the engagement occurred when they were first let outside in the morning, and they became preoccupied with extracting the mealworms and peanuts from the buoys and drinking juice melting from the black-currant ice-block. As mentioned in the methodology section, only a single buoy containing mealworms (*Tenebrio molitor*) was provided on Day 2 (Day 3 of trial) of enrichment (because of low stocks) and two black currant ice-blocks were provided. This combination (more ice-blocks) proved to be better in terms of "long-term" enrichment as the ice-blocks lasted the entire day by slowly melting whereas the mealworms were gone within a matter of minutes. Although the mealworms did not last long, the chimps still investigated the buoy throughout the day and the two youngest chimpanzees (1.5 and 4.5 years old) took great delight in swinging and hanging off the empty buoy. A number of the chimpanzees became so engrossed in the enrichment devices that some of them, included the alpha male, on Day 2 of enrichment (Day 3 of trial), missed the midday chimpanzee talk and feeding session (where they would normally get fruit and interact with the keeper) and instead concentrated on extracting the peanuts. They were observed shaking the buoy (containing peanuts), tipping it upside down as they learnt the largest hole was at the top, and used fingers and twigs (tools) to extract the peanuts. These actions showed that they used their cognitive abilities to solve the problem at hand. In other studies, this behaviour, using tools to extract food (honey from a bottle), occupied the chimpanzees for a large proportion of their day but, again, no subsequent decline in abnormal behaviours was seen (Celli et al., 2003). However, it is important that food enrichment is provided even though stereotypic behaviours are not reduced because other natural foraging and tool use

behaviours increase (Celli et al., 2003). Wild chimpanzees also spend a large proportion (~50-80%) of their day foraging for food which often requires the use of cognitive skills, dexterity, tool use, and high levels of locomotion. However, because of the confinements of captivity, captive chimpanzees cannot partake in the same level of foraging activity, thus stimulations to generate these activities are needed (Celli et al., 2003). It is also important to mention that when using food enrichment it must be considered as part of the total diet although the food items used in this trial were treat food items only. This needs to be taken into account when feeding captive chimpanzees to ensure they get a balanced diet.

It was not only the chimpanzees that benefitted from the enrichment but also zoo visitors. I heard excited comments and positive feedback from a number of members of the public who enjoyed watching the chimpanzees interacting with the enrichment devices. This response is positive because it not only enhances the experience of visitors at the zoo but also it increases the zoo's reputation because the animals are perceived to be happier.

The chimpanzees rested for a longer time on Day 4 than on Days 1, 2, and 3, and this resting may have been because the weather deteriorated on Day 4 as it was cloudy and windy with patches of light rain instead of blue sky with sunny patches. Because of the rain, the chimpanzees spent more time sitting under their heated rock cave and hence less time foraging for food and picking grass. This may have been a cause of an increase in coprophagy on this day.

It is controversial whether coprophagy is a natural or stereotypic behaviour, or a nutritional disorder. Previously studies have shown that coprophagy is common amongst captive housed chimpanzees and is more prevalent in captivity than in the wild (Krief et al., 2004, Bertolani and Pruetz, 2011). Wild chimpanzees "sort" through their faeces for undigested seeds that have been softened after being passed once through the digestive tract (Krief et al., 2004). This "sorting" behaviour was not seen in these captive chimpanzees as they would catch their faeces and eat them straight from their hand and manipulate them with their tongues and lips. This suggests it to be of different origin/cause than the wild behaviour.

Although the enrichment provided did lessen the presence of coprophagy on the enrichment days, the trial would have to be carried out for a longer period to see if the enrichment is successful in alleviating this behaviour for the longer term. Thus, because of the limitations of the trial, and the increased occurrence of coprophagy on Day 4, I conclude that the enrichment was only partly successful in alleviating this stereotypic behaviour. Other studies, however, have concluded that endless enrichment programmes have not yet been successful in eliminating stereotypic behaviours in captive chimpanzees (Birkett and Newton-Fisher, 2011). This may be because the underlying needs have not been sufficiently met. Nevertheless, further enrichment trials of a longer duration, with a degree of variation to avoid habituation to the devices, would be beneficial for these highly intelligent animals as they require continuous and varying mental stimuli in confinement.

5.4.2.3 Giraffes

The giraffe trial was harder to manage and interpret than those of the AWDs and chimpanzees as the giraffes were contained in their indoor quarters on the first two days of the trial because of bad weather. The behaviours on those days differed from those seen on the last two days of the trial when the giraffes were kept outside during the day. The results showed that some problem behaviours, such as social harassment and aggression, were higher on the first two days because the female giraffes could not avoid the male giraffe as easily, who was hitting and trying to mount one of them. However, standing still, solitary behaviours, pacing, and oral stereotypies were more prominent on Days 3 and 4 when the giraffes were kept in their outdoor quarters. The pacing occurred ~1 hour prior to being let indoors for the night for dinner, and this pacing could be classed as anticipatory. However, longer trials would have to be carried out to see if pacing occurs at other times. An interesting aspect of these results, is that they suggest that the enclosure variable of indoor versus outdoor access has a greater effect on behaviour than the presence/absence of environmental enrichment. It may have been that because the giraffes were physically restricted inside that pacing could not be displayed to the same extent that it could be when they were kept outside. This indicates that poor welfare is not always the cause of stereotypic behaviours as one would generally think that being confined inside and

having less space would increase the frequency of stereotypic behaviours rather than the other way around.

Oral stereotypies in the form of licking bars, sticks, fences, and walls occurred on Day 1 but were more common on Days 3 and 4. On these days (3 and 4) the giraffe had enrichment for one of the days, Day 3. There was a problem regarding the location of one of the enrichment devices, the carrot juice ice-block, because it was tied to and hanging off bars that make up part of the giraffes' indoor enclosure that is semi-open because it is roofed and connected to their bedroom. The main problem was that as the carrot juice ice-block melted, it dripped onto the bars below, which the giraffes then licked. As a major aim of the enrichment programme was to *reduce* licking behaviour, then this location spot for the enrichment device was clearly problematic. The buoy that was used to make the ice-block was not obvious for the giraffes as the holes on the underside were too small. The enrichment devices were also suspended at quite a low height, which was potentially beneficial because it would be novel for the giraffes, but at the same time may also have meant the giraffes were less interested in engaging with them.

Since giraffes spend ~ 50-70% of their day grazing (Baxter and Plowman, 2001), once the food in buoys and fire-hose ball was gone, they became less interested in them. They continued to sniff and rub their heads on them, and stick their tongues inside throughout the day, but not often. The largest part of the giraffes' day was taken up with feeding or masticating on boluses of food but, as mentioned, stereotypies, in the form of pacing, were still displayed. Elsewhere, the provisions of more complex feeders (Fernandez et al., 2008) that increase tongue manipulation and prolong feeding time as well high fibre diets (Baxter and Plowman, 2001), have all reduced oral stereotypies but have not eliminated them. The application of chemical sprays on problem stereotypic licking areas has also been trialled but resulted in the giraffe finding new areas to lick (Tarou et al., 2003). Although the giraffes did engage with the two buoys and the fire-hose ball in my study, such interaction did not reduce oral stereotypies or have any effect on the pacing. Another cause of stereotypies may be boredom in between feeding times when the giraffes have to wait until their next feed. This time is often characterised by more frequent oral stereotypies. Increasing

the number of feeds throughout the day may mimic a more natural lifestyle and could be beneficial in at least reducing the presence of oral stereotypies (Baxter and Plowman, 2001).

Head shaking was only displayed by one giraffe and the reasons for this behaviour are uncertain. It tended to occur prior to the nightly feed when pacing behaviours began and the female giraffe would pace and shake her head simultaneously. It also occurred when a very noisy school group turned up for the giraffes' daily talk and feed. This behaviour suggests that it may be a coping mechanism.

Although the enrichment provided did not alleviate the stereotypic behaviours displayed by the giraffe, my observations were able to highlight a number of points and issues that need to be further addressed and researched, such as increasing feeding time to mimic more natural behaviours, which could reduce oral stereotypies. A similar lack of effect of environmental enrichment in giraffes has also been seen in other studies and so further research into overcoming these problems would be beneficial for captive giraffes to reduce the presence of stereotypies, and especially oral stereotypies.

Human and social interactions as well as locomotion were fairly consistent over the four day trial period. However, for three of the four days, this human interaction was only with the zoo staff and only on day four did the giraffes (only two animals, and the male more so than the female) participate in the daily giraffe talk and feed. On the other days, the giraffes did not willingly participate. I observed a visit by one large school group when the giraffes were locked inside. The giraffes became fairly restless and stayed away from the children. Although these 'meet and greet' events are an important educational tool, the behaviour of the children should be more closely monitored because their noise levels appeared to have a negative effect on the giraffes. During this daily talk (Day 2), and when feeding was meant to occur, none of the giraffes engaged with the keeper or members of the public, and the female giraffe shook her head a number of times. This may have been a sign of a coping behaviour.

Similar to research on AWDS, few studies have been published on the stereotypic behavioural problems that occur in captive giraffes and other exotic ungulates (Bashaw et al., 2001, Baxter and Plowman, 2001, Fernandez et al., 2008). Giraffes are known to perform oral stereotypies and pace in captivity. Although efforts to decrease this have been trialled with a number of enrichment programmes, it is still a problem in captive wildlife institutes (Bashaw et al., 2001, Tarou et al., 2003). Therefore, increased efforts to attempt to eliminate this behaviour should be made and further enrichment trials conducted.

5.5 Conclusions

Although the short-term enrichment provided for the African wild dogs (AWDs), chimpanzees, and giraffes did not have a substantial effect on the stereotypic behaviours displayed, the enrichment devices did occupy the animals when they were provided.

The pacing displayed by the AWDs primarily occurred on feed days rather than starve days which indicates that it could be an anticipatory feeding behaviour and not a stereotypic one. Pacing occurred only prior to feeding and not after the AWDs had eaten. This pacing may be the AWDs way of mimicking natural hunting behaviours. It may also indicate restlessness in anticipation of food rather than because the AWDs are bored, frustrated, stressed, or lacking stimuli. Therefore the findings do not necessarily mean that there are underlying welfare issues such as boredom because the animals may be exhibiting pacing to cope with captivity and to mimic natural behaviours. In any event, all of the AWDs engaged with the enrichment programme.

The pacing displayed by the giraffes is most likely to be a form of food anticipation as it too occurred prior to feeding and before the animals were let inside for the night. However, it occurred primarily when the giraffes were kept outside and not when they were confined indoors, which indicates that stereotypies are not always an indicator of poor welfare. Oral stereotypies, in the form of licking inedible objects, is a common stereotypic behaviour seen in captive giraffes and is thought to be caused by the lack of tongue manipulation and hunger arising from waiting between feeds. It

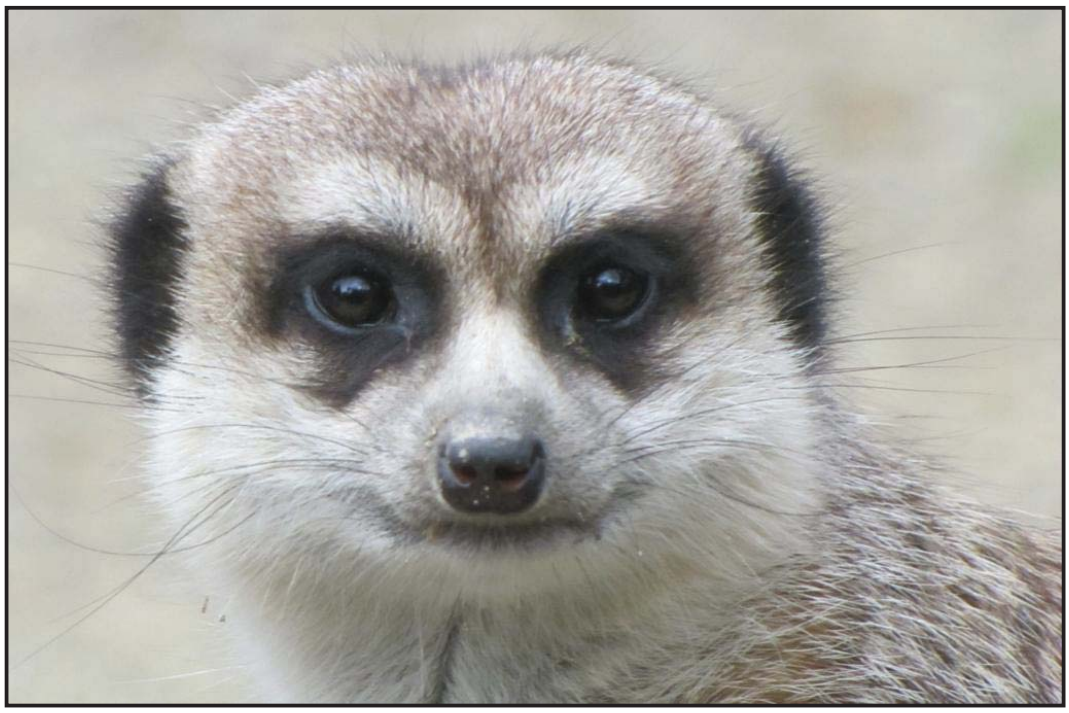
was displayed by the giraffes primarily on Days 3 and 4 and was not affected by the presence of enrichment and it occurred between feeds. The giraffes also licked the carrot juice from the dripping ice-block hanging off the bars above (a result of poor positioning of the device in this case). Care must therefore be taken to avoid positively reinforcing this stereotypic behaviour. The stereotypic behaviours displayed by the giraffes were exhibited primarily when they were confined to their outdoor enclosure. This occurrence suggests that the enclosure variable, indoor versus outdoor access, had a greater effect on behaviour than the presence/absence of environmental enrichment and that stereotypies are not always an indicator of poor welfare. However, although the enrichment device was engaged with, the giraffes essentially lost interest once the food had been consumed.

The stereotypic behaviours displayed by the chimpanzees, coprophagy and body rocking, were reduced in frequency because of the presence of enrichment but were not alleviated, a finding consistent with those of other studies. The chimpanzees spent nearly 20% of their day engaging with the enrichment when it was provided which was beneficial for their mental stimuli and for enhancing the viewing experience for members of the public.

Whilst all three animal groups engaged with the enrichment programmes, the level of engagement differed for the different species. Consequently, I conclude that the provision of enrichment alone does not alleviate stereotypic behaviours. Furthermore, although there is a large quantity of research about chimpanzees in particular, there are still gaps in understanding the mental capacities of chimpanzees and the reasons why stereotypies are displayed, and methods of alleviating stereotypies in chimpanzees are also not well understood. Much less research has been carried out on exotic ungulates, such as giraffes, and even less on AWDs. This shortage leaves lots of gaps not only in understanding the husbandry of the giraffes and AWDs but also regarding stereotypies and possible environmental enrichment devices to reduce them. An expansion on this research would be beneficial in an attempt to solve the pacing, oral, and other stereotypies seen in these three species of captive mammal.

Chapter 6

General discussion and conclusions



"People are not going to care about animal conservation unless they think that animals are worthwhile"

David Attenborough 1926 -

6.1 Chapter 3: Zoo staff perceptions on stereotypic behaviour

Stereotypic behaviour is well documented but remains a largely unresolved problem in the captive care of zoo animals. There are still numerous gaps in understanding this problem behaviour, including its underlying causes, why some species display it more than others, and how to treat it. As well, difficulties arise in attempting to define which behaviours should be classed as stereotypic. The attitudes of people to stereotypic behaviour can vary greatly, even though they may be working in the same field or at the same institutes. Zoo staff may acquire the perceptions based on the viewpoints of other zookeepers, from scientific papers and scientists, or form their own opinions about the subject based on their own beliefs, past experiences, and directly from their current working environment.

Survey results

When presenting zoo staff at three New Zealand captive wildlife institutes with a definition of stereotypic behaviour, I asked them in a specially constructed survey (Appendix 1) question about stereotypies and enrichment to gain an understanding about their attitudes towards them and enrichment. I asked them questions about which species they thought displayed stereotypies the most, whether any species that they currently looked after displayed them, and some possible causes and treatments, it was clear that most participants had formed their own opinions (Chapter 3). Although most participants held their own opinions, those at one institute, Institute 2, evidentially held very similar attitudes in responding to the questions. This uniformity indicated a degree of organisational culture which was discussed in Chapter 3. The responses from staff at Institutes 1 and 3, however, showed a wide range of views (i.e., many staff had formed their own opinions), and that they had drawn their own conclusions even though researches and captive wildlife institutes have tried to define stereotypic behaviour. The consensus was that stereotypic behaviours are undesirable because they are a possible indicator of underlying welfare issues. Moreover, most staff felt that environmental enrichment is potentially a good tool to alleviate these issues. Nevertheless, animals they currently care for are displaying stereotypies. The staff at all three captive wildlife institutes acknowledged that stereotypies are of

concern both from an animal's welfare perspective and also from public perception. There is a widespread belief that stereotypic behaviour cannot always be treated but the frequency of its occurrence can be diminished with treatments such as environmental enrichment.

However, this raises the concern that although zoos are a place of education and entertainment for members of the public. Zoos are also a place where research is conducted and where endangered species are bred in captivity. At the same time, the ongoing welfare of the animals is also a central issue that has not been fully addressed effectively. Some species clearly do not cope with life in captivity as well as others, yet remain there. Is captivity their only hope for survival? Survey participants indicated that cats (especially big cats such as lions *Panthera leo* and tigers *Panthera tigris*) and great apes (chimpanzees *Pan troglodytes* in particular) are species commonly seen displaying stereotypic behaviours. Great apes have been reported to display a whole array of different problem behaviours that are sometimes classed as stereotypic that include body rocking, hair pulling or picking, and head shaking. Coprophagy or the consumption of faeces, has also been classed as stereotypic in species such as the chimpanzee, but it is a behaviour that also occurs in the wild and so may be considered deliberate rather than stereotypic. Hence some authorities have suggested that coprophagy is natural because wild great apes, such as chimpanzees, consume their faeces for nutritional benefits and thus captive chimps must do so for these reasons also. However, some people have suggested that although some aspects of coprophagy are natural, a chimp that smears its faeces on an exhibit wall and proceeds to lick/eat them from the wall may be an expression of either a stereotypic behaviour or other class of problem behaviour induced by frustration and/or is undesirable. Pacing in big cats, which was covered in the Chapters 4 and 5, could be described as an anticipatory behaviour, not necessarily a stereotypic one, and it is displayed by the animals as a way to mimic natural hunting/feeding behaviours.

The underlying issues that are causing the display of stereotypic behaviour are still not understood. Most participants who partook in the survey felt that environmental enrichment, or the provision of items (such as food, toys, and odours), would alleviate stereotypic behaviour. However, environmental enrichment does not always result in

the alleviation of stereotypic behaviours but may reduce the frequency of it occurring. In hindsight, I would have liked to ask if participants felt that species that display high levels of stereotypic behaviour, which is clearly a consequence of underlying welfare issues, should remain in captivity and, if so, why. The findings of such a question would be informative in circumstances where a species' survival was not reliant on captive breeding, and where education and entertainment for members of the public were the main reason for holding that species. In other words, where survival of the species is in not paramount, then the animal's welfare should take precedent in a zoo situation rather than simply providing education and entertainment.

I would also like to further investigate the attitudes of participants concerning behaviours such as anticipatory pacing and coprophagy and whether they think these behaviours are stereotypic or not and why. Having more participants to undertake the survey from not only in New Zealand but also elsewhere would be interesting to compare the attitudes of captive wildlife institute staff about this topic from a wider international perspective.

6.2 Chapter 4: Observing animals for stereotypic behaviour

When carrying out the observations at the three captive wildlife institutes, I found that the chimpanzees and Sumatran tigers (*Panthera tigris sumatrae*) displayed levels of stereotypic behaviour or anticipatory pacing (by the tigers). Four other species, of the eight observed (Chapter 4) also displayed stereotypies which included the African wild dogs (AWDs) (*Lycaon pictus)*, Asian short-clawed otters (*Aonyx cinerea*), giraffes (*Giraffa camelopardalis*), and zebras (*Equus burchelli bohmi*). The two species that did not display any stereotypic behaviour were the meerkats (*Suricata suricatta*) and southern white rhinoceroses (*Ceratotherium simum simum*). Previous work has shown that some species are more likely than others to display stereotypic behaviours (Clubb and Mason, 2007, Mason, 2010), and my observations thus supported this finding.

The observation periods were carried out over four days at each of the three captive wildlife institutes and each species was observed for a total of 120 minutes at each institute. Within this time, a range of stereotypic behaviours was displayed

including (i) head shaking, body rocking, hair picking and engaging in coprophagy by chimpanzees; (ii) pacing by tigers, AWDs and giraffes; (iii) licking of inedible objects by giraffes and zebras; (iii) begging and circling by the otters; and (iv) head tossing and coprophagy by the zebras. Of these species, the chimpanzees, tigers, giraffes, and AWDs had the highest frequency of stereotypic behaviour. The possible reasons these species displayed these stereotypic behaviours were covered in Chapter 4. Key points that arose were the importance of the animals' welfare and underlying conditions that resulted in the displaying of stereotypic behaviour, and whether all the behaviours seen could be considered normal, stereotypic, or both e.g. was the pacing anticipatory and was the coprophagy by chimpanzees normal or stereotypic.

The animals studied at the three captive wildlife institutes were well cared for by zoo staff who were conscious that the animals' welfare is of concern. The animals were also part of current enrichment programmes being undertaken by staff at each institute and the displaying of stereotypic behaviour was taken seriously. Nevertheless, stereotypic behaviour was still occurring, with six out of eight species of mammal observed displayed stereotypies. This occurrence may be inevitable because captive conditions, no matter how good are they, are not as well balanced as in the wild. However, as mentioned previously, two species that did not show any signs of stereotypic behaviour were the meerkats and southern white rhinos, which also indicated that some species are easier to house in captivity than others as their needs seem to be met more easily. These two species are also quite different from each other, especially when it comes to size, thus indicating that size is not necessarily important. Perhaps species such as these should be kept in captivity for conservation, education, entertainment, and research purposes rather than species, such as chimpanzees and tigers, that clearly 'suffer' and are not as comfortable with life in confinement. The chimpanzees, I feel, should be of major concern, because they displayed a whole range of stereotypic behaviours (other behaviours not seen during my observations include self mutilation, fumbling nipples or genitals, poking anuses, and slapping body parts (Birkett and Newton-Fisher, 2011)), and they are intelligent animals that require a lot of stimulation. Carrying out more observations and concentrating on species that have been seen displaying stereotypies would be

beneficial for helping to pinpoint the underlying reasons why they are displaying the behaviour. However, even though some species, such as the meerkats and rhinos, did not display any stereotypies during this study it does not mean that they cannot develop stereotypies and hence should also be continually observed because stereotypies develop over time rather than appearing suddenly (Mason, 1993). Observations outside normal zoo opening hours, e.g. at night time, would also be beneficial as some stereotypies may occur during this time but not during the day. Night vision cameras would probably be most beneficial for those observations as the presence of a human would distract the animal by altering normal conditions. I would also like to investigate further the pacing that was displayed by the AWDs, tigers and giraffes, which were described as being anticipatory, and also the effects of starve and feed days on the tigers and AWDs.

6.3 Chapter 5: Effectiveness of short-term environmental enrichment on stereotypies

Out of the eight species of mammals observed for stereotypic behaviours, three species that displayed stereotypies were selected to trial the effectiveness of short-term environmental enrichment programmes (Chapter 5). These three species were the AWDs, chimpanzees and giraffes at the Wellington Zoo. As mentioned, they were selected because they were seen displaying stereotypic behaviours: pacing by the giraffes and AWDs, licking of inedible objects by the giraffes, and body rocking and (debatable) coprophagy by chimpanzees. Environmental enrichment is one commonly used method to help ameliorate stereotypic behaviours, but results are often mixed because there is no clear understanding of the factors that are contributing to animals' distress (Swaisgood and Shepherdson, 2005). However, prior to any enrichment being introduced to the species in this study, I undertook another day of observations for each of them to gain a better understanding of the occurrence of stereotypies throughout the day. I also used this extra period of observation to compare the frequency of stereotypic behaviour displayed prior to, during, and after its enrichment.

The enrichment devices used (see Chapter 5) were very similar for each of the three species and were changed slightly to suit each species. All were designed to be novel and to stimulate the senses of the animals. The devices incorporated food, sensory, physical, and cognitive enrichment treatment methods. The introduction of

the enrichment for the AWDs did occupy the animals throughout the day but, because of the late introduction of the enrichment on the second day of the trial, a good comparison could not be made. I concluded that although the enrichment provided some stimulation for the AWDs, their pacing was not alleviated. The experiment may have been impacted by the rotation of starve versus feed days for the AWDs, and hence the pacing may have been anticipatory behaviour prior to feeding.

Similarly, the giraffes engaged with the enrichment but once the food was gone they were less interested in it, although they did still investigate the devices intermittently throughout the day. The pacing that the giraffes displayed also increased on the days they were housed outside their sleeping quarters, which I concluded to be a form of anticipatory rather than stereotypic behaviour. Unlike the giraffes and ADWs, the frequency of stereotypic behaviours displayed by the chimpanzees did decrease while the enrichment devices were present in their enclosure but, overall, the enrichment did not alleviate the frequency of it.

These results indicate that short-term environmental enrichment is unsuccessful at reducing the frequency of stereotypic behaviours in AWDs, giraffes, and chimpanzees, although the behaviours were reduced when enrichment was present for the chimpanzees, and the animals did engage with the enrichment devices. Thus, short-term environmental enrichment is not a solution to alleviating stereotypic behaviours because the causes of them need to be treated also. Instead, enrichment activities should be used in conjunction with the treatment of the underlying causes of the stereotypic behaviour. In the future, I would like to trial enrichment for a longer period of time and on different species of animals, and try to determine the underlying causes of the stereotypies. I would also like to investigate why enrichment does not alleviate stereotypies even if underlying causes may be known. More work should also be carried out on those species that seem to ‘suffer’ more in captivity, such as the chimpanzees, that display a number of stereotypies as acknowledged by zoo staff in the survey, and as I have observed in the study before, during, and after the enrichment trials. In addition, the ability of zoos to satisfy the behavioural requirements of the diverse range of species they keep is often limited by lack of knowledge, limited availability of space, and insufficient funding (Clubb and Mason,

2007, Mason, 2010). Research concerning stereotypic behaviours and environmental enrichment is limited for many species kept in captivity (Swaisgood and Shepherdson, 2005, Melfi, 2009). Thus, expansion in this field is necessary for improving the long term welfare and possible survival of many endangered species.

6.4 Synthesis of stereotypic behaviour

Stereotypies include a wide range of behaviours that range from pacing, hair picking, self mutilation, and licking inedible objects. These types of behaviours are expressed by numerous species kept in captivity and it is thought that they are primarily being displayed due to underlying welfare issues. However, research has not yet been able to identify those welfare issues. For instance, we are able to look at the behaviours the animals display and come to a conclusion on what the behaviour means, but we are unable to know the motive is behind its expression as we cannot ask the animals directly. The management of animals kept in captive wildlife institutes (zoos) has drastically changed over time and many institutes are conscious about stereotypies and provide enrichment programmes for the animals to aid their welfare. However, due to the difficulty of identifying the underlying welfare causes, many institutes and researchers can only make good guesses based on observation and previous studies of stereotypic behaviour.

Past research has attempted to define stereotypic behaviour, but, as illustrated in Chapter 2, there are flaws in these definitions. For example, in some species coprophagy is considered a stereotypic behaviour and it may occur on a regular basis, but not in a repetitive manor like pacing. Similarly, pacing was displayed by the AWDs, giraffes, and tigers in this study, but for anticipatory reasons and not because of underlying welfare reasons. I feel that some behaviours are classed into the stereotypic behaviour category but, sometimes, not enough attention is given to why the behaviour is being displayed. More thought needs to be given about the term stereotypic behaviour and what it entails. It may need a new definition that encompasses behaviours that may be normal in some species such as coprophagy in chimpanzees, but it may become a stereotypic behaviour if displayed in excess, for example. A possible way to define stereotypies could be to look at groups of related

species, the stereotypies they display and for what reasons and have a number of definitions that suit different species. This might be a way to decrease the amount of uncertainty that surrounds whether a species is displaying a stereotypy or not.

6.5 Conclusions

In this study, I found that zoo staff acknowledged stereotypic behaviours and such behaviours are displayed by numerous species currently in their care or in previous institutes. Many survey participants considered that stereotypies are a concern, but also acknowledged that there a number of underlying causes that contribute to the problem. Zoo staff also agreed that enrichment is a good tool for the treatment of stereotypic behaviours and that some species are more susceptible to stereotypies than others – for example, cats and great apes do not cope as well in captivity as other species. Although attitudes were fairly consistent, Institute 2 participants showed more uniformity in their answers for a number of questions. This uniformity of responses by staff at Institute 2 possibly indicates a level of organisational culture influencing staff attitudes.

When observing eight selected species of mammal (AWDs, chimpanzees, giraffes, meerkats, otters, southern white rhinoceroses, tigers, and zebras) for signs of stereotypic behaviours, I documented stereotypic behaviours in six of the eight species listed above, but not in the meerkats and rhinos. These behaviours included pacing, licking inedible objects, begging, circling, head shaking/tossing, hair picking and body rocking. The underlying specific causes of these behaviours are unknown. I concluded that not all the behaviours could be classed as stereotypies. For example, the pacing behaviours exhibited by the tigers, AWDs, and giraffes were more likely to be anticipatory food behaviours as the behaviours occurred prior to the animals being fed. My observations also indicated that not all species are susceptible to stereotypies and that for some species, regardless of body size, welfare needs can be met adequately (e.g., the meerkats and rhinos displayed no signs of stereotypies).

The AWDs, giraffes, and chimpanzees kept at the Wellington Zoo were selected to test the effectiveness of short-term environmental enrichment. Although all three species engaged with the enrichment, it did not alleviate the frequency of

stereotypies, but the stereotypies did decrease when the enrichment was present for the chimpanzees. These results indicate that underlying factors that have caused the stereotypies to develop need to be addressed in conjunction with the development of environmental enrichment programmes to obtain optimum results.

Stereotypies are a sign that there may be underlying welfare issues, but it is difficult to pinpoint what these underlying welfare issues are. However, stereotypic behaviour is exhibited by animals in captive wildlife institutes worldwide and zoos recognise the need to understand and manage both the behaviour and its causes. Environmental enrichment is a method used to alleviate the frequency of stereotypies, but on its own is not adequate and needs to used in conjunction with treating the underlying causes of them problem. Captive wildlife institutes are likely to continue because the future survival of animals is of high importance, as is educating the public about animals. However, the well-being of captive animals must be paramount, and so their welfare must be maintained and improved to the highest possible standard.

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Photographs.

All photographs were taken by L.R. Lowe (2011-2012) unless stated.

Firehose ball: Accessed 16.5.12 from:

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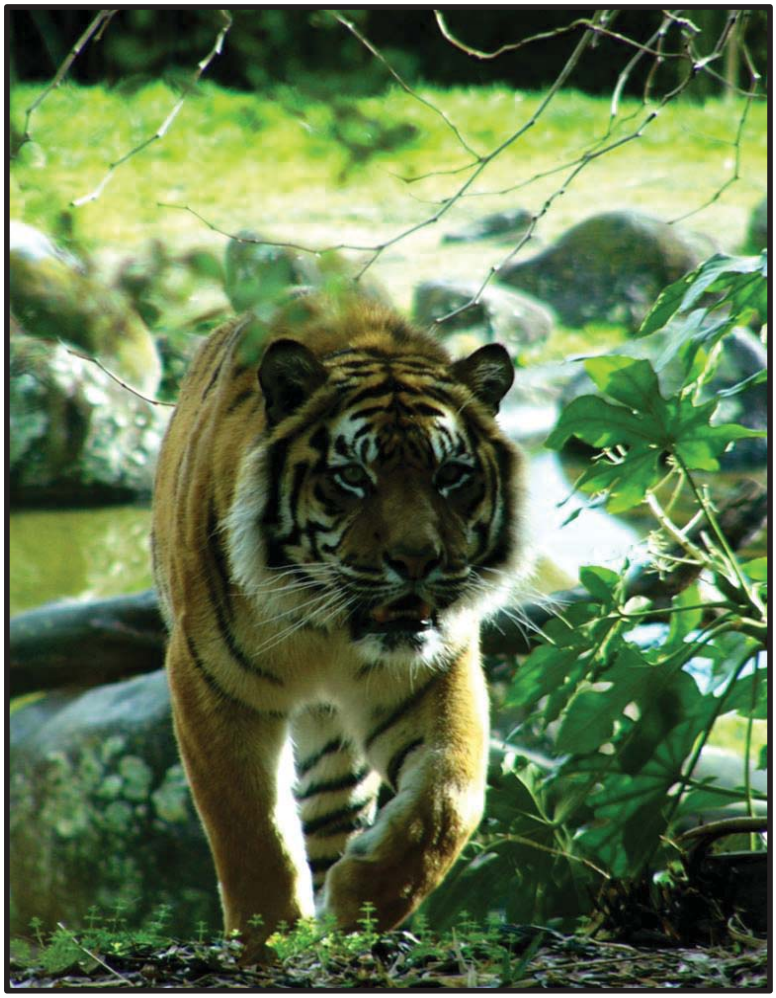
Appendices



"Some people talk to animals. Not many listen though. That's the problem"

A.A. Milne 1882-1956

Appendix 1. Questionnaire

Introduction

Firstly, thank you for participating in this survey. Your input is greatly appreciated.

I am a fifth year student at Massey University studying towards a masterate in zoology. I am undertaking research that examines risk factors associated with stereotypic behaviours in captive mammals. For the purpose of this survey I am defining stereotypic behaviours as "a series of movement of whole body parts of an animal's body which are repeated regularly and which serve no apparent function". Such movements include pacing, hair pulling, and body rocking. There will be an opportunity at the end of this survey to comment on this definition.

To help determine risk factors this survey has been designed and directed at zoo staff to help me understand how they perceive stereotypic behaviour.

This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researchers named below are responsible for the ethical conduct of this research. If you have any concerns about the conduct of this research that you wish to raise with someone other than the researchers, please contact Professor John O'Neill, Director, Research Ethics, telephone 06 350 5249, email: humanethics@massey.ac.nz.

Please note that by participating in this survey you are agreeing to and providing consent to partake in this research project. Please also note that the questionnaire is anonymous and all survey responses will be destroyed upon completion of the project. Once again, I would like to thank you in advance for your time and participation in this survey. The survey will take about 20 minutes to complete.

Researcher: Lydia R. Lowe

Chief Supervisor: Assoc. Prof. Brett Gartrell

Questionnaire

Q1 What zoo do you currently work at?

- Auckland Zoo
- Hamilton Zoo
- Wellington Zoo

Q2 What title best describes your position at the zoo you currently work at?

- Keeper
- Curator
- Management

Q3 Gender

- Male
- Female

Q4 How old are you?

Q5 How many years have you worked in the zoo industry?

Q6 How many years have you been working at the zoo at which you are currently employed?

Q7. List the mammals for which you currently provide care.

Q8. Have any of the mammals that you currently care for displayed a stereotypic behaviour?

- Yes
- No (if you select no you will skip questions 9-11 and go to Q12)

Q9,Q10, and Q11. With respect to the animals you currently care for, please indicate which species displayed the stereotypic behaviour and what the behaviour was? This table was split into three tables for the questionnaire to make it easier to read the SB categories across the top.

Species	Locomotion (e.g. pacing, pattern swimming)	Self mutilation (e.g. hair pulling, biting)	Oral (e.g. licking or chewing of inedible objects)	Repetitive body movements (e.g. swaying, body rocking)
Egg laying mammals				
Marsupials				
Bats				
Insectivores (e.g. moles, shrews, hedgehogs)				
Rodents (e.g. agouti, squirrels, mice, rats, capybara, porcupine				
Anteaters and relatives (sloths, pangolins, armadillos)				
Rabbits, hares, and pikas				
Dogs and other canids (e.g. foxes, dingoes, wolves, coyotes)				
Bears and giant panda				
Raccoons				
Red panda				
Mustelids (e.g. otters,s skunks, stoats, weasels, ferrests, minks, badgers)				
Cats (e.g. lynx, serval, tiger, puma, leopard, cheetah, lion)				
Civits and relatives (e.g. meerkats, mongoose)				
Hyenas and aardwolf				
Great apes (e.g. gibbon, siamangs, chimpanzee, gorillas, orang-utans)				
Monkeys (e.g. capuchins, tamarins, baboons, mandrill)				
Prosmiians (e.g. lemurs, loris, tarsier, aye-aye)				
Horses and relatives				

(zebra)				
Tapier				
Rhinoceros				
Giraffe and okapi				
Deer				
Cattle and relatives (e.g. sitatungas, buffalo, bilgai, bison, oryx, wildebeest, springbok, impala)				
Camels and relatives (e.g. llamas, alpacas)				
Pigs				
Peccaries				
Hippopotamus				
Aardvarks				
Elephants				
Cetaceans (whales, dolphins, porpoises)				
Seals and sea lions				
Dugongs and manatee				

Q12. From what you have experienced in your career, which species most often displayed stereotypic behaviours?

Q13. Rate the extent to which you think, in general, the following factors contribute towards the development of stereotypic behaviour.

	I don't know	Not a contributor	Low contributor	Medium contributor	High contributor
Abnormal social groups					
Unnatural lighting (e.g. cycles, intensity)					
Unnatural sounds (to the animal e.g. machinery)					
Restricted area					
Absence of retreat space					
Forced proximity to humans					
Restricted feeding and foraging opportunities (e.g. food in a bowl and not hidden/scattered around enclosure)					

Unnatural odours					
Husbandry procedures (cleaning and disturbing animal)					
Lack of environmental enrichment (e.g. natural, trees)					
Lack of structural enrichment (e.g. human made structures, swings)					
Lack of behavioural enrichment (e.g. work for food)					
Unnatural temperatures					
Unsuitable enclosure design					

Q14.What single category of stereotypic behaviour do you think is most common in zoo mammals?

- Locomotion (pacing, pattern swimming)
- Self mutilation (biting, hair pulling)
- Oral (tongue twisting, licking and chewing of inedible objects, crib biting)
- Repetitive body movements (body rocking, head tossing, swaying)

Q15. Please rate the following question using the scale below

From an animal's perspective, stereotypic behaviour is....

Undesirable Neutral Desirable

Q16. To what extent do you agree with the following statement, from an animal's perspective.

"I believe stereotypic behaviour is a desirable behaviour because it is a good coping mechanism"

- Never
- Rarely
- Occasionally
- Usually
- Always

Q17. To what extent do you agree with the following statement, from an animal's perspective.
"I believe stereotypic behaviour is undesirable behaviour because it indicates a level of distress and underlying welfare issues"

- Never
- Rarely
- Occasionally
- Usually
- Always

Q18. Please rate the following question using the scale below

From the public's perspective, stereotypic behaviour is...

Undesirable Neutral Desirable

Q19. To what extent do you agree with the following statement, from the public's perspective.
"I believe that stereotypic behaviour is a desirable behaviour because the animals look occupied, can be more easily seen and provide entertainment"

- Never
- Rarely
- Occasionally
- Usually
- Always

Q20. To what extent do you agree with the following statement, from the public's perspective.
"I believe that stereotypic behaviour is an undesirable behaviour because it indicates a level of distress and underlying welfare issues"

- Never
- Rarely
- Occasionally
- Usually
- Always

Q21. In general, do you treat an animal with stereotypic behaviour if it is being displayed?

- Yes
- No
- Sometimes

Q22. Rate the extent to which you think, in general, the following possible solutions contribute towards the treatment of stereotypic behaviours.

Treatment	**I dont'know**	**Now a contributor**	**Low contributor**	**Medium contributor**	**High contributor**
Ignore it					
Environmental enrichment					
Behavioural enrichment					
Alter social interactions					
Medical therapy					

Q23. How do you measure the success of your treatment of animals exhibiting stereotypic behaviour?

- We don't
- When the animal no longer displayed the stereotypic behaviour
- When the stereotypic behaviour has diminished

Q24. Stereotypic behaviour is often defined as "a series of movements of whole body parts of the animal's body which are repeated regularly and which serve no apparent function". Do you agree with this definition?

- Yes (go to Q26)
- No
- Neutral

Q25. Please explain why you answered no or neutral to the definition "a series of movements of whole body parts of the animal's body which are repeated regularly and which serve no apparent function".

Q26. Is there anything that you would like to add or comment on?

- No (go to end)
- Yes

Q27. Please feel free to add your comments.

Thank you once again for participating in this survey. If you have any further questions please feel free to contact me via email or phone. Lydia

Appendix 2. Stereotypic behaviours (videos)

Please see enclosed CD Rom that contains some short videos of the stereotypic behaviours displayed.

2.1 AWD's pacing

2.2 Zebra coprophagy

2.3 Otter circling

2.4 Giraffe licking

2.5 Giraffes pacing and licking

2.6 Giraffes pacing

2.7 Chimp coprophagy

2.8 Chimp body-rocking

2.9 Tiger pacing

Appendix 3. Engaging with environmental enrichment (videos)

Please see enclosed CD Rom that contains short videos of the animals engaging with the environmental enrichment devices provided in this study.

3.1 AWDs & EE1

3.2 AWDs & EE2

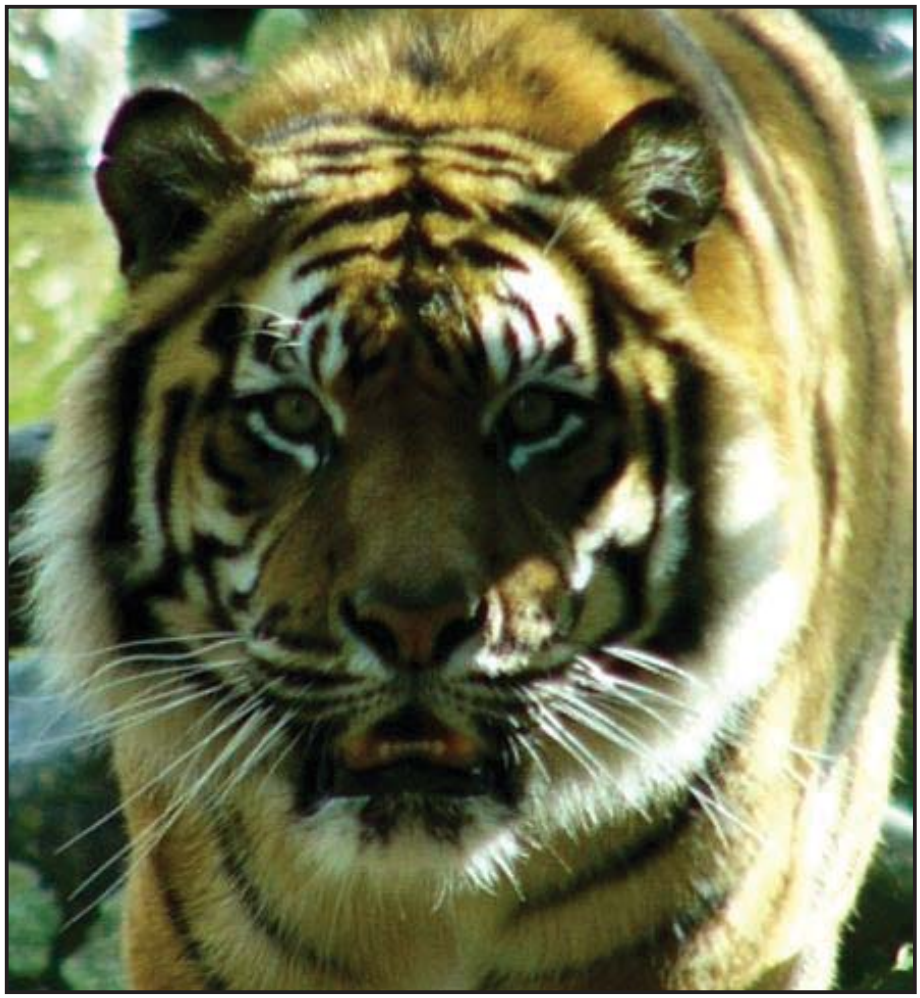
3.3 Chimps & EE1

3.4 Chimps & EE2

3.5 Chimps & EE3

3.6 Giraffe & EE1

3.7 Giraffe & EE2



“Who can believe that there is no soul behind those luminous eyes?”

Theophile Gautier 1811-1872