16+ Animal Behaviour

Student resource

Marwell Wildlife

Marwell Wildlife is a conservation charity dedicated to the conservation of biodiversity and other natural resources. Just by visiting us, you'll be making a big contribution to our projects to conserve species and habitats.

Ethology: The study of Animal Behaviour

Modern behaviourists attempt to explain behaviour patterns in terms of the underlying physiological processes involved, i.e. the operation of the sensory nervous system. In the past field based studies and laboratory based studies have both been used to study behaviour (for example, measuring hormone levels in the blood) to try and gain an understanding of motivation, stimuli and responses involved.

In a captive situation, as seen at Marwell, an understanding of animal behaviour is essential to ensure that animal welfare is kept to the highest standard.

What is behaviour?

Behaviour can be defined as the actions or reactions of an individual animal in response to external or internal stimuli. Basically, behaviour is anything an animal does (for example walking, sitting, sleeping and eating). The only time an animal is not behaving is when it is dead.

A stimulus is essentially anything that elicits a response and these can be either internal (inside the body) or external (outside the body). **There are three main types of stimuli:**

1. **Motivational** Motivational stimuli **encourage** the animal to act or react (behave) e.g. the physiological state of being hungry is a motivational stimulus, it encourages an animal to search for food.

2. **Releaser** Releaser stimuli may appear simple but can elicit a series of complex behaviour patterns, e.g. the red dot on the beak of an adult herring gull stimulates the chick to peck it, and this in turn causes the adult bird to regurgitate food which the chick can then eat.

3. **Terminating** These stimuli bring a particular behaviour to an **end**, e.g. a full stomach terminates feeding behaviour.

Before behaviour takes place in response to a stimulus, the animal becomes motivated.

Motivation originates from the animal's internal physiological state, as governed by various hormone levels in the blood. These may be controlled by external or internal factors known as motivational stimuli.

In birds, for example, sexual behaviour is induced by increasing day length. Receptors in the eyes detect the daylight and send nervous impulses which result in the pituitary gland releasing gonadotropins which bring the bird into a reproductive state. The bird is now motivated and will respond positively to releaser stimuli such as the appearance of a potential mate.

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Behaviours occur after a series of events take place. This series of events leads to specific behaviours such as hunting in cheetah.

The following flow charts show how the events occur in any given situation and also specifically for the cheetah example.

Internal/external stimulus occurs

↓

This causes a change in the physiological state of the individual

↓

The change creates a motivation in the individual

↓

The release stimulus occurs

↓

The behaviour occurs

↓

The terminating stimulus occurs

Contractions of the stomach wall/drop in blood sugar levels

↓

The individual cheetah feels hungry

↓

The individual starts to roam and look for prey

↓

The cheetah sees a suitable prey individual

↓

Hunting begins

↓

As the individual has eaten, the stomach walls no longer contract so the individual no longer seeks food

Types of behaviour

Behaviour is a result of interplay between an organism and its environment. In the classical study of behaviour there is a lot of "pigeon-holing", but in reality it is usually impossible to look at particular aspects of behaviour in isolation.

1. Species-specific behaviour

This is a behaviour pattern common to all members of a species, e.g. courtship display, territorial marking, etc. It may be referred to as **instinctive or innate** in as much as it occurs in individuals reared in isolation. Individuals are born 'knowing' to behave in this way.

2. Individual-specific behaviour

Includes patterns learned during an animal's lifetime, e.g. dogs learning tricks, blue tits removing milk bottle tops. This can also be referred to as **acquired** behaviour. Animals may learn or acquire new behaviours through experience.

A particular behaviour pattern will inevitably be the result of 'innate' and 'acquired' behaviour and will be modified by the demands of the environment.

Learning and behaviour

Learning is an adaptive change in behaviour as a result of experience. It involves changing old behaviour patterns and developing new ones in response to changing environmental conditions. Such behaviour cannot be inherited, however intelligence, and therefore the capacity to learn, can.

Learning can be divided into five categories, although not all species of animal exhibit all of these types of learning.

1. Habituation

If an animal is repeatedly subjected to a harmless stimuli (one with no positive or negative consequences) it may cease to respond to further stimulation by this stimulus.

In this way the performance of unnecessary behaviour is prevented. By eliminating unnecessary behaviour, an animal can spend more time on useful activities such as feeding. An example of this includes a snail which ceases to withdraw its eye stalks when repeatedly touched with no positive or negative consequences.

2. Associative Learning

An animal learns to associate a particular response with a reward or punishment, and adapts its behaviour accordingly.

ii) Classical conditioning (the conditioned reflex)

The classic example of associative learning is demonstrated by **Ivan Pavlov** and his salivating dogs. Ivan Pavlov was a Russian physiologist who observed the learned response of salivation to other stimuli whilst studying digestion in dogs. Pavlov then investigated how the dogs learned or acquired this behaviour and found that he could condition the dogs to salivate to the sound of a bell. This meant that the bell had gone from being a neutral stimulus to a conditioned stimulus, and the production of saliva in response to hearing the bell meant that this was now a conditioned response. This is illustrated below:-

1. **When a dog sees food (unconditioned stimulus), the natural reflex response is to salivate (unconditioned response).**


2. **Pavlov showed a dog food and rang a bell (neutral stimulus) at the same time. The dog salivates.**



3. **After a period of conditioning (showing the dog food whilst ringing a bell) Pavlov just rang a bell (now a conditioned stimulus). The dog still salivates (now a conditioned response). The dog has learnt to associate the sound of the bell with the presence of food.**


Conditioning is not just something that takes place in the laboratory; there are many examples of conditioned responses in the wild. For example: when a young animal relates the sight of a predator, (the unconditioned stimulus) with the need to flee (the unconditioned response). In time the animal may learn to associate the behaviour or alarm calls of other species with the appearance of the predator. This means that over time the animal will learn to flee as a result of hearing just the alarm calls of the other species; in which case the alarm calls are the conditioned stimulus and fleeing the conditioned response.

ii) Operant conditioning (trial and error learning)

In this form of learning, the animal associates **rewards or punishments** with its behaviour. **Edward Thorndike** used a puzzle box which could be opened from the inside with a lever. A cat was shut in the box. Eventually, by exploring its surroundings, the cat would trip a lever that opened the door. On repeated trials the cat increasingly concentrated its efforts around the site of the lever until it learned to move directly to the lever and open the door. The cat had learned to concentrate on rewarding behaviour, associating pressing the lever with the reward of getting out of the box.

The development of co-ordination in young mammals and birds is probably due to trial and error learning. There are also many examples of species accessing 'tricky' food resources, such as monkeys getting nuts out of their shells by hitting them off certain rocks, and this must have been learnt through a trial and error process.

Intelligence is sometimes measured by the time an animal takes to cease making errors, the complexity of the situation to which it can respond and the period it retains information.

iii) Latent (exploratory) learning

Many animals explore their surroundings and store useful information for future use. For example, baby monkeys observe their parents smashing nut shells to access the nuts by hitting them off the rocks but they do not carry out this behaviour themselves until they are older. They can do this without being directly taught by their parents because they have learnt it through observation. This form of behavioural learning is characteristic of more intelligent animals and is invaluable to survival in a complex environment.

3. Insight learning

Intelligence can, in part, be assessed by the complexity of a problem solved and the speed at which it is done. In humans, a sudden 'brainwave' can overcome an apparently insoluble problem. Insight is often described as the ability to reason, to draw together past experiences and apply them to new situations. Insight learning has been credited to humans and to chimps.

4. Imprinting

Is a behavioural characteristic of vertebrate young. During a critical time, often the first few hours after hatching/birth, offspring learn to recognise their parent/s and follow them. Imprinting is both an example of **innate and acquired** behaviour – the young will instinctively form a social attachment during this critical time, but they have to learn to recognise the individual they imprint on as their parent/s.

Konrad Lorenz showed that newly hatched goslings followed the first moving object they saw... be it a goose or a human.

In the wild, parents would usually be the first object seen – imprinting on them means youngsters would be less likely to get lost.

In captivity, imprinting can cause all sorts of problems. An animal that is hand-reared by its keeper can be difficult to reintroduce to a group of its own species. Great care must be taken to minimise 'humanisation'.

5. Memory

All learning requires some sort of memory; in simple organisms memory may consist of chemical blockers at a synapse. 'Intelligent' animals have far more complex storage and retrieval systems, usually associated with the major sense organs and always linked to the rest of the body via an intricate nervous system.

Why study animal behaviour?

There are many different reasons why you may want to study behaviour.

You might be personally interested in a certain species and therefore wish to learn more about their behaviours and try to ascertain what these may mean. Dian Fossey and Jane Goodall are people who have spent most, if not all of their lives, observing primates to learn more about their behaviours.

Alternatively, you could be looking at behaviour to improve productivity. For example, dairy farmers aim to produce as much high quality milk as they can. Therefore they may study the effects of different feeds/environments on the productivity of the dairy cows to see which supports the greatest yield.

Breeding behaviour is very important both for productivity and also in terms of conservation. Whilst a livestock owner may study their cattle to determine the best environment for the production of offspring for profit, conservation organisations will aim to study threatened species to determine the most effective environment to support breeding and increase the captive population for future reintroduction. An example of this is that of the giant panda where for many years there was great concern over the lack of any breeding behaviour and the failure to mate in captivity. After much research it has been found that the addition of high vegetation and climbing opportunities within their enclosure along with secluded areas encourages breeding behaviour.

When conserving a species you would not only want animals to breed effectively, but you would also want to promote natural behaviours. This is important for the wellbeing of the animals and is also important if we hope to reintroduce a species back into the wild one day. This is another reason you may choose to study animal behaviour.

Planning a behavioural study

Step 1: Identify your aim

The first step to working out your aim is to identify the independent and dependent variables in your experiment. The independent variable is the factor that you, as the researcher, will manipulate. The dependant variable is what you will measure. The independent variable can be manipulated either directly or indirectly. For example, independent variables might include the addition of enrichment devices (directly controlled by you) or visitor numbers (an indirect measure since you cannot control it). The dependent variable might be position of the animal(s) in the enclosure or behaviour frequencies or durations.

The dependent variables that you may wish to observe could include: use of apparatus within the enclosure, modes of locomotion, general behaviour, facial expressions, hierarchy within the social structure and social interactions.

If your project requires observation of detailed behaviour you will need to construct an ethogram through observations of your chosen species before you start. An ethogram is a detailed list of objectively described, mutually exclusive behaviours that you can focus on to answer your research question. These behaviours provide you with measurable units for which you can record frequencies and durations or latencies. To determine these behaviours you will need to carry out a preliminary observational study of your chosen species. This study will also provide you with information that will allow you to work out how many hours you will need to complete your research project.

Think carefully about the context of your data collection – what else might be going on at the same time and possibly affecting it? Eliminate as many confounding variables as possible so that the only factor/s that affects your dependent variable is/are your independent variable/s. Those that cannot be eliminated should be controlled for as far as possible and acknowledged and discussed in your evaluation.

For the purpose of your trial study here at Marwell you will be doing a comparative study of general behaviour. This means that you will be comparing the behaviour of two individuals. These could be two individuals of the same species or different species. Again you should consider variables, especially species of different physiological forms. For example comparing the behaviour of a scorpion and a penguin is not ideal as you are introducing too many variables.

Step 2: Choosing sampling methods

Once you have determined your aim, you can determine the type of data you need to collect. The variables you measure should be chosen to best describe what is of interest to answer the research question. To avoid taking unnecessary data remain focused on your aim.

For example, instead of collecting general data on, for example, everything that each individual of a group does, you might focus specifically on where individuals are found in the enclosure and behaviour shown there. If you are looking at the effect of enrichment devices, you might focus on behavioural elements relevant to that device but it would not be necessary to collect data on other details such as social behaviours.

There are two main types of sampling method, these are:

1. Focal animal sampling

For this type of sampling, you focus on one individual for a fixed period of time and record its behaviour either continuously or at fixed points in time.

2. Scan sampling

At fixed intervals in time scan the whole group of animals and record the frequency of selected behaviour categories (these will have been determined during your preliminary study).

You must ensure that you are using the most appropriate sampling method to answer your question. This is important as it will determine whether the data you collect is suitable for statistical analysis if it is required.

Step 3: Data collection

The major area of concern, when observing animals, is how to achieve an accurate study whereby they have not been disturbed by your presence. You could spend a great deal of time with them to acclimatise them to your presence however your presence may affect other species nearby, which could influence the behaviour of the animals you wish to study. This is something you will have to consider when choosing your method of data collection.

There are several methods that you can use, each of which has its associated problems, these include:

- Using still photography or a hand-held voice recorder – your presence and the sound of the camera/your voice could influence behaviour.
- Using a camcorder – this could be hidden in the enclosure, however more inquisitive species could become interested in the equipment itself.
- Using a notepad and shorthand – your presence could influence their behaviour therefore you could hide yourself.
- Record on a data table with tick boxes – same issues with your presence.

You also need to determine when you are going to collect the data. You will need to consider the time of day, visitor numbers, temperature, weather conditions, animal breeding season, etc. You will need to make sure you plan your data collection so that you have enough time to answer your questions and allow extra time for unexpected problems. Please note that when interpreting the results of a short-term project that the outcome cannot be seen as being representative for the animals' behaviour all year round.

The length of time needed for your study will depend on your question (aim), the species, the sampling methods being used and the environment that the species are in.

The number of observations you take will depend on how many animals you have available, how many different experimental conditions you are planning to compare, the probability tests you have decided to use (if any) and how strong the effect of your independent variable is. You will also need to decide how long you will leave between sampling periods (among other factors, this will depend on the duration of the behaviours observed) and how you will avoid bias when choosing a subject to sample. It is important that these issues are carefully considered to avoid generating errors in interpreting results and/or any statistical analyses. If certain individuals are more active/visible, their behaviour maybe recorded repeatedly (and so be over-represented in the results) instead of obtaining data from all individuals evenly.

Once you have planned your data collection it is very valuable to carry out a pilot study to iron out any unforeseen problems with your research design or sampling strategies. It also enables you to judge realistically how long the data collection for the whole project will take and to plan a timetable accordingly (with extra time added for further unforeseen problems).

Step 4: Interpreting your results

When interpreting your results you may need to carry out some statistical analyses or represent them in a graphical format for ease of interpretation.

To evaluate your results you will need to reconsider the planning and design part of the process and think back over any confounding variables. Did any others arise during the course of your data collection (e.g. new animal arrived in collection, new feeding method, strong weather change)? How might these have directly or indirectly affected your results? You need to discuss these thoroughly; in some studies these can have a larger effect than the independent variable. Consider the value of your results for the observed captive animals and also, if appropriate, how applicable these results are for the subject species in other zoos/wild.

Other things to consider when interpreting animal behaviour

Avoid preconceptions that you may have about the species or type of animal that you have observed. For example, you may have the misconception that all cats dislike water, which is in fact not the case, especially for our Amur tigers who would regularly come across and use water in the wild (the Amur river).

Avoid making assumptions about species. For example due to the reputation of the red-bellied piranhas you may assume that they would only eat flesh, however they have been observed eating fruit.

Beware of being anthropomorphic, which means attributing human characteristics, motivations or behaviours to non-human species. For example, a smiling macaque is not a happy macaque. Through research, we have found that when primates show their teeth it is often a sign of fear or aggression and therefore not the positive response many consider it to be.

The three fact files on the following pages provide you with some information about three specific species and their behaviour.

Sulawesi crested macaque

Scientific name: *Macaca nigra*

Habitat: Rainforest

Distribution: Found on the Indonesian island of Sulawesi

Status in the wild: Critically endangered

Diet: Fruit, leaves, buds, invertebrates

Life span: 18 years, longer in captivity

Gestation period: 5-6 months

Notable features: Pink fleshy bottoms especially of females

The Sulawesi crested macaque is a monkey despite having little to show in the way of a tail.

Social Harmony

This is achieved by every member of the group having a place on the 'social ladder', although an individual's position can change for all sorts of reasons. For example, the dominant male may be ousted by a stronger rival and an adult female's status tends to increase when she comes into season.

The Hierarchy

1. Dominant male
↓
2. Females on heat (in season)
↓
3. The juvenile son of the dominant male
↓
4. Expectant mothers and mothers with new babies

The juvenile male is not yet sexually mature but has become sexually active. He continually tests his status among his group peers and his father tolerates this behaviour, presumably because his son poses no threat as a potential father.

Grooming

Grooming is a social activity which reinforces relationships. Touching is a sign of reassurance and acceptance, emphasising the individual's sense of 'belonging' to a group. No matter what rank they hold, each individual is groomed by someone else presenting themselves to be touched and smoothed.

Facial expressions and displays

These are used by the dominant male to signal his authority to others. He warns young males off by throwing his head back and opening his mouth to reveal his teeth. He will stand on all fours with shoulders hunched making himself look as big as possible.

Sulawesi crested macaques have mobile heads and flexible faces, allowing for a wide range of facial positions and expressions. The "fear grin" with the crest of hair raised, is an indication of anxiety or alarm.

Pink, fleshy bottoms

These are a brilliant way of keeping the group together, as they are easy to see in the dark, dense rainforest and act as a "follow me" signal.

Until puberty, these patches of skin, called ischial callosities, are quite pale in colour. When sexual maturity is reached gonadal hormones cause a heightened colouration of the skin in both sexes. For the females, the skin colour is exaggerated every month and is accompanied by an increased swelling. Both are visual indications that she is in season. Sulawesi crested macaques are polygamous, i.e. they do not have fixed breeding partners. Females in season will first invite the dominant male to mate but if he seems uninterested she may invite a lower ranking male within the group to mate with her.

Newborn infants

Newborns are often the focus of attention for youngsters of both sexes, as well as other mothers and females. If one of the group is interested in touching the infant, they will approach the mother, sit down at arms length and stretch out their hand tentatively. Although the infant is dependent on its mother for milk for many months, it will start becoming independent at around 4 months and as it gets older and stronger it will become more adventurous, leaving its mother to play with other group members.

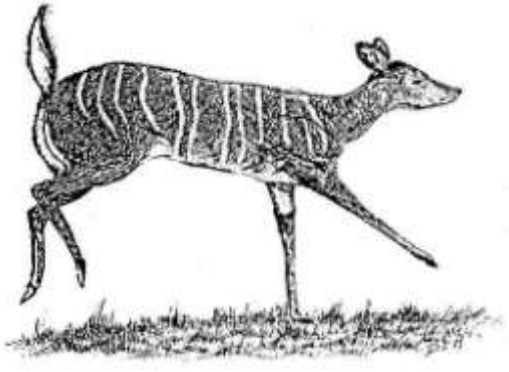
Nyala

Scientific name:	*Tragelaphus angasii*
Habitat:	Forests and woodlands
Distribution:	South-eastern Africa
Status in the wild:	Least concern
Diet:	Leaves, fruits and grasses
Life span:	Up to 18 years in captivity
Gestation period:	7-8 months
Notable features:	'Sexually dimorphic' – the male and female differ in appearance and colouration

Nyala are medium sized antelope that form herds. Nyala show 'sexual dimorphism'. The buck (male) has a shaggy dark grey coat with faint white stripes and a long fringe along the underside. They have a white chevron between their eyes and well developed curved horns. The doe (female) is smaller with a bright chestnut coloured coat with boldly marked stripes. The doe does not have horns.

Alarm

Nyala don't have the speed of open ground antelope, so they rely on camouflage to escape predators. But when there is danger a nyala will not only run away but also warns the other individuals in the group. It does this by raising its tail to reveal a white underside and rear and by emitting an alarm bark. Other nyala will see and hear these signals and immediately run off. This behaviour is common to many species of antelope.



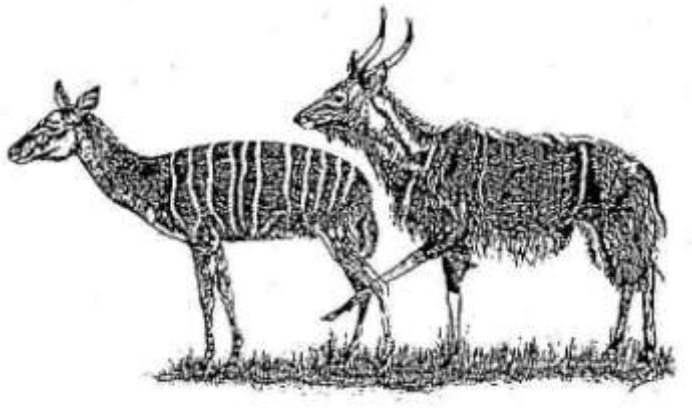
Nyala also use other signals when responding to threats in order to signal to others that something is wrong. These signals include nodding their heads, twisting their heads from side to side and opening and closing their mouths

Dominance displays

Behaviour displays between males establish which individual is dominant. Two bucks will fluff up the hair on the ridge of their backs (to make them look bigger) and slowly walk forwards parallel to each other. Usually one will decide that the other is too big to challenge and will back down, forsaking any claims over the females in the group. However, if neither back down they will engage in a head to head tussle interlocking horns. This can lead to death of one of the animals. Sometimes bucks can be seen practising for these fights on branches or bushes.

Courtship

Female nyala come into season every three weeks. During this time a male may escort a female for several days if unchallenged. A courtship ritual may then take place with the buck following the doe kicking her back legs. If she accepts him, mating will follow. Calves are generally fathered by the most dominant buck.



Mother and calf

Nyala almost always bear single calves. The newborn calf is concealed in dense undergrowth or tall grass away from the main herd, its camouflage helping it hide from predators. The mother returns at regular intervals to feed the calf. She communicates to the calf by making clicking and creaking noises with her tongue.

Amur tiger

Scientific name: *Panthera tigris altaica*

Habitat: Mostly forests

Distribution: South-eastern Russia and Northern China. Possibly North Korea

Status in the wild: Endangered

Diet: Opportunistic predator; ungulates, boar, etc

Life span: Up to 20 years in captivity

Gestation period: 3-4months

Notable features: The white spots on the back of ears are used for communication

The Amur tiger is the largest of all big cats. It is a solitary cat, and although it is unusual to find adult tigers living together for long periods in the wild, Marwell's tigers are kept in pairs to ensure the best possible breeding success.

Scent marking

Amur tigers are territorial. One male occupies a large range which overlaps the smaller territories of several females. This gives ample opportunity to mate with as many females without forsaking his territory. The territory must be large enough to provide a plentiful supply of food. For the female this will have to be sufficient to feed both herself and her cubs. Adult tigers mark their territorial boundaries by spraying urine on prominent landmarks, this is scent marking. Scent marking is a labour saving device which means that the tiger doesn't have to be everywhere at once.

Greetings

Tigers recognise each other's scent, so when family members meet they greet each other by rubbing noses, sniffing, touching and licking. Strangers approach with extreme caution as for them physical contact of any kind might be misconstrued as an attempt to attack.

Fighting can be fatal, so it is usually avoided by displays of aggression. Whatever the reason for the display the visual signals are very clear. The aggressor's body posture is head on so that he/she can stare directly at the other individual with eye to eye contact. The back is raised and fur erected to increase body size, and the tail swished

from side to side. Snarling reveals its teeth and the ears lay flat to show their prominent white spots which signal imminent danger. In contrast the submissor lowers its body posture, redirects its gaze so to avoid eye to eye contact, keeps its mouth shut, and its ears forward so to keep the warning spots hidden.

Mating

Males and females lead solitary lives, but when the female is on heat (in oestrus) the male will seek her out, following a pheromone (scent) trail. The pair consort for several days, perhaps mating many times. The female will crouch so that the male can mount her. To keep her still the male may hold the females head or neck in his mouth.

Parental responsibilities

These are left to the mother. In the wild the female will seek out a suitable den where she can give birth and then leave her cubs safely whilst she hunts. The cubs are blind at birth and dependant on their mother to provide them with milk and meat (when they have been weaned). As the skills of hunting and killing take practice, the cubs will stay with their mother for about 2 years until they can fend for themselves. The routine after feeding usually includes licking each other's faces. This is an act of hygiene as well as mutual trust, the gentle contact helps to strengthen the parent-offspring bond.

Play

This activity not only allows the animal to 'let off steam' by getting rid of excess energy, but it also fulfils another important function – staging mock battles and chases helps to develop the skills which will later be vital for successful hunting.

Stalking

Stalking is probably an instinctive part of cat behaviour, but an aspect that needs a lot of practice and muscle development before it is a worthy tool in the art of hunting. Anything animate or inanimate can be used for target practice.

Animal enrichment at Marwell Wildlife

The Marwell Wildlife enrichment group was formed to address the behavioural aspects of welfare of the animals housed at Marwell.
The two main aims of the group are to:

i) **Stimulate and preserve species typical behaviour** in captive populations through the management of their environment, by providing animals with opportunities
to behave in a naturalistic way. "Species typical behaviour" are those actions carried out by a specific species which are not carried out by every other species. This refers to individual behaviours, such as leaping to catch a bird. To behave in a "naturalistic way" means that in general an animal's captive behavioural repertoire closely resembles that of a wild counterpart. Therefore it refers to an animal's broader activities.

ii) **Prevent or reverse the development of abnormal behaviour** patterns, i.e. those which would never be seen in a wild counterpart, such as stereotypes like pacing, etc.

This will be achieved by:

i) **Improving enclosure designs and husbandry** routines that have an impact on behaviour.

ii) **Introducing novel enrichment** techniques.

Enrichment can take many forms and aims to stimulate the animals mentally and physically. Here are some examples of how we do this:

Scatter feeds

Food is not placed into bowls or other feeding equipment; instead it is spread across the enclosure or hidden so that the animals have to forage for their food, just as they would have to in the wild. This feeding regime is used for many animals, including the meerkats.

Enclosure design

When designing the layout of enclosures and the furniture put in them, the species' natural habitat must be considered to ensure that the animal will exhibit natural behaviour. Sometimes natural objects are used such as trees, but where these are not available other furniture is constructed to stimulate the animals. One such example of this is the coati enclosure which containsboth fixed and flexible materials (such as wooden poles and ropes) to simulate ones that they come across in the wild (such as trees and moving branches).