NOTES ON SOME TOPICS IN APPLIED ANIMAL BEHAVIOUR

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INTRODUCTION

Why do we study domestic animal behaviour?

There are several reasons:

(1) To manage and move stock without causing undue stress.

(2) To design facilities which consider the needs of the animals. These facilities include housing systems for intensive husbandry, holding pens, loading and unloading ramps, transport vehicles, and provision for special operations, e.g. slaughtering, shearing, dipping.

(3) To manage grazing animals and pest species.

(4) To learn about the behaviour of pet animals and the bond between pet and owner.

If these factors are taken into account, not only will animals be more productive but their welfare will be assured.

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CHAPTER 1: THE STUDY OF BEHAVIOUR

This chapter is concerned with the following points:

1. What is behaviour and what questions can be asked when considering any given behaviour?

2. How behaviour is observed and recorded.

3. The quantification of behaviour.

4. Writing up a project on behaviour.

WHAT IS BEHAVIOUR?

Animal behaviour is the expression of an effort to adapt or adjust to different internal and external conditions, i.e. behaviour can be described as an animal's response to a stimulus.

The actions of animals are directed toward:
1. keeping themselves alive (i.e. individual survival), and
2. reproduction (i.e. species survival).

It is worth pointing out at this stage that animals do not act for the 'good of the species'. This is an archaic view – in fact, it is more appropriate to think of them as acting for the good of their genetic material and to think of genes as being selfish (Dawkins, ***The Selfish Gene***).

Behaviour has evolved by natural selection and a knowledge and understanding of it has always been a practical matter for early trappers, hunters, traditional shepherds and herdsmen. It is a sequence of movements with a beginning (appetitive behaviours), a middle and an end (the consummatory act). The study of behaviour (ethology) involves not only what an animal does but also when, how, why and where the behaviour occurred (Lehner, 1979). Social behaviour involves the development of relationships in which animals build up regular patterns with each other and their environment. This is a dynamic process and leads to stable relationships. These relationships are important when we examine domestic and captive animal behaviour (applied ethology).

Only by understanding animal behaviour can we really begin to appreciate whether the way we keep animals is appropriate. There are a number of ways of considering behaviour. The father of modern behaviour science is Niko Tinbergen, who established fundamental methods of analysing behaviour. Tinbergen's four questions can be asked of any behaviour:

1. ***Causation (mechanism)***: How is the behaviour accomplished?

For example, cockroaches running away from one of their most effective predators, toads, use wind-sensitive hairs on their cerci to predict the point at which the toad has committed itself to a strike in a certain direction. The cockroaches then turn and immediately run away once the strike is initiated.

2. ***Function***: How does the behaviour contribute to the animal's survival and reproductive success?

An animal that behaves most appropriately in a given situation will be the one most likely to succeed, e.g. fighting, feeding, breeding. For example, cockroaches running only when they are certain of an actual threat. Therefore, they don't waste energy on unnecessary effort.

3. ***Development (ontogeny)***: How does the behaviour develop during the animal's lifetime)? Some key issues here would include, for example, does the animal have to learn the behaviour or does it behave appropriately without prior experience? Also, how much can an innate behaviour be modified after birth?

When you think about the relationship between age and behaviour you might also like to think about a dog cocking its leg and how this behaviour develops. It is not present at birth but instead appears as a product of hormonal activity at puberty. This is a useful reminder, therefore, that genes and the environment continue to interact throughout life.

4. ***Evolution***: How did the behaviour evolve (same as asking how the horse's hoof evolved) is asking how did a certain behaviour develop (e.g. beak-wiping in zebra finch is thought to exist in 'embryonic form in the bow-minus-wipe of the closely related spice finch and striated finch). A more puzzling question may be how stereotypic behaviours evolve in the absence of environments that elicit them.

HOW BEHAVIOUR IS OBSERVED AND RECORDED

Before behaviour is recorded a decision must be made about what responses are to be observed. This will depend on what questions must be answered. Some things to be considered are:

1. Choice of relevant observations.
2. Careful definition of the behaviour to be observed and methods of ensuring clarity and so avoiding confusion among observers.
    a. The behaviour must be described on a strictly empirical basis: based on observation and experiment. Alternatively, one can refer to an existing ethogram (a catalogue of the behavioural repertoire) for the species in question.
    b. The behaviour must not have an interpretation of functional or inferred aspect such as sleeping, yawning, was bored, happy, restless. These words do not describe the behaviour observed but are observers' subjective opinions of what was observed.
3. Choice of observation schedule. This is important as it will affect the type of data collected: observations can focus on one individual (or one dyad or one litter or other husbandry unit) for a specified amount of time (focal animal sampling) or be a record of the behaviour of each individual or all the behaviours evident in a whole group of subjects as observed at a single instant every day, once per week (scan or time sampling).
4. Some factors to be considered when observing behaviour include:
    a. spacing arrangements between animals (pigs tend to huddle together in a group, sheep graze in flocks and continually monitor each other so a fixed distance between them is maintained, dams and their offspring having a relationship that is undergo-

ing change from birth to weaning and often beyond);
b. orientation;
c. posture;
d. various behavioural rhythms that occur over different times and seasons;
e. behaviour is influenced by the age and sex of the animal and also by its past experience.

The recording of observations can be done in different ways:
1. By the observer using a notebook and pencil. The position of the observer may influence the animal's behaviour (a so-called operator effect) and it should always be stated whether the observer was in full view of the animals or hidden from them (e.g. in an established hide or by using mirrors).
2. Using video-tape recordings. Despite the initial costs of setting up a video system, it is currently the most common technique in long-term studies of animal behaviour. Topics worth noting when considering the use of video footage in behavioural studies include
a. video can be used under normal lighting conditions but infra-red cameras will be required if a 24-hour record is needed and artificial light would create behavioural artefacts;
b. good microphones plumbed into the video recorder are the most convenient means of linking vocalisations with behavioural patterns.
3. Single-event recorders can be an efficient means of creating data from many animals at the same time without the need for video analysis. For example, infra-red beam breakage can be recorded for simple behaviours such as a horse putting its head in a bucket.

THE QUANTIFICATION OF BEHAVIOUR

Once the behavioural sequences have been recorded, by one or several methods, they must be quantified so the behaviours can be analysed. Quantification is giving numbers to behaviours and it can be done in several ways:
1. The frequency and/or magnitude can be recorded for behaviours that are unitary or discreet (Calhoun, 1975), e.g. defecation, urination, stretches, shakes.
2. Duration of behaviour can be recorded, e.g. for how long does a pig drink, a chicken dust-bathe, or a fight last between two goats? To quantify these types of behaviour in full both the frequency and duration should be recorded over a specified time period.
3. If the social relationships in a group of animals is being studied, it is necessary to record which animal initiates a behaviour (performer) and which animal it is directed toward (recipient). It is also worth noting which animal terminates the interaction. This is important in agonistic interactions where the relationship between two animals involves conflict (fighting, threat, avoidance or displacement at a service point).
4. Information can be taken from recording devices and quantified.
5. Once a behaviour has been quantified the observations can be repeated and checked.

In any behavioural experimental set-up, details of the experiment must be carefully recorded so the experiment can be repeated by other observers.

In the past many behavioural studies included no quantitative data at all and were often anecdotal. This does not mean they were of no value. In fact they stimulated the interest and enthusiasm that has led to the truly scientific studies of animal behaviour.

WRITING UP A PROJECT ON BEHAVIOUR (ETHOLOGICAL RESEARCH)

This involves the following sections:

1. Introduction
2. Materials and methods
3. Results
4. Discussion
5. References (if used)
6. Abstract or summary

1. Introduction
   a. States aims and objectives of study,
   b. OR hypotheses under investigation.
   c. Literature review is not necessary for a short student project.

2. Materials and methods
   a. Species—their numbers, breed (if applicable), age, sex (and whether or not they were desexed).
   b. Environmental context—temperature, humidity, wind, etc. For field observations a scale map or plan is useful.
   c. Observational techniques and strategies (a schedule is a useful inclusion giving time and duration).

3. Results
   a. Include basic data of what was actually seen.
   b. Results should be clearly and concisely stated and relevant tables referred to.
   c. The behaviours studied should be defined—a table is a good way to do this.

4. Discussion
   a. Once the results have been stated any noteworthy points should be discussed in order.
   b. If previous studies help throw light on any point these may be referred to.
   c. Comments on how the current study adds to what was already known.
   d. Any justifications explaining shortcomings can be put here.
   e. Any ideas generated from the study.

5. References (if used)

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CHAPTER 2: SOME BASIC CONCEPTS OF APPLIED ANIMALBEHAVIOUR

Animal behaviour studies are called 'ethology'. This is derived from the Greek root 'ethos' meaning 'nature' or 'disposition'.

Ethologists study the behaviour of animals in a natural setting. Because it is often difficult to study domestic animals in a natural environment, Applied Ethology evolved to study domestic and captive animals in environments designed by humans.

The central theme in Applied Ethology is the study of the interface or relationship between people and domestic animals.

This chapter will study:

1. Human–animal interface model
2. Dominance concept
3. Flight distance
4. Crowding and over-crowding
5. Social facilitation
6. Stress and its measurement

MAN–ANIMAL INTERFACE MODEL

Traditionally, humans tend to have a dominating influence on domesticated animals, and our relative importance in their social environment varies with the species and with the frequency and duration of the relationship. This influence has become more pervasive as animals have been moved from extensive husbandry systems to the intensive husbandry systems used today in many countries.

In order to look at the interface between humans and domestic animals, Hediger (1964) proposed a model of human–animal relationships, which was later modified by McBride (1978). Not only is this interface concerned with many aspects of husbandry but it always has a behavioural element, and involves a knowledge of the animal's behaviour throughout its entire life cycle.

The interface (McBride, 1980) is defined as 'all of the contacts, interactions, transactions and relationships between domestic animals (including their social relationships) and the various components of their surroundings which constitute their environment organised by man'. A convenient classification is as follows (McBride, 1978; Blackshaw, 1980):

DIRECT influence of human on domestic animals	ACTIVE Droving Vaccinations Operations Restraint Milking (hand)	PASSIVE Monitoring for health
INDIRECT influence of human on domestic animals	Automatic services e.g. egg collecting, feeding, watering, dung removal	Fences, shelters Design features

The active, direct component occurs when humans and animals come into physical contact and interact with each other; there is handling and restraint. The passive, direct contacts include monitoring activities ,where humans are with or near the animals but not in physical contact with them. Automatic services, usually feeding and the provision of water, are active, indirect interfaces. Fences, shelters and their design features are the passive, indirect interfaces. It is in these design features that the behavioural component is often inadequately considered. Behaviour, if properly observed, could give a good indication of what design features may be important, e.g. width of ramps and doorways, types of flooring, pens and fences.

With every additional step toward intensive husbandry there is a change from a DIRECT to INDIRECT interface. This means that the services given by people directly (e.g. labour) are substituted for indirect transactions, with more complex built environments and automated services (e.g. where electronic ear-tags are used to identify stock and allow them into a feeding bay to receive a computed ration via an automatic delivery system. While there is gain to producers in not paying for costly labour, there may be some loss to the animals due to increasing impersonality and direct lack of monitoring for problems.

DOMINANCE CONCEPT

The first studies of dominance relationships in groups of animals were published in 1922 by Schjelderup-Ebbe. He studied the organisation of flocks of chickens (1922, 1935) and developed a concept of simple dominance where one individual had preferential rights over another. This was the 'peck-right' (or pecking order) of one hen over another. This concept was widely used until 1942 when Allee reviewed dominance–subordination in vertebrates and noted that irregularities, such as triangular relationships, often occurred in a simple straight-line hierarchy, so that, for instance, a hen with medium or even low status might have the peck-right over some individual that out-ranked her in the linear hierarchy. Since then many variations of the classical hierarchy system have been studied. For example, horses use coalitions so that affiliated pairs in a herd have an accumulative power to displace a third horse that normally out-ranks both of them on a individual basis. That said, linear hierarchies remain a useful construct with valuable properties if used cautiously and if one is aware that the nature of resources being contested may influence the outcome of a contest.

The construction of a dominance hierarchy

A dominance hierarchy is the system of space sharing in a group arranged on a priority basis that keeps friction to a minimum. Once the division of space is complete there is no further strife or challenge to the order unless a young member of the group matures significantly (e.g. reaches sexual maturity) or an aged member becomes senescent (McBride, 1971).

The construction of the dominance hierarchy is based on the observation of a group of animals. The following table shows the number of encounters initiated and received by five animals (A,B,C,D,E) in a group.

Initiator (of agonistic behaviour)
e.g. biting, pushing, fighting

	A	B	C	D	E	$Total_2$
A	\	3	8	2	1	**14**
B	0	\	7	3	0	**10**
C	6	4	\	1	0	**11**
D	2	0	12	\	4	**18**
E	1	3	5	1	\	**10**
$Total_1$	**9**	**10**	**32**	**7**	**5**	\

Recipient of agonistic behaviour

1. The observer records the agonistic interactions for a fixed time in a group of animals, making sure to note the initiator and recipient.

2. The frequencies are recorded in a table as shown in the example above.

3. Column totals (T_1) indicate which animal initiated the most agonistic interactions. This gives an indication of the most dominant animal, so from the example above it can be seen that the hierarchy is in the form of:

C
B
A
D
E

The row totals (T_2) give an indication of the animal receiving the most agonistic behaviours, in this case D. The model also tells us other facts, e.g. A did not initiate any interaction with B, but B initiated three interactions with A, although A has a slightly lower position than B in the dominance hierarchy. It also shows that E (the most subordinate animal in the hierarchy) did not interact with B or C.

Properties of the dominance hierarchy concept:

1. It is a model that describes some aspects of social relationships within a group.

2. It ignores the role of appeasement behaviours, e.g. active submission that may often have a more critical role in social behaviour than aggression ***per se***.

3. It ignores many individual qualities of different relationships, e.g. are the animals mutually dependent, grazing companions or grooming companions?

4. It deals only with agonistic interactions.

5. It is logically linear, but this is not always so.

It can be useful in husbandry studies and McBride (1968) proposed a model relating production and hierarchy, in which he suggested that a suitable husbandry system ensures that all animals, no matter what rank in the hierarchy, should have equal production opportunities. In adverse conditions the high-ranking animals would have priority in any competitive situation (for food, water, space).

Some consequences of the dominance hierarchy in husbandry systems:

1. Animals culled on productivity tend to be the subordinate animals.

2. Facilities must be placed where all animals can reach them without the group structure being too disrupted. Sometimes it is worth providing one more access point to a given resource than there are animals (e.g. with four horses in a paddock, reduced friction is seen if five piles of hay are provided).

3. The dominant animal usually has mating advantages and also resource advantages when they are limited.

How is a hierarchy maintained?

To maintain a hierarchy every animal must recognise each member of the group and remember the dominance–subordinate relationship. In flocks of poultry (n = 80 birds) it was found that individuals did not move freely but remained attached to a site so they learned to recognise a small sub-group (McBride and Foenander, 1962). It was suggested by these workers that this territorial behaviour should be encouraged in large flocks, such as are commonly found on modern broiler units (e.g. n = 10,000), since it reduces the number of conflicts when strangers meet. A more recent study (Hughes et al., 1974) on spatial behaviour of Shaver 288 pullets shows different results. In a series of six experiments using flocks of 4 to 600 birds, site attachment was not shown by many subjects. This could be due to breed differences, or light intensity, as these observations were conducted under much lower light levels.

Although there are limitations in the dominance model it is a useful construct to look at the social organisation within a group of animals.

FLIGHT DISTANCE

This is the minimum distance of approach to an animal before it flees. A tame animal has a flight distance of zero (Hediger, 1964). The concept is used when droving animals by man or dog, and is of considerable importance in round-pen gentling of horses.

Animals can be imagined as having a ‘zone of safety’ around them and when this zone is penetrated the animals will move away. Retreating from the flight zone will cause the animal to stop moving. If an animal starts to turn back the handler should retreat. In round-pen training the flight zone is repeatedly penetrated until the horse shows a reduced fear response. When it shows less fear it is rewarded by having the pressure of the handler’s presence removed. It therefore learns to walk toward rather than attempt to escape from the handler.

The flight distance during handling is usually 1.5 to 7.6 m for beef cattle raised in a feeding operation and up to 30 m on mountain ranges (Grandin, 1980). Brahman cattle have a larger flight distance than most English breeds (Grandin, 1978). If handlers lean over

fences over animals they penetrate the 'zone of safety' around the animals and may cause the animals to rear.

CROWDING AND OVER-CROWDING

Crowding begins, not when animals jostle each other, but when they are forced into the personal spaces of their neighbours (McBride, 1971). Animals need space to walk on, space to lie on and also a personal space around them. Rigorous spacing systems operate in natural populations so that crowding does not occur.

In domestic animals kept close together in various husbandry systems, crowding may become an important problem, often affecting biological fitness and so productivity. At this point it is labelled over-crowding. As animals are forced into each other's personal space there are interactions, often of a violent nature. At high densities it is difficult for animals to avoid such intrusions as they cannot move away. Some may adapt to the intrusion while others may become so stressed that productivity is affected.

From this discussion it can be seen that the concept of crowding does not only involve the number of animals per m^2. It involves also the use of the space. So when considering crowding several important questions should be asked:

1. When does crowding occur? This time element is very important, e.g. animals may be crowded only when feeding or moving around, but not crowded when lying down.

2. Where does crowding occur? It may be only around certain service points.

3. For whom does crowding occur? As has been discussed, if productivity is affected it will be the lower-ranking animals that suffer most.

McBride (1971) suggests how some of the effects of crowding may be controlled systematically.

1. Service facilities, such as nest boxes, feeders and waterers, should be adequate and equally attractive to animals.

2. Subdued lighting quietens animals.

3. The partitioning of space to restrict visual or social contacts between animals.

4. Group size can be lowered with the use of partitions so that sub-groups form with their own dominance hierarchy.

Crowding and over-crowding are not simple problems and intensive husbandry systems must take into account these various factors.

SOCIAL FACILITATION

This is an important behavioural phenomenon that can cause problems, especially in intensively housed animals. It is the tendency for animals to join in an activity, e.g. feeding, and means that this activity requires a large space, which can cause competition for the key resources, which leads to crowding stress. It may also increase the quantity of food being eaten. In nursing sows housed together, social facilitation can increase the number of suckling bouts that have to be undertaken by all sows. Grunting by a nursing sow in one pen can cause piglets in a neighbouring pen to approach their own dam and initiate a suckling bout.

STRESS AND ITS MEASUREMENT

The term 'stress' means different things to different people, and so a great deal of confusion has arisen in both lay and scientific literature (Selye, 1976). Selye commented that essentially different things such as cold, heat, drugs, sorrow and joy would provoke an identical biological reaction. These agents are known as stressors.

In animal management, stress is often associated with effects due to 'weaning stress', 'transport stress' or it can refer to 'behavioural stress', which are problems associated with intensification.

There have been several proposed definitions of stress for use in animal husbandry conditions:

1. McBride (1968, 1971) used the definition of Lee (1966), who described stress as the pressures acting on individuals to cause strain.

2. Fraser et al. (1975) suggested that in a veterinary context 'stress' be used when there was a profound physiological change in the condition of an animal. The definition proposed was, 'an animal is said to be in a state of stress if it is required to make abnormal or extreme adjustments in its physiology or behaviour in order to cope with aspects of its environment and management'.

However, these definitions still do not tell you what stress actually is.

McBride (1980) proposed a model that suggested how animals adapt to stress at an individual level. There are three levels where adaptation of the animals to stress could occur:

1. Behavioural level

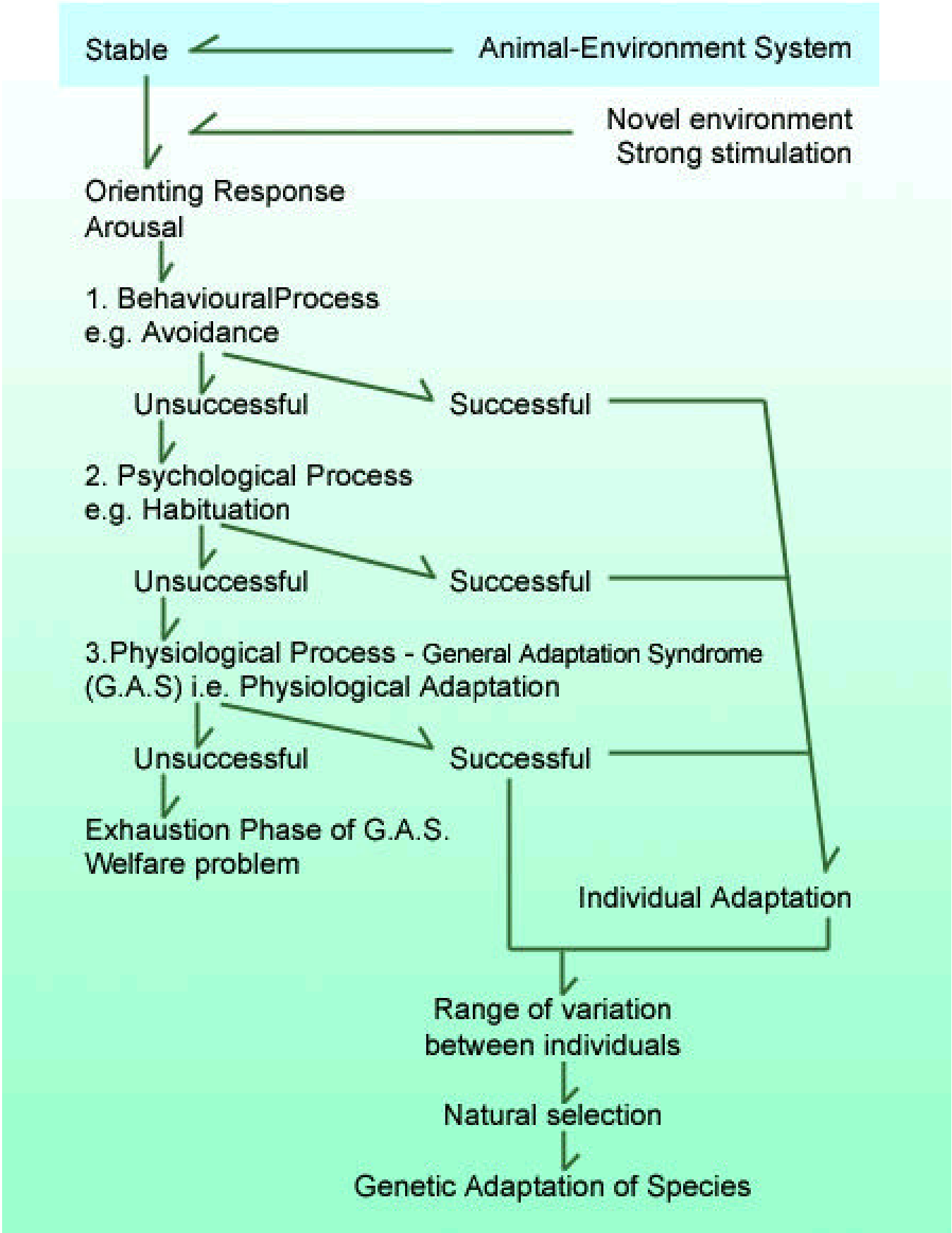
If an animal can avoid an unpleasant stimulus it has removed itself from the stress. In many intensive situations this may be difficult for all animals in a group to do and possibly the dominant animals will be the only ones able to adapt.

2. Psychological level

Those unsuccessful animals must try to adapt by the psychological process of habituation. If they do not habituate to the aversive conditions they may enter a state of learned helplessness or apathy in which they remain distressed but no longer attempt to make appropriate responses to improve their plight.

3. Physiological level

In the animals that still have not adapted, continued arousal generates the General Adaptation Syndrome (GAS) of Selye (1976). There is a general pattern of alarm (alarm reaction) leading to homeostatic resistance to change (stage of resistance) and the stage of exhaustion follows if the stressor is severe enough and is applied for a sufficient length of time. It is at this stage that strain develops and may be characterised by a susceptibility to a variety of infectious or other environmental stressors. In other words, the animal has not been able to adapt to the environment.



It is at this level that problems arise which affect the welfare of the animals. When this happens serious questions should be asked about the suitability of the husbandry system.

Often there are comparisons of the stresses to which free-living and domestic animals are exposed. The sources of these stresses are quite different, but in both conditions the model suggests that there will be environmental challenges that may contribute to the well-being of an animal. It can either adapt and be successful or fail. Failure of an animal to adapt in the wild lays no blame on humans, whereas failure to adapt to husbandry systems is a failure on the part of humans.

Here the HUMAN–ANIMAL INTERFACE MODEL

(McBride, 1980) can be used in a systematic approach to examining environments for animals designed by man.

1. All the human–animal interfaces should be examined.

2. Examine the many environmental designs in use and see where, when and how behaviour–environment fits or misfits. It is unfortunately fairly easy to find examples of inadequate design in any intensive situation.

Another point of view is outlined by Beilharz (1982), who cautions against considering only environmental design to fit an animal's current needs. He points out that there is no evidence to suggest that animals have stopped changing in response to environmental changes so it seems rational to use genetic change, as well as environmental change, in our solution to 'welfare problems'. He suggests that animals may be selected who suit the environment rather than changing the environment to suit the animals. Clearly, this is a long-term approach and requires many generations to withstand sub-optimal conditions before tolerant strains emerge.

The measurement of stress

1. The physiological reactions of animals to stressors are difficult to measure, especially in the field. Some measurements may require the slaughter of animals (e.g. weighing of adrenal glands) others involve attachment of leads, withdrawal of blood and restraint, all of which may upset the animal. The use of telemetric transmitters taped to an animal, e.g. pig's back (Mayes, 1982), can send signals of the animal's heartbeat. This technique has shown that as the animal is forced to climb a loading chute, its resting rate increased from 100-160 beats/minute to 250-260 beats/minute. Technological advances including the refinement of microchips are allowing scientists to record large amounts of physiological data from animals wearing implanted and telemetric devices. Meanwhile, the use of ACTH stimulation tests and cortisol assays in samples ranging from blood, saliva, faeces and even eggs is becoming more commonplace as a means of plotting trends in physiological stress responses. However, the importance of diurnal rhythms and the possibility of physiological fatigue as a result of chronic stress mean that such measurements should not be interpreted in isolation from behavioural observations.

2. Changes in behaviour, most notably the appearance of displacement or stereotypic behaviours, may be an early indication of a stressful situation.

It is apparent that the measurement of stress is a difficult problem.

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CHAPTER 3: BEHAVIOURAL PROFILES OF DOMESTIC ANIMALS

Before recommendations can be made about management of animals, design of facilities for holding, special operations (e.g. shearing, branding) and transport of animals, it is necessary to have an understanding of the animal's behaviour.

This chapter will look at the behavioural profiles of horses, sheep, cattle, goats, pigs, poultry and deer.
The following aspects will be discussed in each species:

1. Vision and other special senses
2. Social organisation and dominance hierarchies
3. Sexual behaviour
4. Maternal-offspring behaviour
5. Abnormal behaviour

HORSES

VISION AND OTHER SPECIAL SENSES

Horses can see near objects clearly but also maintain distant watchfulness. They have panoramic vision of 330° to 350° and binocular vision of 60° to 70°. The blind zone accounts for a proportion of startle responses, including shying (Enzerink, 1998). The width of the blind zone is determined by the level at which the head is carried (Saslow, 1999). Horses also have night vision and are thought to see colours (Grzimek, 1952). In a variety of discrimination trials, yellow test colours were identified most easily, followed by greens, then blues, with reds the least easily identified. Colour vision studies are still the source of some debate because it has been suggested that horses may be better than humans at discriminating between shades of grey (Harman et al., 1999). Both cones and rods are present in the retina and there is clear functional duality of responses indicative of cones and rods (Smith and Goldman, 1999).

The horse's hearing is similar to humans but it has been suggested that they might hear a higher pitch than we do. The olfactory senses are well developed. Horses have a sense of taste that discriminates between safe and toxic plants with variable accuracy (Marinier and Alexander, 1991) and may be useful in detecting sources of trace elements (McGreevy et al., 2001a). Habituation by gradual exposure to increasingly concentrated solutions of innately aversive chemicals has been reported in horses as a means of modulating water intake in performance horses (Murphy et al., 1999).

Horses are very sensitive to tactile stimulation especially around the muzzle and ears, and it is important to be aware of this when handling them. In each horse, there are zones of cutaneous sensation that can be plotted according to their effectiveness in reducing heart rate during allogrooming (mutual grooming) (Feh & De Mazieres, 1993). The cutaneous sensitivity of horses is used to control horses by a process of negative reinforcement (McGreevy, 2001a). Positive reinforcement is rarely used in horse-riding (McGreevy, 2001b).

SOCIAL ORGANISATION, DOMINANCE AND LEADERSHIP

Studies done on groups of feral horses (Tyler, 1972; Feist and McCullough, 1976; Salter and Hudson, 1982) suggest that the social groups consist of:
1. harem groups, typically one male, a variable number of females and immatures;
2. bachelor groups composed of excess males.

Under this permanent harem-type of social organisation, females are in constant association with a male and so detection of heat is assured. It is the harem males who do all or most of the breeding.

In the feral state the stability of the harem group depends on:
1. the herding instinct of the stallion;
2. the strong social attachment between harem members;
3. rejection of intruders.

Dominance hierarchy. In any group of horses, feral or domesticated, a dominance hierarchy develops and, once it is established it remains stable. In feral groups the adult males tend to rank at the top, with dominance being expressed as threats to bite or kick, or actual biting and kicking. Tyler (1972) described kicking fights between strange mares.

Domesticated groups show expressions of dominance in competitive situations, e.g. for a restricted food source. The faeces of a subordinate are often topped by a more dominant individual. Feist and McCullough (1976) and Salter and Hudson (1982) found that dominant and subordinate males in harems and bachelor males all urinated on elimination products of other group members and both dominant and subordinate males in harems marked in the vicinity of their groups.

Houpt, Law and Martinisi (1978) studied dominance hierarchies in 11 herds of domestic horses (n = 3–11 horses) and found that in small herds linear hierarchies were formed but in large herds triangular relationships were observed. Bodyweight, but not age, appears to affect rank, and the daughters of a dominant mare were dominant within their own herds. Colts leave the natal band at between 0.7 and 3.9 years of age (Khalil and Murakami, 1999). Fillies leave when slightly older as they become sexually mature. While spring-born fillies tend to ovulate during the late spring when they are 12–15 months old, late-born fillies show surges of luteinising hormone and progesterone that allow some (but not all) of them to display oestrus and ovulate at younger ages (Wesson and Ginther, 1981). It is recognised that sneak matings occur regularly in free-ranging horse herds and that the biological fitness of harem mares is greater than that of mares that consort in multi-stallion groups (Linklater et al., 1999).

Leadership. This may be shown by the stallion in feral groups (Feist and McCullough, 1976) and often by the

dominant mare in domestic herds, although other mares sometimes lead (Tyler, 1972). It is important to note that the stallion may not always be the alpha member of his band (Keiper and Receveur 1992). Agonistic behaviour is also dependent on herd size since, in small groups, a linear dominance hierarchy is usual while triangular and more complicated relationships can develop in large herds (Estep et al., 1993). There are considerable data to suggest that isolation from the group can be aversive (Mal et al., 1991).

SEXUAL BEHAVIOUR

Horses are seasonally polyoestrous. Mares show a cyclical active oestrus (7.1 ± 4.2 days; Ginther, 1974) and quiescent dioestrus (16.3 ± 2.9 days; Ginther, 1974) throughout the breeding season (152 ± 50 days; Ginther, 1974). An unreceptive mare kicks, squeals and lays back her ears if the stallion approaches. Receptive mares indicate readiness for mounting by standing still, spreading hind legs, lifting tail to one side, lowering the pelvis and repeatedly exposing the pink tissue of the vulva ('winking'). Stallions are more responsive to olfactory stimuli from conspecifics than are mares and geldings (Marinier et al., 1988). Foreplay is important and the male will smell, nibble and lick the mare and exhibit flehmen (curling of the top lip to expose teeth). Following ejaculation the stallion may smell the mare's genital area and the ground, flehmen and urinate.

Copulation is first achieved at about 15 months to three years, although interest is shown by young males by pelvic oscillations and erection of the penis, at as young as three months. Comparisons of semen characteristics and stallion behaviour during semen collection using a dummy and an oestrous mare have shown that, while the dummy is a safer technique, it produces semen with reduced motility. Despite having a higher concentration of spermatozoa, it also has a lower total sperm count (Silva et al., 1999). It is estimated that up to 50 per cent of geldings show stallion-like behaviour to mares McDonnell (2000a). Stabling stallions together, away from the mares, in a stallion barn has the potential to impose some characteristics of the bachelor group on some occupants of the barn, including reduced spermatogenesis (McDonnell, 2000b). Masturbation is part of the normal ethogram of male horses (McDonnell et al., 1991).

MATERNAL-OFFSPRING BEHAVIOUR

Gestation period is about 340 + 5 days. There is a tendency for foaling to occur in feral horses in the early morning hours (Tyler, 1972) with the mare lying down. Stabled Thoroughbred horses tend to foal at night and towards dawn, but this might be due to human disturbance during the day (Rossdale and Short, 1967). After birth, the mare remains lying down and if the foal moves within reach she will nuzzle it. Once she stands up the mare nuzzles and vigorously licks the foal. This is the start of a bond forming. The mare–foal bond seems to grow at the expense of the bond the mare has with her herd affiliates (Estep et al., 1993). The mare stands in a suitable position so the foal will locate the teats and suckle. The behaviour of the mare is, to some extent, predicted by the behaviour of her foal, e.g. if the foal is lying down, the mare is more likely to remain close by (Weeks et al., 2000). Some mares may resist suckling and in extreme cases the foal is kicked and bitten. The mare keeps the foal away from direct contact with herd members or intruders by calling it to her side and often by herding it away. The mare keeps the foal with her for many days until it gradually begins to socialise with other horses. However, the mare–foal relationship with nursing may continue for up to two years (Tyler, 1972).

Arabian mares seem to be more predisposed to rejection of foals than Thoroughbreds, with the presence of one of two related sires being statistically higher in the pedigrees of rejecting versus non-rejecting mares (Juarbe-Diaz et al., 1998). Fostering is difficult and the mare probably recognises her foal by smell, visual and auditory cues. When attempting to foster a foal, it is advisable to mask an introduced foal's odour by smearing it with the prospective surrogate dam's own milk and applying her own faeces to the tail and head of the foal. It also helps to apply vaporous ointments to the nostrils of nurse mares prior to the removal of their own foals (Kelly, 1999). It has been reported (Tyler, 1972) that a mare accepted an orphaned foal draped in the skin of the mare's dead three-year-old filly. Mares accept foals within 1 to 12 hours of an introduction but it is not advisable to leave the pair unsupervised until they have been together for three days (Kelly, 1999). Coprophagy (eating faeces) is normal in foals and commonly occurs at 4–6 weeks of age, possibly as a means of learning preferred forage types (Crowell-Davis, & Caudle, 1989).

ABNORMAL BEHAVIOURS

Housed animals sometimes exhibit behaviour patterns that are rarely seen in extensively managed horses. Stereotypic behaviours are characterised by being repetitive, relatively invariant and apparently functionless (Mason, 1991). They include frequent urination, weaving (where a horse rocks to and fro), and crib-biting (where a horse grasps some fixed object with its incisor teeth and swallows air). Owen (1982) gives a full description of crib-biting and wind sucking, and points out that it occurs worldwide in domestic horses and ponies, but does not occur in feral horses and ponies. These behaviours may be due to boredom associated with lack of exercise and it is suggested they may be learned behaviours. Once they have become established, stereotypic behaviours may become emancipated from their initiating causes, i.e., they are not easily removed from the animal's behavioural repertoire by rectifying the factors that contributed to their emergence (McGreevy and Nicol, 1998).

Data from 4,468 UK Thoroughbred horses in training showed the total prevalence of all three of the most common stereotypies (crib-biting/wind-sucking, weaving and box-walking) to be 10.8 per cent, similar to the prevalence of lameness (McGreevy, 1997). Wind-sucking (where the horse swallows air without the aid of a fixed object), licking walls, gnawing woodwork, and pressing the head against a fixed object are other abnormal behaviours that indicate some changes in the physiological or psychological condition of the horse. These behaviours can sometimes be eliminated by giv-

ing the horse more outdoor exercise or by introducing a companion animal, e.g. a donkey or a goat. A study in dressage and eventing horses demonstrated that the amount of time spent in the stable correlated with the likelihood of stereotypies being reported (McGreevy et al., 1995). Management factors that might frustrate motivation in the horse and may contribute to the emergence of stereotypies, e.g., concentrated feeds at weaning can increase the risk of crib-biting by a factor of four (Nicol, 1999). Stereotypic behaviours are unwelcome because they can result in weight loss, because affected horses rest less and eat less than normal horses (McGreevy et al., 2001b).

Abnormal sexual behaviour is also sometimes seen. The stallion may fail to obtain an erection, have incomplete intromission or lack of pelvic thrusts, may dismount at the onset of ejaculation or fail to ejaculate. These abnormalities may be associated with several factors, lack of libido, association of copulation with pain or previous injury, or injuries received during breeding (Pickett, Squires and Voss, 1981).

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VISION AND OTHER SPECIAL SENSES

Sheep have panoramic vision of 330°–360° and binocular vision of 25°–50°. They are thought to have colour vision and are able to distinguish between a variety of colours: black, red, brown, green, yellow and white (Alexander and Shillito, 1978). They have no accommodation, so must lift the head to see distant objects. This also means that they are unable to judge depth.

Sheep eyes possess very low hyperopia with little astigmatism. Such physiological optics are likely to produce a well-focused retinal image of objects in the middle and long distance (Piggins, et al., 1996).

Sight is a vital part of communication and when sheep are grazing they maintain visual contact with each other (Crofton, 1958; Kilgour, 1977). Each sheep throws its head to check the position of the other sheep. This constant monitoring is probably what keeps the sheep in a mob as they move along grazing.

Psychological stress induced by isolation is reduced if sheep are provided with a mirror, indicating that the sight of other sheep has stress-reducing properties (Parrott, 1990).

Work has been done by Franklin and Hutson (1982a,b,c) to find what stimuli attract sheep to move along a laneway. They found that olfactory stimuli were of no use as attractants and that there was no practical advantage in using sheep calls to attract sheep to move along a race. The use of a decoy sheep was effective in attracting sheep to move out of a pen and along a race, and sheep moved out of a pen faster towards a mirror that reflected the countryside, or towards open-wire mesh than towards a covered race ending.

Deprivation of the senses of smell, sight and hearing on the mating behaviour of rams indicated that the absence of sight has the most inhibitory effect on behaviour and reduced the oestrus detection activity and dexterity of mating. The loss of hearing has no marked effect on mating behaviour (Smith, 1975).

Taste is the most important sense in establishing forage preferences, with sweet and sour plants being preferred and bitter plants being more commonly rejected. Touch and sight are also important in relation to specific plant characteristics, such as succulence and growth form (Krueger, et al., 1974).

SOCIAL ORGANISATION, DOMINANCE HIERARCHIES AND LEADERSHIP

Dominance. In a flock of grazing sheep there is little or no sign of dominance. In small domestic flocks, sheep will compete for small amounts of food by pushing and shoving rather than active bunting. Dominance–subordination relationships were assessed in Merinos and Border Leicesters by Squires and Daws (1975). They found an almost linear hierarchy in Merinos and a less rigid structure in Border Leicesters when a competitive feeding situation was created.

Social groups. Sheep form strong social groups that are stable and the social organisation of the flock influences grazing patterns. Animals are not randomly dispersed in any environment and free-ranging groups may exhibit extreme non-randomness in the use of resources, particularly vegetation. Young lambs form strong social bonds with each other or other objects (e.g., goats, humans, dogs, cattle). Sometimes a strong bond forms between two animals and they become mutually dependent.

The number of dominance fights within flocks is higher in single-sex, single-age groups than in mixed-sex groups of varying ages (Stolba, et al., 1990).

The social system of sheep appears to have been shaped by anti-predator and foraging strategies that rely upon learned traditions (Festa-Bianchet, 1991).

Age-effects studies on cohesive and aggressive behaviour in sheep indicate that older animals are more likely to be involved in fights (Stolba, et al., 1990).

Family groups are less likely to display fighting and attention-seeking behaviours, indicating that a socially stable flock may be less affected by environmental heterogeneity than groups that are not as well integrated socially (Stolba, et al., 1990).

Characteristics of flock structure. Research has shown that different breeds have different flock structures (Arnold et
al., 1981):

1. Merinos are a tightly knit flock and rarely form sub-groups. They graze close to each other and disperse into sub-groups only under extreme food shortage, when sex and age groups segregate out.
2. Southdowns usually form a few sub-groups and are closely associated when grazing, but not when camping.
3. Dorset Horns always form many sub-groups.

In cases where sub-groupings occur, the flock maintains a social entity because membership of sub-groups is constantly changing. The identification of a flock structure is important to understand when managing sheep. One important aspect is that, irrespective of breed, flocks of sheep drawn from different sources do not readily integrate into a socially homogeneous group (Winfield et al., 1981). This means that if the paddock is large enough, each group will use a different area, even if the food is better in one part. This can lead to some sheep being under-nourished.

In a gregarious breed, such as Merinos, the flock moves as a unit and is unsuited to grazing in pastures that are not uniformly abundant. The net effect of such behaviours, particularly on an extensive scale, is that to increase or decrease stocking rate will not necessarily lead to improved animal production of an area. This is because the non-random spread of animals in that grazing area makes some sectors virtually psychologically unavailable to some individuals.

Sheep have a strong bias for associating with others of their own breed both when grazing and camping (Arnold, et al., 1974).

Observations in undisturbed flocks shows that group identity develops when small flocks are estab-

lished. Breed identity perception also exists within flocks composed of groups of sheep of different breeds (Arnold, et al., 1974).

Leadership. Squires and Daws (1975) found that position in a moving flock was highly correlated with social dominance, but there is no definite study to show consistent voluntary leadership by an individual sheep.

Under mixed-stocking situations, sheep do not usually associate with cattle. However, sheep will stay close to and follow cattle when forced into close association with cattle at an early age, with wethers staying nearer to cattle than ewes (Anderson, et al., 1996).

Sheltering behaviour. If shade is available in summer, sheep use it, but if it is not available they stand about in groups, shading their heads under the flanks or between the hind legs of adjacent lambs rather than lying down (Schreffler and Hohenboken, 1980). A major problem in Australia is that about 20% of winter-born lambs die from lack of shelter. An important research project has looked at ways in which Merinos can be forced to take shelter before their lambs are born. Research has shown that it may be possible to train sheep to spend resting periods in sheltered areas by shearing during the cooler months; subsequently, a high proportion may lamb in shelter, thereby reducing lamb mortality (Lynch et al., 1980).

The use of-artificial wind-breaks—either a tall, relatively unpalatable hybrid phalaris or polythene shade cloth, provided protection from wind and reduced the death rate of single lambs from 35.5% without shelter to 8.8% with shelter, when the temperature was less than 5° during the 6 hours after birth (Alexander et al., 1980).

The selection of sites for shelters is important so the behaviour of the sheep must be considered and the shelters placed where the sheep naturally prefer. Sheep tend to graze into the wind on treeless plains, in hot weather, but on cold wet days they huddle in the downwind corner of the paddock, so shelters can be put there. They also tend to camp on hilltops in cold weather, so shelters could be placed on ridge tops. Least-used shelters are typically near roads, human activity and paddock ends (Pollard, et al., 1999).

Under most conditions, sheep tend to spend more of their time closer to trees than would be expected by chance. This effect is intensified in paddocks with trees planted at low density (Sibbald, et al., 1996).

Camping behaviour. Certain breeds of sheep have definite 'bedding habits', known as camping. Choice of campsite is important and often the sites chosen for day camps differ from night camps. Sheep have clearly defined tracks leading from the water points to day campsites (Squires, 1981). Merinos camp on high ground during cold weather and near water or under shade during hot weather. In adjacent small pastures, camping is along the common boundary or adjacent corners. Because sheep camp, a large proportion of faeces is dropped at the campsite and so plant nutrients are transferred from the pasture to the campsite. The distribution of plants is also influenced and there can be a build-up of internal parasite eggs at the campsite. In the management of pastures it may be necessary to fence off campsites at times and force the sheep to move to other areas.

Grazing. Grazing is a social behaviour like sheltering and camping. Sheep tend to have two primary grazing periods, during the early morning and again late in the afternoon. The period from mid-morning to mid-afternoon is the least active. Grazing time, which may range from about 5½–10 hours a day, is affected by many factors, including day length and other environmental factors, breed, availability of pasture and water, and topography.

The grazing patterns adopted by sheep in small experimental paddocks are likely to be affected by daylength, lack of grass, and rate of loss of liveweight (Lynch, et al., 1979).

The satiety mechanism is of much greater importance in sheep than the hunger mechanism in stimulating grazing (Forbes, 1978).

Sheep have a cleft upper lip that permits very close grazing, lower incisor teeth and upper dental pad. As the animal grazes, it jerks its head slightly forward and up to break stems, leaves and grass blades against the dental pad and lower incisors.

The intake of herbage by grazing sheep is influenced by the age, size, weight and physiological state of the animal, climatic conditions and the availability and quality of herbage on offer. Little is known, however, about the interactions between body condition, cold stress and pasture availablity on the intake of grazing sheep (Arnold, 1970).

Sheep grazing and efficiency is affected by paddock shape. Ewes grazing in retangular paddocks grazed for less time, had lower intake levels and used forage less efficiently than ewes in square paddocks (Sevi, et al., 2001).

SEXUAL BEHAVIOUR

In a pen environment it has been shown that no relationship exists between dominance and mating behaviour (Schreffler and Hohenboken, 1974). In open environments there are conflicting results and although the dominant ram can prevent others from mating, it did not necessarily have the highest scores for percentage of ewes mated, number of mounts per oestrous ewe, or total number of mounts. Also, competition of ewes for a ram may have an effect, although there is no evidence (Squires, 1981).

Exposure to recently mated rams increases the sexual performance of other rams. Odour cues associated with the ewe or mating ***per se*** is thought to enhance the sexual efficiency of unmated rams (Maina, et al., 1997).

The odour of the oestrous ewe stimulates the ram, although it is the ewe who seeks out the ram and stays close beside it. The male responds to urination of the oestrous female by sniffing, extending the neck and curling the lip. This is the flehmen response. The tongue goes in and out and the male may bite the female's wool, and raise and lower one front leg in a stiff-legged striking motion. If the female is receptive she will stand for copulation.

In sheep, the duration of sexual receptivity in the presence of the ram is reduced when the ram is contin-

uously present with the ewes (Romano, et al., 2001).

The continuous presence of a ram after the removal of progesterone sponges hastens oestrus onset and reduces the interval between sponge removal and ovulation, without modifying oestrus duration and time between oestrus onset and ovulation in ewes synchronised during the breeding season (Romano, et al., 2001).

Ewes in oestrus will often display ram-seeking behaviour, defined as a ewe being persistent in staying at the common fence with attention focused on the ram to the virtual exclusion of grazing (Ortman, 2000).

Mating efficiency may drop if food is short and ewes disperse into small sub-groups. In this situation the rams may not be able to find them at the usual ratio of 4 rams per 100 ewes. This is one reason that understanding flock behaviour under various environmental conditions is so important.

There are several advantages to using wethers, which include low cost and convenience of treatment compared to the cost of vasectomy of the ram, and the use of wethers to identify ewes for artificial insemination or in the post-mating period to detect non-pregnant ewes.

The use of wethers (castrated male sheep) treated with oestrogen or testosterone has been shown to be as good as vasectomised rams for inducing ewes to ovulate and for detection of ewes in oestrus (Fulkerson et al., 1981).

MATERNAL–OFFSPRING BEHAVIOUR

Some ewes remain with the flock during lambing and others seek isolation. Within seconds of birth the ewe faces the lamb and begins vigorous licking and eating of foetal membranes. The young must find the teat within 1–2 hours of birth, and it seems that visual cues are very important for successful teat location (Bareham, 1975). Strange lambs are accepted immediately after birth and some ewes adopt new-born lambs if they have lost one. Adoptions in sheep flocks are more common than is generally realised and has some consequences in genetic experiments where lambs are identified with their mothers many hours or even days after birth. From about 12 hours after birth, a strange lamb is actively rejected.

Add-on fostering is limited only by the inability to properly match odour-familiar cues on a ewe's own and alien lambs (Price, et al., 1998).

Lambs recognise their mothers' voices by individual differences (Shillito-Walser, 1980) and ewes recognise their lambs by a variety of cues. These cues may be vocal recognition (Shillito-Walser et al., 1981). Other workers (Morgan, et al., 1975) suggested that recognition depended mainly on smell, while other studies (Alexander and Stevens, 1981) showed that ewes could recognise their lambs from auditory and visual cues alone, but that the correct olfactory cues are required for suckling to be permitted. These cues may be of differing importance depending on the breed of sheep, size of groups, and the environment they are running in.

Litter size has a strong effect on the time spent grooming by the ewe. The birth of the second-born twin results in a dramatic reduction in grooming of the first-born twin (O'Connor, et al., 1989).

Analysis of lamb behaviour found that singles were more active, lying for less time and having a greater number of suckling attempts than twins (O'Connor, et al., 1989).

Offspring behaviour has no effect on the onset of bonding behaviours of the ewe, and neonatal lamb activity is largely independent of the behaviour of the dam (Dwyer, et al., 1999).

Suckling behaviour is modified by ewe behaviour and this affects the strength of the bond between ewe and lamb (Dwyer, et al., 1999).

The sheep is a follower species and in the first day of life the ewe remains within one metre of the lamb, so the placement of water, food and shelter is important. The distance between ewe and lamb when both are grazing increases rapidly over the next 10 days of life, reaching a plateau with an average distance of 20 metres. Accidental separation in the first few days causes great agitation of both lamb and ewe, and reunion is immediately followed by suckling.

In the first 24 hours after birth, lambs identify their mothers at close quarters only (less than 50 cm), and discrimination at a distance of several metres becomes established only when the lambs are between 2 and 3 days old (Nowack, 1991). This helps to account for the prevalence of cross-suckling and mismothering in the early days of life.

Suckling has strong rewarding properties in the establishment of a peferential relationship with the mother by the lamb but the maintenance of this preference does not rely strongly on suckling (Nowack, et al., 1997).

The strength of the ewe–lamb bond is determined mainly by milk yield with a threshold level below which weaning occurs (Arnold et al., 1979).

Lambs become familiar with and recognise individuals (twins and non-twins) as a result of direct association. They also discriminate between novel scents and artificial odorants associated with their familiar agemates, but such odors neither mask nor substitute effectively for lambs' individually recognisable phenotypes (Porter, et al., 200I).

The management of the maternal-offspring bond is important in the husbandry of lambing ewes. The main objectives are:

1. To produce lambs capable of finding teats and suckling successfully;
2. To produce ewes whose behaviour facilitates suckling.

Some circumstances delay suckling which will reduce the chances of successful suckling. These include:

1. mother remains lying after birth;
2. mother circles;
3. mother is absent—she may be attending to one twin at the expense of the other; and
4. the weather may be too hot or too cold.

The sheep producer can help to ensure that suckling is successful in several ways:

1. environmental control such as positioning of shade, shelter, food and water;

2. supervision of lambing; and
3. selection of suitable breeds who make good mothers.

ABNORMAL BEHAVIOUR

The most important abnormal behaviour is concerned with maternal behaviour. Sometimes a ewe may wander away from her lamb, butt the lamb or move away as the lamb approaches to suckle. These behaviours are more common in ewes with twins, who seem unable to recognise that they have more than one lamb.

Aggressive behaviours are preferentially directed towards members of the same flock (Ruiz-d-la-Torre, et al., 1999).

A small percentage of rams commonly will not mate with oestrous females and, if given a choice, will display courtship behaviour towards another ram in preference to a female. This partner-preference behaviour of rams may be traceable to foetal development and could represent a phenomenon of sexual differentiation (Resko, et al., 1998).

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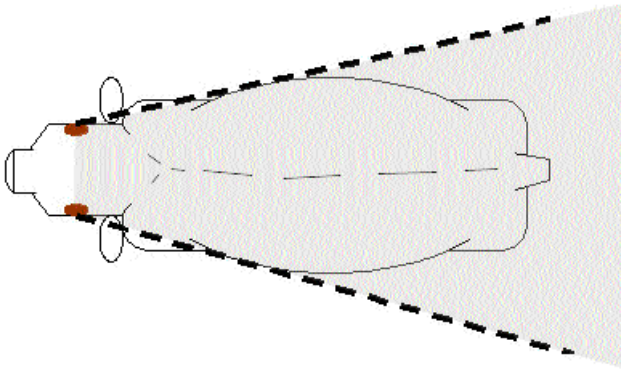
CATTLE

VISION AND OTHER SPECIAL SENSES

With their eyes positioned on the side of the head, cattle have panoramic vision of 330° and binocular vision of 25°–50°, which allows for good predator awareness (Phillips, 1993). Despite the wide set of their eyes, however, they do have a blind spot directly behind them (see below).



Cattle have slit-shaped pupils (Smith, 1998) and weak eye muscles, which inhibits their ability to focus quickly on objects (Coulter et al., 1993).

Cattle can distinguish long wavelength colours (yellow, orange and red) much better than the shorter wavelengths (blue, grey and green), which may have aided their response and survival when a herd member was attacked and blood was spilt (Phillips, 1993). Cattle can distinguish all colours from a grey background except blue (Dabrowska et al., 1981), and have a poor depth perception. Because of this poor depth perception and lack of definition, cattle will often baulk and refuse to cross a shadow or drain grate and are best moved through diffuse light.

While grazing, cattle constantly sniff the pasture, but it is not known if plants are rejected on the basis of odour. Cattle can distinguish smell, e.g. they will baulk at the smell of blood and offal.The sense of touch is important in determining which herbage is rejected or preferred. The secondary/special olfactory system can detect pheromones, volatile chemicals that are important in reproduction and feed selection (Currie, 1995).

The ears of cattle are very sensitive. Cattle can be calmed by playing soothing music, or stressed by loud noises such as yelling (NSW Feedlot manual 1997). Dairy breeds are more sensitive to sound and touch than beef breeds, high-pitched sounds, such as the whistle used to control most farm dogs, will increase the animals' heart rates (Lanier et al, 2000). Hearing in cattle is important in inter- and intra-species communication (Phillips, 1993).

Cattle flight zones can vary greatly. Feedlot cattle may move away from people, especially strangers, entering their flight zone of 1.5m, whereas less handled range cattle have a flight zone of 30m (NSW Feedlot manual, 1997).

Cutaneous sensitivity can be used to calm cattle by scratching under the neck and behind the ears, areas they find difficult to access (Moran, 1993).

Sensory input at the level of the penis is important for sexual behaviour during mounting (Hafez, 2000).

Older cattle grazing on rangelands will spend less time grazing than younger cattle due to their experience and learned paddock patterns (Krysl et al (1993).

SOCIAL ORGANISATION, DOMINANCE HIERARCHIES AND LEADERSHIP

Under farm conditions the dairy herd is organised into a social hierarchy. Schein and Fohrman (1955) found age and weight to be significantly correlated with rank, and height at the withers is also a contributing factor in steers (McPhee et al., 1964).

Other workers (Reinhardt, V. and Reinhardt, A., 1975) have shown an inverted U-shaped relationship between dominance and age. They found that cows rose in rank up to about 9 years old as their weight increased; thereafter, dominance declined as weight was gradually lost.

In free-range heterosexual herds of cattle there are several hierarchies among adult males, adult females and juveniles. As they age, young males fight adult females and eventually dominate them.

The hierarchy tends to be linear and large herds probably break down into a series of smaller hierarchies (Hafez and Bouisson, 1975). There is evidence that dominance hierarchies in young beef steers are formed soon after weaning and that they remain stable even when the groups are moved to other pens (Stricklin et al., 1980). Dominance and eating behaviour have been observed in beef cattle where only one animal at a time could eat, and it was found that high-ranking cattle had fewer meals but tended to spend more time per day eating. Also dominant cattle did not prevent subordinates from gaining access to the stall, and the lower-ranking cattle replaced higher-ranking cattle as frequently as they were replaced by higher ranking cattle. Dominance becomes important only when there is a very limited amount of food for which to compete (Stricklin & Gonyou, 1981).

Although early work has not shown a relationship between dominance and milk 26 production, recent field observations on ten commercial dairy farms showed that cows yielding a higher amount of milk came earlier for milking and those yielding a lower amount of milk came later (Rathore, 1982).

Aggressive interactions in cows appear to be ritualised and occur in sequence: approach, threat, physical contact or fighting. Once the dominance relationship of any pair of animals is learned (Beilharz and Zeeb, 1982), it eliminates the need for further combat. The subordinate animal retreats from the dominant at the slightest threat and physical contact is of minor importance as long as the animals can see each other's posture.

Leadership. Until recently there appeared to be no evidence for a relationship between leadership and dominance. It had been suggested, but not substantiated, that the most dominant animals were in the middle of

the herd (Kilgour and Scott, 1959). A recent study looked at patterns of leadership during grazing movements (Sato, 1982), which were divided into following, independence and leading. It was found that high-ranking animals tend to lead, medium ranks tend to follow and low-ranking animals tend to be independent. An interesting suggestion was that it was the active movement of high-ranking animals and the independent movement of low-ranking animals that governed the voluntary formation in grazing patterns.

Grazing. Grazing occupies a large amount of time in both dairy cows (about 8 hours/day) and in beef cattle (about 9 hours/day). Grazing behaviour is affected by many factors, including environmental conditions and plant species. These will be discussed in detail in the chapter on grazing animal management and behaviour. Cattle usually stand to graze and the pattern of grazing behaviour of each herd member is relatively similar. The animal moves slowly across the pasture with the muzzle close to the ground, biting and tearing off grass, which is swallowed without much chewing. They ruminate when resting and time devoted to ruminating is approximately three-quarters of that spent in grazing. This will be altered by the type of pasture. A useful ratio is the R:G ratio, i.e.

$$\frac{\text{ruminating hours}}{\text{grazing hours}} \quad \text{per day} \qquad \text{i.e.} \quad \frac{6}{9} \qquad = 0.6$$

if grazing is not restricted by management and is influenced by abundance of pasture and environmental factors (Tribe, 1955). If pasture is good, ruminating time is short, and the R:G ratio is low (0.4); if the herbage is poor and fibrous, ruminating time is longer and R:G value is high (1.3).

Group cohesion. In open treeless areas, free-ranging cattle group into large mobs and the distances between individuals are smaller than in areas with sparse to moderate tree and shrub cover. This means that the mob is more tightly clumped in open areas (Dudzinski et al., 1982) and this affects the grazing pattern.

Resting behaviour. The amount of time cattle spend resting depends on environmental conditions, time spent ruminating and grazing, and on breed. Studies on Zebu cattle showed individual preferences for particular resting areas, which could be traced throughout 12 months. The consistency with which an animal lies on its resting place is independent of its dominance hierarchy, which indicates that no competitive situation arises with other herd members for particular resting sites. The animals will avoid sources of noise and disturbance and choose non-habitual resting sites if the preferred ones are close to the noise or disturbance (Reinhardt et al., 1978). Zebus and Zebu crossbreds will remain out in the bright sunlight resting or grazing, while British breeds seek the shade (Kelly, 1959). In a dairy herd of Friesian cows it was found that there was a consistent order for lying down and standing up (Benham, 1982)

Cattle have long memories (NSW Feedlot manual, 1997). They can individually identify 50–70 other herd members (Fraser & Broom, 1997).

Cattle will follow the lead animal (not necessarily the most dominant animal) quietly (NSW Feedlot manual 1997, Fig 9.1). This animal may lead, but often does not have control over herd direction but rather if a change of flight direction is caused, will run forward to the front position.

Bos indicus cattle are generally more excitable than the European ***Bos taurus*** breeds (NSW Feedlot manual 1997, Fig 9.1).

Subordinate status can lead to attenuation of sexual displays (Hafez, 2000).

High hair whorls on the face are found in reactive cattle (Grandin, 1995).

Cattle will graze pasture that is 5 cm above the ground, distinguishing plants while grazing (Hosokawa, 1990).

The herd's day involves maintenance behaviour: standing, walking, lying, feeding, drinking, self-grooming, allogrooming, agonistic behaviour and ruminating (Mitlohner et al., 2001).

Grazing is affected by temperature. In very high temperatures cattle will graze predominantly at night (Krysl et al., 1993).

Cattle accustomed to a rotational system of paddock allocation will graze faster than cattle that are left in paddocks for longer periods, they will also tolerate lower feed supply, knowing that feed will be available in the next paddock in the rotation (Krysl et al., 1993).

Cattle in rangelands graze with younger animals in the centre of the herd, surrounded by the more aggressive members. Aging and weak cattle will often graze away from the herd, sometimes due to an inability to keep up; this exposes them to potential predator attack (Manning et al., 1998).

Dairy cattle that are placed in new herds and exposed to dominance struggles involving aggression will often show a reduction in milk production for several days (Fraser et al., 1997).

Fear may contribute significantly to the establishment of dominance (Albright et al., 1997).

In an exchange between two animals where one is clearly larger, healthier, stronger and older than the other, it may take no more than a movement gesture or threat to make the smaller animal submit or yield space (Albright et al., 1997).

An aggressive bull will turn his body perpendicular to a challenger to display his full height and length (Houpt, 1998). Aggression is expressed by bunting or striking a challenger with the head (Houpt, 1998).

Dairy bulls are generally more aggressive than those of beef breeds, as well as being larger (Houpt, 1998). The unpredictable nature of a bull's aggressiveness leads farmers to use artificial insemination techniques so they no longer have to house bulls on the farm.

There is a tendency in the milking hierarchy for more dominant cows to enter the dairy first, and these individuals are also more likely to produce higher yields (Phillips, 1993).

Grazing time will be increased with the introduction of cattle (both dairy and beef) into new pasture, as more time is spent exploring the paddock, which could be associated with search grazing (Krysl et al., 1993).

The grazing time of calves in the presence of experienced grazing cattle was significantly longer than that

of calves grazing by themselves (Fukasawa et al., 1999).

A study of 7 breeds of cattle indicated that in windy wet weather grazing occupied 48% of their time and in windless cloudy conditions, grazing occupied 67% of their time (Rogalski, 1975).

Cattle lie down to sleep, ruminate or drowse for nearly half of their day (Houpt, 1998).

When cattle lie down they hold their heads up or drawn back to the flank area (Albright et al., 1997).

Lying-down times of a lactating dairy cow depend on the type of housing, the comfort of the stall or lying out area, the type of diet, whether or not pregnant and climatic factors (Albright et al., 1997).

SEXUAL BEHAVIOUR

As the cow reaches oestrus the bull becomes very excited and follows her closely, licking and smelling her external genitalia and often exhibiting flehmen. Recent work has shown that the bull uses the tongue to transfer fluid (probably urine) to a short incisive spur located on the dental pad. It is then transferred to the vomeronasal organ (Jacobs et al., 1980) which is considered to be the site of pheromone identification. Pre-copulatory patterns include pawing the ground and snorting, chin-resting on the cow's rump just before mounting and then copulation. Copulation is short (seconds) compared with horses and pigs (minutes).

Social ranking of bulls can influence their sexual activity, the most dominant animals mating the most. Chenoweth (1981) has written a useful review of libido and mating behaviour in bulls and other species.

The female becomes hyperactive when oestrus begins and the number of indiscriminate agonistic interactions and mounting attempts increase (Schein and Fohrman, 1955). A subjective measure of the intensity of oestrus from how 'excitable' a cow seems to be, can be designated as strong, medium or weak. Relative differences between breeds, ages and individuals can be fairly accurately rated (Hafez and Bouisson, 1975).

Castrated males (steers, bullocks) may display similar sexual behaviour as intact/complete males (e.g. mounting); the lack of androgens inhibits actual mating/copulation. After male cattle are castrated, erections are the last aspect of male sexual behaviour to be lost (Hafez, 2000).

Female sexual behaviour depends on 'the circulating endocrine balance', controlled by ovarian secretions, primarily oestrogen (Hafez, 2000).

As cows become sexually receptive they may mount or be mounted by other cows, sniff males or become involved in mock fighting. Cows are receptive for approximately a day (Hafez, 2000).

The level of sexual behaviour displayed is determined by genetics, environmental factors, physiological factors, health and previous experience, e.g., bulls of dairy breeds are generally more sexually active than those of the beef breeds. New herd members attract greater sexual attention. Therefore, their introduction to a breeding group can be a useful means of stimulating sluggish bulls (Hafez, 2000).

Testosterone and oestrogen enhance the libido of males and females respectively (Currie, 1995).

Oestrous duration of cows is longer when there are many other cows in oestrus at the same time (King, 1990).

The bull detects the pro-oestrous cow about 2 days before oestrus and remains in her general vicinity (Albright et al.,.1997).

During the oestrus period the cow increases her frequency of urination so the bull can sample both the odours and the taste of her urine (Phillips, 1993).

The period of sexual receptivity (mounting behaviour) ranges from 1 to 18 hours, with the average being about 4.4 hours (King, 1990).

Bulls that are used for AI or hand-breeding may have poor semen quality or poor reproductive behaviour, due to the lack of stimulatory effects that result from the prolonged courtship (Houpt, 1998).

Bulls commonly masturbate, especially at times of inactivity (Houpt, 1998).

Mounting causes an immobilisation reflex (rigid stance) in the oestrous females that are being mounted (Albright et al., 1997).

MATERNAL-OFFSPRING BEHAVIOUR

Suckling behaviour begins 2-5 hours after birth and the mother must be standing. The calf vigorously butts the mother's udder with its head while suckling. It has been noted that heifers which had a difficult birth took longer to stand than cows who had already had several calves. Experienced cows usually stand within one minute of the birth of the calf (Edwards and Broom, 1982). The mother licks the young to stimulate breathing, circulation, urination and defecation. The cow is a 'hider' species so the young are hidden near the birth site straight after birth and the afterbirth is eaten, because it could attract predators.

Teat sucking by the calf is most intense soon after it stands up and it is common for suckling to occur first from a front teat (Edwards and Broom, 1982). The distance maintained between the cow and calf increases steadily with time after calving but they keep in contact by vocalising. Within the first week of life the calf begins to follow the cow, but for periods of the day, groups of calves will be found lying together for much of the day while the cows are grazing. It is in the period before calves are themselves grazing that 'nurseries' may form (Squires, 1981). There may be 'guard' cows left in charge and observations are reported from cows under extensive rangeland conditions. Fostering of calves is possible if a group of calves is placed with several nurse cows, but there is a large variation in the number of sucklings permitted by the cows (Kilgour, 1972).

A cow becomes restless 1–2 days before calving. If possible, she will leave the herd shortly before birth, finding a quiet place to calve. This is often not possible in most domestic contexts, so herd interference can occur at the birth, and bonding may be disrupted (Hafez, 2000).

If calves are removed from their mothers immediately after weaning, they can be pre-conditioned. This involves handling quietly, early castration and dehorning to accustom them to human handling, making them qui-

eter to handle as they age. They will suffer less stress than cattle that have had less frequent human contact (Grandin, 1999). This is in comparison with calves that are left with their mothers and learn behaviours to avoid humans (NSW Feedlot manual, 1997).

Vision, olfactory and vocal senses are involved in cow and calf identification. Cows will groom their calves, 'labelling' them as their own (Hafez, 2000). Calves usually stand 45 minutes after birth, and are suckling 2–5 hours later; the mother aids suckling by positioning her body for easier access (Hafez, 2000). Between birth and 7 months, the mean duration of suckling time for calves was seen to be 34 minutes, with the suckling frequency being 4.5 times per day (Hattori et al., 1995). Weaning studies in ***Bos indicus*** have shown that heifer calves are weaned at 8 months of age, whereas bull calves are weaned at 11 months (Houpt, 1998).

Twins may receive less grooming than single calves (Hafez, 2000). Cows will lick the urogenital/rectal areas to stimulate urination and defecation (Hafez, 2000). Hormones regulate maternal behaviour (Currie, 1995).

At calving, cows should be allowed to seek isolation in a sheltered place, which will allow a dry and soft surface to lie on. Dairy calves should be licked by their mothers, but the duration must be controlled so that calves are able to suck (Lidfors, 1994).

The heritability of maternal behaviour is low in cattle (Houpt, 1998), so it is difficult for farmers to select for good mothering ability in bloodlines.

Contact between the cow and her calf for a period as brief as 5 minutes postpartum results in a strong specific maternal bond (Houpt, 1998).

ABNORMAL BEHAVIOURS

1. ***Mismothering***. This may be due to the mother having suffered a long and difficult birth and not being able to stand up for suckling. The calf may also be too weak to suckle. Cases of mismothering are common with cows calving in synchrony in intensively managed maternity groups (Albright et al., 1997).
2. ***Nymphomania***. Such cows behave like bulls, pawing and mounting but refuse to stand for mounting by other cows. It could be an inherited trait. Nymphomania is more common in high-producing dairy cows than in cows of beef breeds (Houpt, 1998). Nymphomania is usually associated with follicular cysts (Houpt, 1998).
3. ***Buller-Steer Syndrome.*** This a common health and economic problem in feedlot operations (Ulbrich, 1981). The typical buller-steer sexually attracts his penmates who take turns following and mounting the abnormal animal. It does not seem to be associated with rank, and may be due to boredom. When detected, bullers are segregated and treated for injury or illness. Approximately 2% of steers in a feedlot situation are buller steers (Houpt, 1998).
4. ***Illness/disease.*** Cattle that are not healthy will show abnormal behaviour. Healthy cattle will appear alert, stretch on rising and be vocal – they often vocalise in response to pain or stress (Grandin 2001). Unwell cattle often show little interest in their environment, have dull eyes, sluggish movement, poor grooming and poor appetite (NSW Feedlot manual, 1997). Other indicators of sickness include over-stretching of the neck, hunching the back, kicking the belly area (indicating abdominal pain), grinding teeth, star-gazing, etc. (Moran, 1993).

Atypical sexual behaviour, such as nymphomania, homosexuality, hypersexuality, masturbatory behaviour, may be caused by genetic flaws, endocrine imbalances, management problems, and in many cases may be reversed (Hafez, 2000).

Masturbation in males is common, especially in bulls on a high protein diet (Hafez, 2000).

Humans may modify behaviour by processes such as castration, spaying and endocrine implants to increase production and ease of handling (Currie, 1995).

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GOATS

VISION AND OTHER SPECIAL SENSES

Goats have prominent eyes, a panoramic field of 320°–340° and a binocular vision of 20°–60°. Tests have been done on male goats to determine their capacity for colour vision and they have been found to distinguish yellow, orange, blue, violet and green from grey shades of similar brightness (Buchenauer and Fritsch, 1980). They have a well-developed sense of smell and a new food is investigated by sniffing it.

SOCIAL ORGANISATION, DOMINANCE AND LEADERSHIP

In a herd of feral goats it is a large male that is dominant and maintains discipline and coherence of the flock (Mackenzie, 1980). He leads the group but shares leadership on a foraging expedition with an old she-goat (flock queen), who will normally outlast a succession of kings.

Horn size is a rank symbol and can designate dominance without combat. It has been suggested that scent urination, a ritual where a male goat urinates on his beard, is an indicator of rank and physical condition. O'Brien (1981) has reviewed some aspects of social organisation and behaviour in the feral goat, including the importance of olfactory communication.

Agonistic encounters can be "non-contact" threat which includes staring, a horn-threat with chin down and horns forward, rush or rear as a challenge threat. Contact agonistic encounters include pushing the forehead against another goat, butting (in which interactants engage horns), and the rear-clash, which is a high-intensity encounter.

In feral groups, the group size and composition is highly variable and unstable. Family groups may include a dominant male, and a small number of adult females and their offspring. Males form large bachelor herds during non-breeding periods.

It is almost impossible to drive goats and when danger approaches, goats scatter and face the enemy, depending for safety on agility and manoeuvring (Mackenzie, 1980).

Alarm behaviour is highly developed. The female stands rigid in a typical nursing posture with ears towards the source of alarm. This stimulates the young to run to the female. She may snort loudly several times to alert other goats. Depending on the source of alarm, the group may either take flight, move away slowly or return to previous activities.

Leadership. Early work (Stewart and Scott, 1947) showed that leadership orders did not seem to be related to age or dominance. Donaldson et al. (1967) found milking order was consistent, and that there was a correlation between entrance order and milk weight.

SEXUAL BEHAVIOUR

The male tests the urine of the female and performs flehmen. He then approaches the female with a slight crouch, head slightly extended, horns back and ears forward, the tail vertical and often with the tongue extended (Coblentz, 1974). The female either remains still as the male approaches or begins to move away depending on her state of receptivity. If she is receptive the male does the 'rush-grumble', where he rushes towards the female and vocalises. He then nuzzles her flank, back and anogenital area with his tongue extended. The female signals her willingness to copulate by standing still with her head lowered and tail to the side.

MATERNAL-OFFSPRING BEHAVIOUR

Within a few minutes after parturition the mother begins actively licking and grooming the kid. This not only cleans the kid but probably provides cues for neonate recognition by mother. These cues are a complex interplay of vocal, visual, olfactory and gustatory stimuli. The maternal–offspring bond is very individually specific and the female aggressively rejects the suckling attempts of alien offspring.

Feral goats hide the neonate to prevent attack by a predator. This is similar to cattle behaviour, but the young of the sheep are followers.

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PIGS

VISION AND OTHER SPECIAL SENSES

Pigs have colour vision and a panoramic range of about 310°, and binocular vision of 35–50°. It is thought they have no accommodation (i.e., they cannot focus). Pigs are inquisitive and this must be remembered when moving them. If they are not hurried and can explore as they go along, they can be driven without effort. The extent to which pigs have colour vision is still a source of some debate. However, the presence of rods and cones with two distinct wavelength sensitivities in the blue and green frequencies (Lomas et al., 1998) suggests that at least some colour vision is present.

Pigs have a well-developed sense of smell and use is made of this in Europe where they locate underground truffles. Hearing is also well developed and localisation of sounds is made by moving the head. Olfactory rather than visual stimuli are used in the identification of conspecifics (Houpt, 1998).

Pigs learn quickly to manipulate food and water devices, to turn fans on and off (Ingram and Legge, 1970) and to turn on a source of radiant heat (Ingram et al., 1975).

Auditory stimuli are used extensively by pigs as a means of communication in all social activities (Gonyou, 2001). Alarm or aversive stimuli are transmitted to conspecifics not only by auditory cues but also via pheromones (Vieuille-Thomas and Signoret, 1992).

SOCIAL ORGANISATION, DOMINANCE HIERARCHIES AND LEADERSHIP

The basis of the social structure in feral pigs is the matriarchal herd of several females and their offspring (Kurz and Marchington, 1972). Males are not permanently associated with such herds, and are often solitary or in bachelor groups.

In the domestic situation pigs may be kept together with littermates throughout their lives or be grouped with strange pigs of similar age and size. There are two types of social organisation in the domestic pig (Signoret et al.,1975):

a. Teat order;

b. Dominance hierarchy.

Teat order. Within the first few hours to two weeks after farrowing, the piglets become capable of recognising their positions on the udder and preferentially attach themselves to anterior rather than posterior teats. This was shown in the early work of Donald (1973a, 1973b) and confirmed by many later workers (Hemsworth et al.,1976). It has been shown that stimulation of the anterior teats appeared to be important in causing milk letdown (Fraser, 1973) so it might be to the advantage of the entire litter to have these teats occupied by healthy piglets. The teat order may function as a type of territorial spacing system which, in turn, means a stable family life with minimum competition.

Most fights that occur in young piglets are around the udder (Hartstock and Graves, 1976) and more fights were won at the permanent nursing site than away from it. They called this the 'home-court advantage' and found that fighting declined as the nursing order was established.

Using an artificial sow to rear groups of piglets, Jeppesen (1982) suggested that recognition of a teat in a particular area of the udder depended on visual orientation by means of reference points on the udder to find the area, and then the olfactory sense is used for the search within that area.

Dominance hierarchy. This is the social organisation established in groups of weaned pigs. When a number of unacquainted pigs are mixed together for the first time, they fight to establish a dominance hierarchy, usually of a simple linear type. The fighting behaviour is generally mouth-to-neck attacks with strong thrusts sideways and upwards (McBride et al.,1964).

The establishment of the hierarchy occurs within 24 hours of mixing but the level of aggression drops dramatically after about one hour (Symoens and Van Den Brande, 1969). The dominance hierarchy is important as the social rank appears to influence productivity. It has been shown by some workers (Bielharz and Cox, 1967; McBride et al.,1964) that social rank influences growth, while others (Meese and Ewbank, 1973a) found that weight was not correlated with dominance or sex. The dominance hierarchy is important as a group stabiliser, but under adverse, intensive conditions, animals low on the hierarchy may be disadvantaged by lack of food and water.

The top-ranking pig can be removed from the group for up to 25 days and on return will still retain its position, but only if the social group it left was stable (Otten et al., 1997). A pig at the bottom of the hierarchy is treated as a stranger and attacked when returned after three days (Ewbank and Meese, 1971). Pigs probably recognise each other by sight and smell.

It is an advantage in a husbandry system to have a stable social organisation so that the pigs can settle down and grow and it may be that a system of 'birth-to-slaughter-weight-in-one-pen', in which pigs remain members of the same unchanged social group from birth to slaughter, is a way to reduce disturbances (Ewbank, 1978; Sainsbury D. and Sainsbury, P., 1979).

Huddling behaviour. Pigs are very susceptible to hot conditions and the rate of sweating is very low, so there is inadequate thermoregulatory compensation by respiratory evaporative loss. In the feral state, pigs seek shade and wallow in mud or water and become more active at night (Mount, 1979). Young pigs are sensitive to cold and a behavioural feature retained through a pig's life is the stimulus to huddle with littermates (Mount, 1979). Nest-building activity in the natural state provides shelter from environmental extremes.

Leadership. The work of Meese and Ewbank (1973b) showed no clear relationship between leadership, exploratory behaviour or social rank in groups of pigs in an outdoor area.

Dominant pre-weaned piglets have higher growth

rates than subordinates due to suckling the more anterior teats (which secrete the most milk and have the lowest incidence of mastitis), allowing their dominance to be maintained through to post-weaning (Dyck et al., 1987).

Agonistic behaviour among piglets will decrease if they are regrouped during lactation rather than post-weaning (Olsson and Samuelsson, 1993).

Instability of the dominance hierarchy increases with stocking density, thus increasing stress and aggression. This appears to depress the immune system and thus heighten the herd's susceptibility to disease (Turner et al., 2000).

Grouping pigs by weight heterogeneously rather than homogeneously, as is the current practice, may increase growth rate and reduce hierarchical conflict by allowing clear weight differentiation among littermates (Francis et al., 1996).

Odour masking, by methods such as creating a familiar odour on all pigs, masking the odour of unfamiliar pigs, and the use of pheromones and/or artificial compounds, has had little, if any, effect in limiting aggression and increasing hierarchical stability (Gonyou, 1997).

Isolation from a social group is very stressful for pigs and may result in stereotypies or attempts to escape (Gonyou, 2001).

SEXUAL BEHAVIOUR

Courtship behaviour lasts only a short time when a boar is placed in a small pen with an oestrous female. The sow plays the critical role of meeting sexual partners as boars show equal choice between an oestrous and an anoestrous sow. The male sniffs the female, noses sides, flanks and vulva, and emits a 'mating song'of soft gutteral grunts (6–8 seconds). He foams at the mouth and moves his jaw from side to side as the female poses and bites the male's ears gently. When the sow becomes stationary the boar mounts. Androstenone within boar saliva aids in eliciting the standing response in the sow (Gonyou, 2001). Some sows are more attractive to boars than others and occasionally a sow may avoid and refuse to stand for a specific boar. Rearing females in isolation from males delays the standing response of the females once they are introduced to boars (Soede and Schouten, 1991).

Pheromones in boar saliva and preputial secretions induce oestrus in gilts and sows (this is known as the boar effect) (Pearce et al., 1988).

The presence of stimuli from boars (namely odour) will induce earlier puberty in gilts than if no other stimuli were present (Hemsworth et al., 1988).

Because an oestrous sow will stand near the boar (Bressers et al., 1991), penning breeding females adjacent to a boar makes identification of oestrous sows easy.

The social environment that boars have been raised in influences their levels of sexual activity (Hemsworth et al.,1977). Boars that are raised individually with no visual contact with immature females, but who can hear and smell the females, have reduced copulation frequency and shorter average duration of ejaculation compared to those raised in all-male or male-female groups. Boars that engage in more courting activity, especially nosing of the sow's flanks before mating, have higher conception rates (Hemsworth et al.,1978). This study suggested that extra flank-nosing might stimulate oxytocin release from the sow's pituitary gland and this could increase sperm transport and the number of sperm in the oviduct and so increase the chances of fertilisation.

Dominant boars cover the markings of subordinate animals with urine that is often contaminated with preputial secretions (Mayer and Brisbin, 1986).

MATERNAL–OFFSPRING BEHAVIOUR

In a paddock the sow will nest-build for up to six hours before parturition. She hollows out a depression and lines it with straw, grass, sticks, or other available material. While farrowing crates in intensive piggeries prevent much of this nest-building behaviour, many elements are still present and the sow will often perform similar activities to those of pigs provided with nesting material (Blackshaw J. and Blackshaw, A.,1982).

Pigs of lower social status tend to produce litters with piglets that are lighter in weight (Mendl et al., 1992).

Dominant sows give birth to more male piglets than do subordinate ones (Mendl et al., 1995).

Compared to other mammals, pigs display complex nursing and suckling behaviour (Fraser, 1980; Signoret et al.,1975). Nursing is frequent, every 50–60 minutes, and the sow requires stimulation from piglets before milk let-down. Sensory inputs (vocalisation, odours from mammary and birth fluids and hair patterns of the sow) are particularly important immediately post-birth to facilitate teat location by the piglets (Rohde Parfet and Gonyou, 1991).

Initially, the piglets jostle for position at the udder, then each piglet massages around its respective teat with its snout, during which time the sow grunts at slow, regular intervals. Each series of grunts varies in frequency, tone and magnitude, indicating the stages of nursing to the piglets (Algers, 1993). The phase of competition for teats and of nosing the udder, lasts for about one minute, and ends when milk flow begins. In the third phase, the piglets hold the teats in their mouths and suck with slow mouth movements (one per second), and the rate of the sow's grunting increases and lasts about 20 seconds. The grunt peak in the third phase of suckling does not coincide with milk ejection but rather the release of oxytocin from the pituitary into the bloodstream (Castren et al., 1989). Phase four coincides with the period of main milk flow (10–20 seconds' duration) when the piglets suddenly draw back slightly from the udder and start sucking with rapid mouth movements of about three per second. The sow grunts rapidly, lower in tone and often in quick runs of three or four, during this phase. Finally, the flow stops and so does the grunting of the sow and the piglets may dart from teat to teat and recommence suckling with slow movements, or nosing the udder.

Piglets massage and suckle the sow's teats after milk flow ceases as a way of letting the sow know their

nutritional status. This helps her to regulate the amount of milk released from that teat in future sucklings. The more intense the post-feed massaging of a teat, the greater the future milk release from that teat will be (Jensen, Gustafsson and Augustsson, 1998).

It is often hard to tell if the nursing episode is initiated by the sow or the piglets and almost any disturbance causes the piglets to rise, squeal and then nurse. The sound of one litter nursing may initiate nursing among other litters.Fostering piglets from one litter to another is often carried out in the pig industry and it is recognised that sows may react aggressively to foster piglets and that suckling periods are disrupted. Horrell and Bennett (1981) exchanged three piglets between five pairs of litters at seven days of age after the teat order had been established. Compared with control litters, cross-fostering disrupted the teat order relationships of the whole litter. Weight gain of fostered piglets during the second week was reduced to 79% of that in their non-fostered littermates. If fostering has to be done, it has more chance of success if the piglets are only one to three or four days old. Cross-fostering of piglets should be undertaken before teat order is established and involve movement of larger piglets rather than small ones to minimise teat order disruption and associated mortality and production losses (Gonyou, 2001).

In the natural environment, farrowing nests are built at least 100 m from the communal nest to improve piglet survival (Jensen, 1989).

PGF_{2a} appears to be the hormonal regulator of nest-building behaviours such as nosing, rooting and pawing to create a depression, as well as the gathering of straw to line the nest (Burne, Murfitt and Johnston, 2001).

By the time piglets are 6 days old, they have begun to follow their mother (Stangel and Jensen, 1991).

Recognition between the sow and her piglets is by olfactory and vocal cues (Jensen and Redbo, 1987).

Without human interference, weaning is finished by the time the piglets are about 17 weeks old, but it may begin as early as 4 weeks of age when the mother begins to reduce her nursing efforts (Jensen and Recen, 1989).

ABNORMAL BEHAVIOUR

Abnormal behaviours often found in pig units include:
1. Tail and ear biting (Blackshaw, 1981);
2. Cannibalism;
3. Reproductive behaviour problems such as abnormal mating behaviour and abnormal maternal behaviour;
4. Eating too much or too little; dominance relationships that prevent some animals from having access to food and water;
5. Abnormal dunging habits;
6. Persistent inguinal nose thrusting (PINT) (Blackshaw, 1981). PINT is defined as occurring when a pig repeatedly thrusts its nose into the inguinal area of a resting pig with the top of its snout, until the recipient pig moves. It is a behaviour pattern of high-ranking pigs, although other pigs do it;
7. Various stereotypies, which are repeated actions with no goal direction, have been described (Fraser, 1975) in tethered sows when not provided with straw;
8. Snout rubbing, when pigs rub their snouts on the flanks of other pigs causing necrosed areas (Allison, 1976).

These behavioural problems are easy to see and tell us something about the mental well-being of the animals. However, we do not know if animals experience emotional feelings in the same way as humans. Perhaps, the important thing to recognise is that these abnormal behaviours tell us that all is not well in the husbandry system.

A deficiency in iron may contribute to the incidence of tail biting (Fraser, 1987), but other factors have since been ranked as being of greater importance.

The incidence of cannibalism such as tail and ear biting has exceeded 10% of pigs in some studies (Arey, 1991).

Stereotypies may increase in prevalence through a piggery via social facilitation (Appleby, Lawrence and Illius, 1989).

Some stereotypies, such as ear sucking and biting, may be associated with low levels of fibre in the diet (Meunier-Salaün, Edwards and Robert, 2001).

Belly nosing/snout rubbing by piglets does not appear to be related to stress, diet quality or the presence of milk in the diet but is somehow related to the age at weaning (Gardner, Duncan and Widowski, 2001).

Abnormal behaviours, such as tail and ear biting, stereotypies and belly nosing, may be redirected rooting or nosing behaviour caused by barren commercial environments (Beattie, Walker and Sneddon, 1996).

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POULTRY—CHICKENS

VISION AND OTHER SPECIAL SENSES

Chickens have panoramic vision of about 300°, and possible binocular vision of 26°. Sight is an acute sense and colour vision is important. Preference is probably for colours that are easiest to see against a green background, and this ability to discriminate colour is unlearned.

One-day-old chicks prefer to peck at round rather than angular objects (Goodwin and Hess, 1969). They also prefer to peck small (0.3 cm), solid objects, but would rather approach fairly large ones, especially if moving or making a rhythmical noise.

Selection of food is based on visual cues and immediate taste cues. This is important to know when managing poultry and their food. If the composition of the food changes due to availability of grains, the hens may not change easily to eating seeds of a different shape or colour.

Hearing is an acute sense in chickens, and communication within and among flocks of birds takes place mainly via signals provided by postures, displays and vocalisations (Mench and Keeling, 2001).

Postures and displays are used to signal threat and submission (Kruijt, 1964).

The varieties of vocalisations are in the categories of warning and predator alarm calls; contact calls; territorial calls; laying and nesting calls; mating calls; threat calls; submissive calls; distress, alarm or fear calls; contentment calls; and food calls (Mench and Keeling, 2001).

Morphological features associated with the head and neck are important for both communication and social recognition (Mench and Keeling, 2001). Comb size and colour in males and females are influenced by the levels of sex hormone and are indicators of social status (Guhl and Ortman, 1953).

Little is known about the sense of smell.

SOCIAL ORGANISATION, DOMINANCE HIERARCHIES AND LEADERSHIP

There are three common types of husbandry systems used for intensively housed chickens:

Cages. Chickens are kept in groups of 3–10 birds in cages with space allowances of 350-600 sq cm per bird (Mench and Keeling, 2001). Stocking densities vary around the world, 350 sq cm on average in the United States, to as high as 700-800 sq cm in Norway and Switzerland (Savage, 2000).

Meat chicken sheds. These hold from 10,000–70,000 meat birds, housed on litter in either semi-enclosed or environmentally closed houses. Stocking densities vary from 30–50 kg live weight per square metre (Mench and Keeling, 2001).

Breeder sheds. These house flocks of several thousands in semi-enclosed or enclosed housing on litter or wire. The male to female ratio is about 1 to 8–15, with the space allowance of 0.2–0.3 square metre per bird (Mench and Keeling, 2001).

The social organisation differs in these systems but peck orders emerge in cages and breeder sheds. This has not been shown in meat chickens. In cages, there is a definite hierarchy established by pecking and threatening when the hens are placed in the cage, usually a few weeks before laying commences at six months.

The social order in broiler flocks is relatively unimportant as they are generally processed at an age when the establishment of social stratification is just beginning (Siegel, 1984).

Laying hens have complex interrelationships involving social rank, aggression, feeding behaviour and egg production (Mench and Keeling, 2001).

In large groups kept together for some months, subgroups form and become restricted to an area. This means that birds can recognise their own group members and those of an overlapping territory. It was suggested that this territorial behaviour is important in large flocks as it reduces the numbers of conflicts when strangers meet (McBride and Foenander, 1962). It has also been shown that individuals are more dominant in the area where they spend most time. Thus in larger flocks, hens tend to live in neighbourhoods where they are well-acquainted (Craig and Guhl, 1969).

Laying hens choose to feed close to each other when given a choice of feeding locations, which demonstrates the importance of social attraction (Meunier-Salaun and Faure, 1984).

Chickens show socially facilitated feeding, in particular, they peck more at feed when they have company than when alone (Keeling and Hurink, 1996).

It has also been shown (McBride et al.,1963) that hens do not move randomly in normal intensive housing conditions—they maintain their heads at regular patterns of spacing and orientate them to avoid the frontal aspects of other birds. However, they turn, probably in defence, to face approaching birds.

In cages that are too low for the chickens to raise their heads in a threat, aggression is provoked by an approaching bird rather than by a bird that is in continuous close proximity (Hughes and Wood-Gush, 1977).

Recognition of each other is based on features of the head, the comb being the most important cue (Guhl, 1953).

Hens can distinguish between breeds that are dissimilar but are unable to distinguish between individuals of such breeds.

The ability of flock mates to recognise and remember one another becomes very difficult under commercial poultry husbandry conditions where group sizes are very large (Mauldin, 1992).

Dim or coloured lighting can affect a chicken's ability to discriminate between other birds (Mench and Keeling, 2001).

Mortality, production and behavioural problems are all worse in large groups of hens, which implies the formation of unstable social groups (Mench and Keeling,

2001), so this is particularly a problem in barn/aviary egg-production systems.

Peck orders are regarded as highly stable once established, and in mixed groups, males and females have their own peck order (Guhl, 1958).

Agonistic pecking begins to occur within a few weeks after hatching, stable dominance and subordinate relationships usually do not become established until 6–8 weeks of age in cockerels and 8–10 weeks in pullets (Guhl, 1958).

A potential problem in the industry, depending on spacing and the strain of poultry, is the frequency and severity of agonistic acts. Al-Rawi and Craig (1975) did an interesting experiment, beginning with relatively generous space allowances per hen and then decreasing the space. They found that social interaction rate increased as space decreased then suddenly fell off as space decreased further. It has been shown that individuals behave less aggressively towards subordinates in the near presence of dominant flockmates. This 'third-party-effect' (Ylander and Craig, 1980) is associated with a reduction in agonistic behaviouror it may be due to the lack of space for threat displays.

The results of this experiment on spacing indicate that interpretation of the results is important. Another point to be aware of is that selection for productivity traits may cause behavioural changes. Increased aggressiveness and social dominance, prior to full maturity (Bhagwat and Craig, 1977) has accompanied the selection for early onset of egg production in several genetic stocks studied.

Higher-ranking hens may have better egg production than the lowest ranked bird in a cage, possibly because the higher ranked birds have greater access to feed (Cunningham and van Tienhoven, 1983).

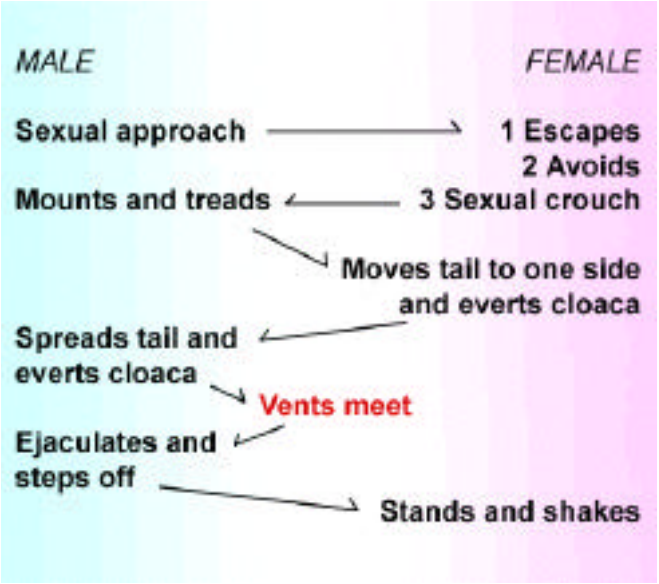
Most aggression is seen at the feed trough, where there is some competition among the chickens (Mench and Keeling, 2001). Aggression in cages is relatively low, as the small group size in the cages allows the hens to establish a stable dominance hierarchy (Mench and Keeling, 2001). Once a social group becomes organised, the incidence of agonistic interactions decreases (Mauldin, 1992).

SEXUAL BEHAVIOUR

A series of displays occurs before mating, based on a stimulus-response sequence (Fischer, 1975) initiated by the male (see diagram).

Male courtship displays are generally elaborate, involving vocalisations and noises, postures, spreading of the feathers to increase apparent size and emphasise plumage characteristics (Kovach, 1975).

Sexual behaviour and dominance relationships are important in the management of mating. Because the female must crouch to elicit courting behaviour in the male and this is also a submissive behaviour, high-status females are often difficult to mate. Although it is never done commercially, research suggests that to overcome this, chickens may be sub-flocked and this reduces the number of individuals each may dominate or be submissive towards. When high-ranking hens are isolated from hens lower in the peck order, they crouch more often than when in the larger flock, and hens in the middle and lower thirds of the peck order crouched less often (Guhl, 1950).



(Modified from Fischer, 1975).

MATERNAL–OFFSPRING BEHAVIOUR

Maternal behaviour or broodiness has been selected out of commercial laying strains so it is not important in intensive poultry husbandry systems.

In a broody hen with chicks, a bond is formed and the chicks learn to respond to the maternal feeding call, distress call and to the hen's 'purring' sound as she settles down. Repeated exposure to her, accompanied by food, guidance and protection, strengthen the filial bond. Exposure to maternal calls during embryonic development may be important for the development of post-hatch species-specific maternal call recognition (Gottleib, 1976).

Being precocial, birds are self-sufficient after hatching, but parents serve an important protective function while also teaching the chicks about edible and inedible foods (Nicol and Pope, 1996).

Precocial chicks imprint on their parents in the first few days of life (Rodgers, 1995). Imprinted chicks remain close to the imprinted object, which is normally a parent, but under laboratory conditions may be a variety of different objects (Mench and Keeling, 2001).

ABNORMAL BEHAVIOUR

1. Sometimes males will hound other males, which can be a problem.
2. Caged birds may exhibit some abnormal behaviour such as head flicks and feather pecking, i.e., pecking and pulling the feathers of other birds (Mench and Keeling, 2001). Feather-pecking may be a form of redirected ground pecking (Blokhuis, 1989). Experience in early life with ground pecking may influence pecking behaviour in later life (Blokhuis, 1991). The motivation for the redirection of ground-pecking happens when the incentive value of the ground is low, compared with the incentive value of pecking substrates (Bindara, 1969). In high-density situations, the birds and feathers make

up a higher proportion of stimuli relative to the litter area. It is possible that the birds may perceive the feathers as dust and that may cause a redirection of ground-pecking to feather-pecking (Hansen and Braastad, 1994).
3. In some housing systems, cannibalism can be a problem.
4. Pseudo-mating occurs most frequently between high-ranking males and low-ranking males, who are pursued and trodden (Guhl, 1949) and indicates that dominance relationships are important. The same situation may occur in flocks of hens.

ALTERNATIVE HUSBANDRY SYSTEMS

There is ongoing research into alternative husbandry systems, which may in the future replace the cage. Commercial egg layers are housed mostly in cages in groups of 3–10, with much restriction on the bird's movement. Meat chickens are housed on litter in either semi-enclosed or environmentally closed houses, often in groups up to 70,000 birds.

Very few birds are maintained in free-range conditions as it is uneconomical in terms of labour, food requirements and wastage in egg handling, problems of predators and disease control, and lack of egg hygiene (Sainsbury, 1980). Free-range eggs have a 15–20% rate of dirty eggs that are classed as second-rate eggs, whereas the rate in conventional caging is 2% (Slack-Smith, 2000).

The problem of deciding what is best for a hen is difficult and some researchers have devised experiments in which they provided birds with a choice of flooring (Hughes and Black, 1973; Hughes, 1976) and a choice of environments (Dawkins, 1980; Wegner, 1980).

The hens chose fine hexagonal mesh over coarse rectangular mesh and over perforated steel sheet. It seemed that the hexagonal mesh supported the bird's foot at more points than the other two floors. In comparing wire and litter floors, it was found that previous experience with either wire or litter floors affected the choice: birds reared on litter spent more time on litter than those raised on wire.

In the environmental preference studies (Dawkins, 1980), hens were given a choice of cage or an outside run. Hens used to living outside in the garden all chose the run. Hens previously used to living in cages tended to choose the cage on first trial, although subsequently they came to choose the run. So choice is strongly influenced by previous experience. The fact that the hens prefer an outside run to a cage is not indicative of suffering in a cage. Preference in itself is no indication of suffering.

Before egg laying, hens will work to gain access to nest sites. The demand for this resource is inelastic. Hens in cages without nests often show abnormal activities during prelaying, such as increased pacing, reduced sitting and displacement behaviours (Sherwin and Nicol, 1993). So, if cages contain a nesting box, there is an opportunity for more normal behaviour. Different systems have been tested for performance and behaviour traits of laying hens since 1977 in Celle, Germany (Wegner, 1980).

Comparison of different maintenance systems. Free-range system with deep litter, deep litter without range and battery cages. Egg production has been found to be more economical in cages (i.e., less feed per egg).

Comparison of different cage types with different numbers of hens per cage. There is reason to suppose that some differences exist in behaviour between battery and deep-litter systems, so cage types other than the conventional battery cages are being compared. There are two types of 'get-away' cages developed in England and The Netherlands.
(i) 80 cm x 100 cm x 65 cm (l x w x d) cage with three perches and two feed troughs at equal levels on both sides of the cage, with 16 and 20 hens, respectively, with four nests per cage. The cages are either filled with wood shavings or the sloping floor that forms the roof of the cage below allows the eggs roll into a collecting tray. Fibre mats are put into the nests to make them more attractive. It is a two-tiered system. This design had problems as the hens used the nests to scratch, sand bath and rest in, so 25–30 per cent of eggs were dirty, destroyed or eaten. Too much labour was required to supply litter daily and collect the eggs.
(ii) 1 m x 1 m x 55–80 cm (w x d x h) Celle cage with four nests, each with a sloping fibre floor, two feed troughs on both sides and one sand bath. The whole cage floor has a 5° slope from the side of the sand bath to the side of the nests. It is also a two-tiered system.

Egg production in these get-away cages with 15–30 hens per cage of 1 sq m floor area is similar to that in a conventional cage with three or four hens per cage. Some disadvantages of this system were cracked eggs at the floor, which was not elastic enough; and the sand bath, which was opened eight weeks after the start of laying, was immediately used for laying and was forced to be shut. Monitoring of hens was also difficult in this system.

Enriched cages (e.g., the Edinburgh modified cage). These cages are similar to battery cages but provide more features for the chickens, which allows a wider variety of behavioural characteristics. The cage houses four hens and provides them with a perch, a nesting box and a dust bath (Wathes and Charles, 1994).

The aviary and perchery systems. The main idea is to make better use of the space between floor and ceiling in the poultry house by installing several horizontal levels and so increase the number of hens per square metre of floor area. The aviary system used was made of plastic foil and measured 8.50 m wide x 12 m long (10 hens per square metre of floor area).

Better use of height is achieved by having two rows of perches along the house. One feed trough is on the floor and the other is on the perches. There is a 'farmer automatic nest' in two parallel rows and in two tiers, which can be moved out of the aviary into a special room where the eggs are automatically removed from the litter. Nipple drinkers provide water. Good results for laying performance and number of losses compared with hens in cages, have been achieved.

The final analysis of results was completed in April

1981, and a report referred to the West German government. Murphy (1982) gives an outline of the final conclusions in her comprehensive report. She states that if all aspects studied are considered, then none of the systems may be described as totally adequate for the overall welfare of the birds.

Cages showed overall advantages in economy and hygiene; there was significantly less social conflict among the birds with a lesser number and intensity of threats, agonistic pecks and associated vocalisations, and fewer deaths from cannibalism than in the floor systems. However, when compared to floor-housed birds, those in cages showed more behaviour indicative of conflict and frustration during nest selection and egg-laying behaviour. It has been recommended that further research into completely new husbandry systems or modifications of existing systems be carried out to provide optimal conditions in all aspects of egg production.

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DEER

Deer farming is a growing industry in Australia with demands for antler velvet and venison. Several useful books on the topic are available (Anderson 1978; Yerex, 1979, 1982) and much of the information in this section comes from them.

TERMINOLOGY

Male	stag, buck
Female	hind, doe
Young	fawn, calf
Pubertal female	jinnock
Young male with spike-like antlers in advance of a later full head	spiker
Castrated stag	havier
Naturally polled stag	hummel

(extra information Haigh & Hudson, 1993).

SOCIAL ORGANISATION, DOMINANCE HIERARCHIES AND LEADERSHIP

In general, dominance orders are linear, but during rutting, triangular relationships are common among males (Lincoln et al., 1970). There seems to be a stable relationship between age and social rank, but this may change during the antler growth period. The most dominant animal does not necessarily have the largest antlers.

It is important to understand herd behaviour when deer are farmed. They tend to maintain a loose grouping when tamed, all rising together, moving to the grazing area, all grazing and then all returning to their favourite spot. Deer walk the fenceline and this can open up the ground and make it prone to erosion. This can be overcome by proper placement of fences in areas less likely to be eroded. It is possible that pacing the fenceline indicates stress (Hodgett et al., 1998).

Deer shelter from cold winds, so windbreaks can be provided. Shade and shelter may assist with thermoregulation (Pollard and Littlejohn, 1999).

Wild hinds tend to live in ranges overlapping those of their mothers, while stags disperse from their dam's range at about 2–4 years of age to associate loosely with other stags (Clutton-Brock et al., 1982).

Leadership is usually undertaken by the lead hind, helped by a second female, who assumes a rear-guard position during group movement. It is important when trying to drive a herd that the lead hind is moving in the right direction.

Even under intensive farming conditions, fallow deer may tend to maintain the sexual segregation typical of this species in the wild, especially during the birthing season (Mattiello et al., 1997).

Mature bucks spend most of their time alone or in bachelor groups until rutting, when they become intolerant of each other and move to rutting areas to collect and defend groups of adult hinds (Pépin et al., 2001).

Deer become aggressive to each other during yard confinement, with more aggression being observed in spring. (Pollard and Littlejohn, 1996). Confinement of established social groups may be stressful, particularly to low-ranking individuals (Pollard and Littlejohn, 1999).

Mixing of unfamiliar groups of deer should be avoided. (Pollard and Littlejohn, 1999). Stress manifests in conflict or disturbed behaviour (Wiepkema, 1990).

Reduction in space allowance as a consequence of higher stocking density results in changes in stress levels, particularly in subordinate hinds, which are more sensitive than dominant animals. At high stocking densities, more agonistic behaviour occurs with bites and pushes occurring twice as often as those in lower stocking densities. Fence pacing increases and head movements are more frequent, suggesting a greater motivation to escape. Grazing patterns are modified, with meals being more frequent and synchronisation of grazing with other hinds decreasing. This is more important for the subordinate hinds in the group and leads to breaks in feeding and lower growth rates (Blanc and Theriez, 1998).

Mixed-sex groups of fallow deer occur more frequently when population density increases (Mattiello et al., 1997).

High female densities have a deleterious effect on male forage habitat and nutritional condition. Males require a higher minimum standing crop of grass/forage than females to obtain efficient forage intake. As standing crops are very low after females have grazed, males are unable to obtain sufficient forage intake and must move to areas of lower forage quality but higher biomass (Conradt et al., 1999).

Adult male fallow deer prefer to feed on hay and show higher preference than females for corn and bran meal, while females, depending on lactational status, prefer pasture. In an intensive farming system, males will become more active when supplemented feed is supplied (Mattiello et al., 1997).

Grazing occurs at dawn, declines throughout the day and then increases strongly at dusk. In poor weather, grazing is reduced and sitting periods are increased at feeding times. Pacing along fence-lines increases in poor weather, possibly reflecting motivation to find shelter, which suggests that protection from rain, as well as windbreaks, affect the welfare of the animals. The uses of shade and shelter are important, not only in wet weather conditions but may also assist in thermoregulation of the animals even in temperate conditions, enhancing welfare and possibly productivity (Pollard and Littlejohn, 1999).

Providing cover in a paddock reduces social interactions by up to about 60%, aggression by up to 17%, and reactivity by 50% (Whittington and Chamove, 1995).

SEXUAL BEHAVIOUR

Red deer are seasonal-breeding mammals with reproduction time regulated by photoperiod. Stags are usually silent except when alarmed, but during the rut they produce repeated lion-like vocalisations (Pépin et al., 2001). Other male sexual behaviour includes chasing and mounting a hind in oestrus (Jaczewski, 1989).

Fights occur among males and it is the dominant stag who mates. Male mating success is positively related to dominance and body size (Clutton-Brock et al., 1998). The stag's neck hair grows long, the neck enlarges and he rolls in the mud and thrashes his antlers against trees or posts to display his dominance.

During the rut, males of high rank use low-risk behaviours towards smaller, low-ranked bucks, but when dealing with bucks of similar rank, they use higher-risk techniques, such as antler contact and kicking (Mattiangeli, Mattiello and Verga, 1999).

In domestic herds mating management is important, and there are several different strategies:

1. One stag put with a group of up to 50 hinds. The group of males is first allowed to sort out the dominant stag and this is the one put in with the hinds.
2. The herd sire can be selected by the deer farmer on the basis of bodyweight and head (i.e., antlers).
3 The dominant stag can be introduced into the group of hinds as well as two or three younger males, who keep the dominant male on his toes.

During the rut, stags may express visual and aggressive displays that serve to intimidate, or prompt assessable responses from competing challengers (McComb, 1991). There is a danger of overextending a stag, especially in smaller paddocks (e.g., 10 hectares) where he can defend his hinds against all comers.

In selecting mating areas, females avoid isolated small meadows within scrub areas, preferring larger meadows where a number of sexually active males may be found (Carranza and Valencia, 1998).

Female deer suffer less sexual harassment when in larger groups. When other groups surround their group, they have a greater chance of mating with highly competitive males, promoting male–male competition before accepting a mate (Carranza and Valencia, 1998). Roaring by red deer stags advances oestrus in hinds (McComb, 1987).

Stags may remain within 5 metres of hinds for up to 10 hours post-copulation, chasing away any males that approach (Endo, Doi, Shiraki, 1997).

MATERNAL–OFFSPRING BEHAVIOUR

Gestation is about 233 days and the female is first mated at about 15–16 months (i.e. at about 65 kg). Hinds with fawns have a strong preference for an area far from road disturbances (Mattiello et al., 1997). In the first week of life, fawns lie hidden in the grass, except when being fed. In the second week, the animals become more active, investigating, and tasting possible food resources, including soil, grass, seeds and water, without swallowing. The animals start to graze at 20 days and begin ruminating one week later (Birgersson et al., 1998).

Going into the paddock after the fawns are born is a risky business because they may lie hidden anywhere. They remain in their hiding place until disturbed and then they bolt and often smash into or through the first fence they reach. Gloves should be worn when fawns are picked up for weighing and tagging, as a hind will strike a fawn that has been handled without gloves.

Hinds quite commonly steal fawns and some cases of 'twins' are thought to be due to this.

Mismothering and allosuckling occur in deer where female nurses may take care of calves that are not their own. These calves may occasionally be adopted by a nursing mother (Vankova et al., 2001).

Occasionally, fawns will suckle from a hind that is not their mother (allosuckling). This allows fawns of hinds with lower milk production to have higher growth rates, thus increasing group size. This increase in group size may decrease the risk of predation of the hind's own offspring by creating a dilution effect (Ekvall, 1998).

Male fawns receive more milk than females. This maternal investment bias towards males results in males attaining a large body size. In artificial suckling systems, male fawns were more likely to empty the bottle without interruption, suck harder and be more motivated to obtain milk (Birgersson et al., 1998).

Confinement of fawns indoors and the presence of a hind improved weight gain in the period following weaning, and reduced the weaning stress and fear responses in fawns, especially if the hinds were familiar with humans, e.g., hand-reared hinds (Pollard et al., 1992).

Farmed red deer are normally weaned at 3–4 months of age, whereas wild members of the species are normally suckled for 7–8 months and continue to associate with their dam after weaning (Pollard et al., 1992).

Weaning over a period of 10 days (interval weaning) appears to be less stressful than abrupt weaning and could therefore reduce susceptibility to stress-related diseases such as pneumonia and digestive upsets (Church and Hudson, 1999). Other common reactions include long periods spent pacing fence lines and loudly expressing their distress. This behaviour was not evident in animals weaned over a longer period. Heart rate and neutrophil/lymphocyte levels were also significantly higher in abruptly weaned animals, indicating elevated stress levels (Church and Hudson, 1999).

MUSTERING

It is best not to move the herd when fawning. At other times, in small areas, they can be set moving towards a gate if the farmer can walk around them. Deer are very curious and will move from one paddock to another to look at something they have never encountered before.

Quiet dogs are used by some farmers and others use a farm bike. Yarding is better done in the evening as deer are much quieter as it gets dark. In fact, deer tend to exhibit fewer fear behaviours in dim light (Pollard and Littlejohn, 1994), so mustering late in the evening may be advantageous.

Care must be taken not to alarm groups of deer as they may take flight, but this depends on the level of familiarity with the immediate environment and their habituation to human presence (Recarte et al., 1998). Females looking after young are more likely to take flight than males or mixed groups (Recarte et al., 1998).

If deer do break a fence it is best to leave them until the next day and they will probably be back in the original paddock—it seems they have a strong site-attachment bond.

When deer must be yarded for long periods, they should be kept in familiar groups of the same sex and of similar body size (AACSCAW, 1991).

Movement through races may be facilitated by widening the race to about 1.5 m and allowing the deer to move through two or three abreast (Grigor et al., 1997). Such movement may be enhanced if the handler moves behind the group (Jago et al., 1993).

Following short-term stressful procedures (e.g., mustering), animals will reduce their lying time and increase moving activity when returned to their paddock (Diverio et al., 1993).

Handling practices prior to velvet harvesting are more stressful than the harvesting itself (Mathews and Cook, 1991).

TRANSPORT

Before transport, deer should be able to move freely in and out of the race for a couple of weeks before they need to be loaded. Then they are put into darkened yards prior to loading as this keeps them settled.

The attitude of the farmer to his deer is very important. He must be conscious of their 'feelings' or 'temperament', yet not interfere with them more than necessary. He must also be firm and in control of them. Deer become very tame if the farmer moves freely among them and this makes them much easier to manage.

In deer farming the human–animal bond plays a crucial part in the success of the venture.

Neuroleptics can be used to sedate wild deer, to reduce the stress of translocation. Transport injuries are reduced and the animals adapt more readily. Tranquillised animals were able to maintain normal behavioural patterns while under stress, and were easier to approach and handle. However, there are some side-effects, including hypersensitivity, restlessness and anxiety (Diverio et al., 1993).

Within travelling groups of deer, the larger animals initiated the most agonistic behaviour and targeted this towards smaller animals, hence deer should be transported with animals of similar size (Jago et al., 1997).

Deer can be loaded more easily if the loading raceway is wide enough to allow them to move as a group, since deer rarely move in single file, but narrow enough to prevent them from turning around (Grigor, Goddard, Littlewood and Deakin, 1998a).

The Model code of practice (AACSCAW, 1991) also suggests that there should be sufficient space allowed so that the deer can lie down during the journey.

Both confinement in the truck and the vehicular motion are stressful for deer, which is shown by increases in heart rate, alert behaviour, plasma cortisol levels, plasma creatine levels and a decrease in rumination (Grigor et al., 1998b).

Significant stressors during transportation include removal from the home environment, loading, unloading, confinement, mixing with unfamiliar individuals, food and water deprivation, temperature extremes and vibrations (Grigor et al., 1998b).

In a study conducted by Grigor et al. (1998b), heart rate was significantly increased during loading and during the initial stages of the journey but it decreased as time went on, suggesting that the deer became accustomed to the movement in the transporter.

It has also been suggested that, during transportation, deer should be positioned closer to the front of the transport crate, where the vehicular movement is reduced (Waas et al., 1997).

Confinement of males during transport might lead to aggressive behaviour, especially when space allowances are greater (Jago et al., 1993), so higher stocking densities have some merit, especially for short journeys.

In low stocking densities, deer tend to align themselves parallel to and facing the direction of travel, avoiding diagonal orientations. In higher densities, the animals are prevented from standing in their preferred orientations, with slight avoidance of the right-front and left-rear diagonal orientation. Higher stocking densities prevent loss of balance with the deer often in contact with other animals, which gives a greater amount of support and prevents impacts and injury. However, in higher densities, the animals are prevented from lying down as other animals stand on them. So it is recommended that densities should be decreased on long journeys to allow for lying down (Jago et al., 1997).

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CHAPTER 4: GRAZING ANIMAL MANAGEMENT AND BEHAVIOUR

We have looked at the behaviour of sheep and cattle and we can use this knowledge to manage grazing behaviour and improve productivity. Grazing occupies a large amount of time, for example, dairy cows graze about 8 hours/day; beef cattle graze about 9 hours/day; and sheep graze up to 10 hours/day. These times can differ widely and are influenced by many factors, including:

1. Seasons and diurnal patterns;
2. Temperature and humidity;
3. Wind direction;
4. Breed;
5. Water availability;
6. Topography;
7. Pasture available;
8. Defecation;
9. Social organisation;
10. Social facilitation.

SEASONS AND DIURNAL PATTERNS

Seasonal effects, such as shifts in the time of sunrise and sunset (which affect day length), all influence timing and duration of grazing (Dudzínski and Arnold, 1979; Low et al., 1981a,b,c). Sheep and cattle in Australia have similar grazing patterns, with the onset of grazing soon after sunrise for about three hours, and a grazing period in the late afternoon before sunset. It has been shown that cattle also have a major grazing period at night (Low et al., 1981c).

Seasons can have secondary effects on grazing, as they can alter the quality and type of pasture available and so influence preferences (Provenza, 1997).

TEMPERATURE AND HUMIDITY

Temperature affects total grazing time in sheep and cattle. On hot days cattle and sheep do most of their grazing in the early morning and evening and more than usual at night.

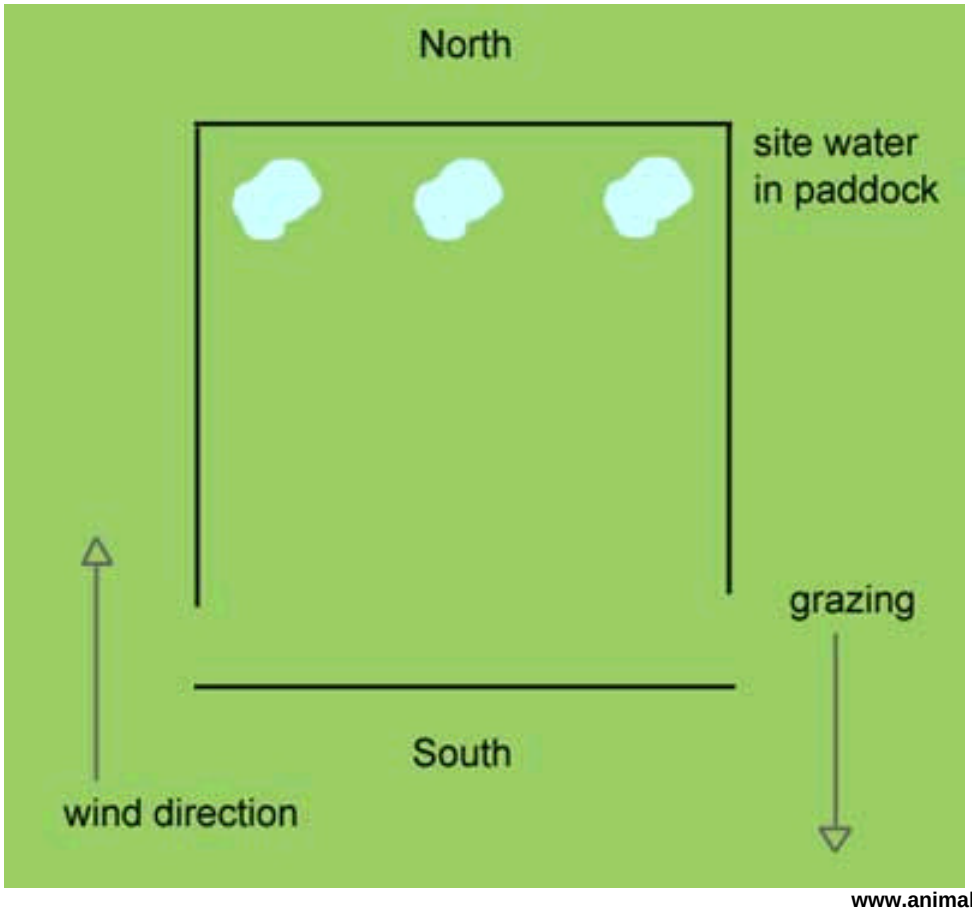
As previously discussed, sheep without shade stand together with heads under the flanks of another sheep. On hot days, cattle without shade may show heat stress and walk excessively to optimise evaporative cooling. Cattle may then be too exhausted to graze in the cooler afternoon temperatures when cattle with shade begin to graze.

When humidity is high during the day, more grazing occurs at night. In winter, sheep begin night grazing earlier the lower the temperature and the morning grazing period begins later, the lower the maximum and minimum temperatures (Arnold, 1982).

The performance of animals in hot dry seasons can be improved if they are able to graze at night. The positive effects of night grazing are decreased when the animals are fed supplements (Ayantunde et al., 2000).

WIND DIRECTION

As mentioned in Chapter 3, sheep and cattle tend to graze facing into the wind. In the heat cattle turn downwind as the wind rises to maximise the radiant heat exchange and remain in the windiest part of the paddock. On hot days the effect of wind direction on sheep is more pronounced (Squires, 1981). They face into the



wind and continue grazing, moving along until they reach the paddock boundary fence. This has management implications. In southern and central Australia the winds come from the south, so grazing is in this direction (Figure 4.1).

To prevent overgrazing as sheep reach the boundary, the water sites should be situated in the northern end of the paddock so the sheep must move back to the water. The best orientation for paddocks in this area of Australia is north to south.

BREED

Different breeds of sheep and cattle behave differently as climatic conditions change. Breeds that can adapt to Australia's often harsh environment should be selected.

Sheep. Dorset Horns and Romneys are less sensitive to temperature changes than Suffolks, Southdowns and Border Leicesters. Cheviots and Suffolks begin grazing earlier in both the morning and afternoon than do Romneys, Dorset Horns, Southdowns and Border Leicesters. The Suffolks graze for longer, in all grazing periods, than sheep of all other breeds (Dudzínski and Arnold, 1979).

The characteristics of flock structure of sheep also affects grazing. Animals are not randomly dispersed and may exhibit extreme non-randomness in the use of resources. Merinos form tight-knit flocks that graze closely to each other. They are unsuited to grazing in pastures that are not uniformly abundant. Border Leicesters form widely dispersed groups, with uniform spacing between individuals, but no subgroups. Southdowns form a few subgroups. This means that the management of grazing behaviour must take into account these very different flock structures.

Different breeds also have different grazing patterns and preferences. For example, Dorper sheep are less-selective grazers when compared to Merino-type breeds, and Dorper sheep browse on shrubs and bushes more than grasses in a particular pasture (Brand, 2000). So, like goats, these sheep prefer to browse.

Cattle. European cattle (***Bos taurus***) seek shade more frequently and spend less time grazing than Zebu (***Bos indicus***) breeds. Brahmans (***Bos indicus***) begin grazing earlier in summer and seek shelter later than Shorthorns and Herefords, while Santa Gertrudis stay longer in the sun than any of these breeds.

WATER AVAILABILITY

The availability of water determines grazing patterns, especially in arid areas. The area around a water hole tends to be overgrazed with consequent erosion, and build-up of parasites may also occur.

Sheep. Sheep walk much more quickly to water (4 km/hr) than away from it and when grazing (0.6 km/hr). In arid conditions sheep will walk 4.7–14 km/day (Squires, 1974).

Cattle. Studies of cattle in the Northern Territory (Australia) show that they tend to remain in grazing areas at night and not near the waterholes. They usually arrive at the water points 1–2 hours after first light, although the hotter the day the earlier they arrive.

An interesting behaviour of these cattle is the presence of 'walkers' and 'non-walkers' (Squires, 1981).

1. After watering, the 'walkers' walk along well-defined tracks to the preferred grazing areas, up to 9 km from water. They arrive about dusk and stay all night. It takes them about two hours to reach their preferred area.
2. As soon as the 'non-walkers' leave the watering site, they begin grazing only about 200 m from the watering point, and the maximum distance moved is about 4 km.

There were no obvious differences in condition, conformation or coat colour between the two groups to explain these behaviours.

TOPOGRAPHY

Steepness of slope is important. Sheep shelter on the less steep slopes and these tend to be overgrazed. Sheep paddocks are most heavily utilized in areas from which the prevailing winds come.

On hilly rangelands cattle develop preferred walking tracks. To prevent over-grazing of areas they can be strategically fenced.

PASTURE AVAILABLE

Sheep and cattle select forage for grazing on the basis of:

1. plant species;
2. part of plant;
3. growth stage and length of plant.

This is complicated with other factors including:

a. availability;
b. nutritional demands;
c. digestibility;
d. learning and prior experience.

Availability is very important: the more food available, the more selective an animal can be. When recording the activity patterns of Merinos on saltbush communities in a 1,400 ha, level, treeless paddock containing saltbush and a herb layer of annual forbs and grasses, Squires (1974) showed that about half the paddock was used on a regular basis and the rest occasionally or not at all. The area used contained a perennial grass and was within 0.8 km from the watering point.

Work done on cattle has also shown that under rangeland conditions, as forage improves, cattle clump closer together. This is true for cattle in open treeless areas as well as in wooded communities, and indicates trends in cattle behaviour that reflect changes in forage conditions (Dudzínski et al., 1982).

Cattle use their tongues to pull forage into their mouths before biting it off and, depending on the type of forage, the bite size can vary as well as the rate of biting. Stobbs (1974) found that if a dairy cow is to maintain a stable production rate, despite poor pasture conditions, then her grazing must alter. On some tropical pastures cows can have difficulty in harvesting leafy material rapidly enough to satisfy their requirements. Sight, smell, taste and feel of the plant are all involved in diet selection. The age, sex and breed of the animal may also have some effect.

In all environments the qualities of the feed will influence the motivation of the animal to eat.

The formation of dietary preference is influenced by learning (Burritt, 1991; Hughes, 1993).

The number of plant species available in a sward can influence the 'fussiness' of individual animals. For example, on heterogeneous resources, animals are more selective and will choose a diet of higher quality than initially offered (Baumont et al., 2000). This selectivity can lead to a higher-quality diet but the animals will often expend more energy walking and searching for the preferred feed.

When the availability of the preferred plant species decreases, animals tend to change to the less preferred but more abundant species (Dumont, 1999).

Spatial distribution of plant species or patches of plant species can affect the selectivity or diet preference of sheep. For example, when ewes discover preferred feeding sites in designed pastures (with grouped species), they continually return to these preferred sites with and between tests. However, in the random block pastures animals fail to learn the precise location of preferred species (Dumont, 1999).

Cattle tend to eat taller plants and more dead herbage, sedges and brushes. Sheep tend to prefer shorter sward canopies, especially those containing more forbes and fine-leaved grasses (Armstrong, 1997).

Taste (and to a lesser degree sight and smell) enables animals to discriminate among different feeds. Feed preferences tend to result from a combination of taste and post-ingestive feedback. The animal's physiological condition is related to the chemical characteristics of the feed (Provenza, 1997).

Animals prefer foods that meet their nutritional needs. Also, animals occasionally show preferences for foods that alleviate illness. This effect is not related to taste preferences (Hughes, 1993). They also sometimes make unwise choices and poison themselves.

Food aversions can occur when foods are deficient in nutrients or when they contain an excess of rapidly digestible nutrients. Excess byproducts of fermentation processes from energy and nitrogen can condition food aversions (Provenza, 1997).

Aversions to particular feeds can also be due to the presence of toxins and the level of toxins present, e.g., condensed tannins in blackbrush cause transient decreases in ingestion of current-season twigs by goats (Provenza, 1997).

Animals, especially non-scavengers, are often reluctant to try unfamiliar foods or familiar foods with unfamiliar or new flavours. The greatest decrease in intake of foods is found when animals are offered novel foods in unfamiliar environments (Provenza, 1997).

When animals are provided with a choice of only novel foods that cause illness, they will avoid the least familiar food. Similarly, when fed familiar foods that cause illness, animals will avoid those foods that have previously caused illness (Provenza, 1997).

Herbivores remember for at least 1–3 years foods that provided either aversive or positive consequences (Hughes, 1993).

Cyclical patterns of intake can occur when plants containing toxins are also nutritious. The positive effects from the nutrients cause preference to increase while the later effects of the toxins cause feed aversions (Provenza, 1997).

Variables involved in food preferences include food novelty, intensity of taste, relative amounts of two foods ingested, the temporal sequence of food injestion and prior experience with illness and conspicuous flavours (Hughes, 1993).

A novel odour must be followed immediately by aversive feedback to produce strong odour-aversion learning (Hughes, 1993). However, strong aversions to novel tastes can be conditioned, although feedback is delayed for up to 12 hours. After this time, the preference response diminishes (Provenza, 1997). This does not apply to all species, because horses, for example, do poorly at learning about food aversions.

DEFECATION

Soiling by faeces strongly influences the selection of grazing areas. Cattle and, to a lesser extent, sheep will not graze over their own faeces, so part of the pasture becomes unavailable. With a large dairy herd, this may make a large area unusable for grazing.

To manage this behaviour, rotation of different animal species over the area can be used. Cows can be followed by sheep and horses.

Mammalian herbivores cannot directly detect the larvae of gastrointestinal parasites, but they avoid grazing areas soiled by faeces (Hutchings et al., 2000).

Herbivores do not defecate at random. Species will defecate where they graze, or where they sleep, or for territorial marking or near water sources. Subsequently, plants growing near these areas tend to have high levels of nutrients. In environments where nutrients are limited, this can make them highly desirable to other herbivores (Hutchings et al., 2000), especially those species that find faecal soiling by another species less offensive.

Animals with gastrointestinal parasites tend to change their feeding strategies. Animals moderately motivated by food reduce their depth of grazing and their bite rates during grazing, thereby reducing the number of parasites ingested. Animals highly motivated by food increase both bite rates and the depth of grazing, so the number of parasites ingested increases (Hutchings et al., 1999).

Parasitised animals showed a greater aversion to faecal areas (Hutchings et al., 2000).

SOCIAL ORGANISATION

Different breeds of sheep form groups and cattle form mobs, the dispersion of which is influenced greatly by availability of forage. In any group of animals a social structure is non-random and depends on the breed of the species. We have already discussed how organisation can affect grazing behaviour.

Sheep differ from cattle in that lambs follow their mothers and cattle hide their young. The distance the lamb is from the ewe depends on the ewe's activity and this distance increases rapidly over the first 10 days of life. Because lambs follow the ewe, the service areas (especially water) should not be too far away. In arid regions, walking a distance of 5 km/day over the first

100 days of life had no apparent ill effect on growth rates of Merino lambs (Squires, 1970).

Cattle often leave their young in nurseries as mentioned, but calves will do some following for short periods within the first week of birth.

SOCIAL FACILITATION

Social facilitation or the tendency to join in, operates as groups of sheep and cattle move along while grazing. The groups also tend to lie and ruminate together, but there is no concrete evidence that any special animal initiates the movement.

Grazing behaviour can give an indication of the main foraging area of cows: the area where a cow is grazing at daybreak is the most used pasture during the 24-hour period and accounts for 54% of the grazing time for the 24-hour period (Low et al., 1981a). Also, grazing behaviour studies can be valuable in assessing the nutritive value of pastures and in understanding pasture-animal relationships (Stobbs, 1974).

Experiences early in life also influence the food preferences of herbivores, such as horses. There is evidence that a mother markedly affects the establishment and persistence of her offspring's dietary habits. This begins ***in utero*** and continues long after weaning. During weaning, young animals depend less on their mothers for milk and the development of dietary habits. At this time, young companions may influence one another's intake of food. Socially mediated behaviours establish traditions in animals. Positive experiences in life can result in herbivores preferring certain foods later in life (Hughes, 1993).

When young animals are separated from adults, the animals are often less productive. They must learn about the new environment through trial and error, which is less efficient than learning from social models (Hughes, 1993).

MANAGEMENT STRATEGIES

Because grazing behaviour is so important it must be managed efficiently. Maximum use of pasture land is the aim of grazing management and this is often difficult to achieve because of several factors:

a) non-random use of space;
b) selective grazing;
c) uneven redistribution of nutrients;
d) areas around waterholes may be completely eaten out.

There are several strategies that are useful in forcing animals to use certain areas:

1. Siting water points away from shade so that animals must walk to them and so graze as they go. Water points can also be manipulated by turning them on and off, so the animals, again, have to walk between them, and overgrazing at any one point is prevented.

2. Rotational grazing around the paddocks ensures a more even distribution of nutrients.

3. Use of strips of fertiliser or reseeding areas high up the slopes on hilly or mountainous country will attract livestock and they will use the intermediate areas as well.

4. A traditional and effective way of persuading cattle to use space on rangelands is by providing salt licks. These should be situated at a distance from the water site and also from the shade.

5. Use of artificial shade when no natural shade exists can also help to manipulate dispersion. Some important points should be considered when designing these shelters:

a. allow enough space for animals to keep their normal social distance when lying or standing;
b. allow enough space for maximum air movement;
c. for sheep with lambs following, the shelter should be reasonably close to water.

6. Fencing of smaller paddocks to make use of less-preferred forage, and to decrease energy expenditure in walking. Also, the closing off of some small paddocks and moving cattle from one paddock to another can maintain correct grazing levels.

7. In central Australia, paddocks should be sited in north-south direction for the winds, and facilities placed to ensure even grazing as has been mentioned.

The awareness of the complexity of grazing behaviour, factors influencing it and some of the strategies that can be used to maximise grazing efficiency have been discussed.

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CHAPTER 5: DESIGN OF FACILITIES FOR MANAGEMENT OF LIVESTOCK

This chapter will look at the design of handling facilities based on a knowledge of the behaviour of each species. Running animals into yards for various husbandry practices such as shearing, weighing, branding, holding stock in pens, or transporting animals, all cause disruption to the animals' social system and stress to the animals. A knowledge of the behaviour of different species of livestock as well as the behaviour of different breeds within a particular species is essential to the proper management and planning of facilities for the stock (Grandin, 1980).

When handling animals, it is important to remember some general factors that can affect their behaviour, such as:
1. the degree of tameness – this will be reflected in the flight distance,
2. breed and species,
3. the type of environment in which the animals were raised.

This section will review cattle, sheep, pigs and deer under the following topics:

1. BREED DIFFERENCES

2. VISION

3. PERSONAL SPACE

4. DESIGN OF FACILITIES

5. NOISE AND SMELL

CATTLE

1. ***Bos indicus*** (Zebu, Brahman types).

2. ***Bos taurus*** (European breeds, e.g. Hereford, Angus).

BREED DIFFERENCES

When ***Bos indicus*** is compared with ***Bos taurus***, the general pattern is that ***Bos indicus*** types are more excitable, harder to handle and more difficult to block at gates. They also tend to ram fences (Tulloh, 1961). Tail swishing or the tail standing straight up is an indication of agitation.

In the European breeds Angus cattle are more nervous than Herefords or Shorthorns and tend to be stubborn and refuse to move. Holsteins tend to move more slowly (Tulloh, 1961).

Brahman-type cattle, if stressed may lie down and become immobile. If more stressed by prodding, they may go into shock and die (Grandin, 1980).

Experience with extensively grazed cattle in Australia suggests the frequency and manner of handling have a greater effect on behaviour traits than does breed (Evans, 1998).

VISION

The understanding of what an animal can see is essential for correct handling and design of facilities.

Cattle have a panoramic view of 360°, binocular vision of 25-50°, and poor depth perception. This leads to several considerations in design:
1. Lead-up chutes, crowding pens, passages, and curved holding lanes, should have high, solid walls to prevent cattle from seeing and being distracted by moving objects, people and other cattle outside (Grandin, 1980).
2. Cattle tend to monitor each other and maintain visual contact and naturally tend to follow each other. If they can always see the animal in front they will move through a narrow passage (Ewbank, 1961). Because of this following tendency, the transition between the single file-up chute and the crowding pen must be smooth to prevent bunching and jamming up of the animals (Grandin, 1980).
3. The relatively poor depth perception and wide-angle vision of cattle makes them reluctant to cross:
   a. shadows or any area of high contrast,
   b. uneven drains or any uneven piece of ground,
   c. downward slopes.

Cattle are also hesitant to go into a dark area from a light area. In designing floors and lighting, these are all important considerations, and lighting should be even and diffuse to prevent areas of contrast. Also the handler should be in visual contact with the cattle and catwalks should not be overhead. Cattle will often balk and refuse to pass under an overhead walkway or through a door if the entrance appears to be too low for their bodies (Grandin, 1980).

PERSONAL SPACE

In cattle there is a critical distance or 'flight'distance that a handler must maintain between himself and the cattle he is moving. The critical distance is 1.5 m (5') to 7.6 m (25') for fattened cattle and up to 30.5 m (1001) for free-range cattle. Brahman cattle usually have a larger critical distance than British breeds (Grandin, 1980). If the handler gets too close, the animal will either,
1. run past the handler,
2. run from the handler.

A handler should not lean over a single-file chute as this penetrates the animal's personal space and can cause rearing up or jumping. When moving a mob of cattle, an experienced handler can keep the group moving by concentrating on moving the leaders (Grandin, 1980).

If one animal does break from the group it is wise to let several more go with it, as cattle are mob animals and a lone animal can easily panic. It is much easier to round up three or four head than one lone agitated animal (Grandin, 1980).

Regular handling reduces avoidance behaviour and improves handling tolerance of young cattle, although interaction can be improved more effectively when associated with food (Jago et al., 1998)

Trials reported in 1990 have indicated the optimal time for establishing social attachment with young cattle is in the first 4–6 days of life (Fraser and Broom, eds,

1990)

The flight distance in cattle is significantly less from a stationary human in comparison to a moving person (Murphey et al., 1981)

DESIGN OF FACILITIES

1. Solid fences, where animals are crowded together prevent them seeing moving objects that may upset them.
2. A solid crowding gate prevents cattle from seeing light through the gate and turning towards it.
3. Curved chutes and catwalks facilitate natural following behaviour and prevent animals from seeing the stunning pen in the abattoir. A curved single-file lead-up chute should have a catwalk along the inner radius which enables the cattle to maintain visual contact with the handler and facilitates the animal's natural tendency to circle the handler (Grandin, 1980).
4. Pen design: cattle prefer to stand around an edge rather than in the middle of a pen. A long narrow pen has a higher ratio of perimeter than a square pen of the same area (Grandin, 1980), e.g.

The troughs for dairy cattle are best placed around the perimeter to prevent competition.

Long narrow pens built on a 60° angle to eliminate the 90° corner facilitate animal movement in a slaughter plant holding pen. Animals enter through one end and exit through the other (Grandin, 1980), e.g.

The visual contact, entering and leaving of an animal's flight zone and subsequent movement of cattle through a curved single file race can be seen in Figure 5 (Grandin, 1998).

NOISE AND SMELL

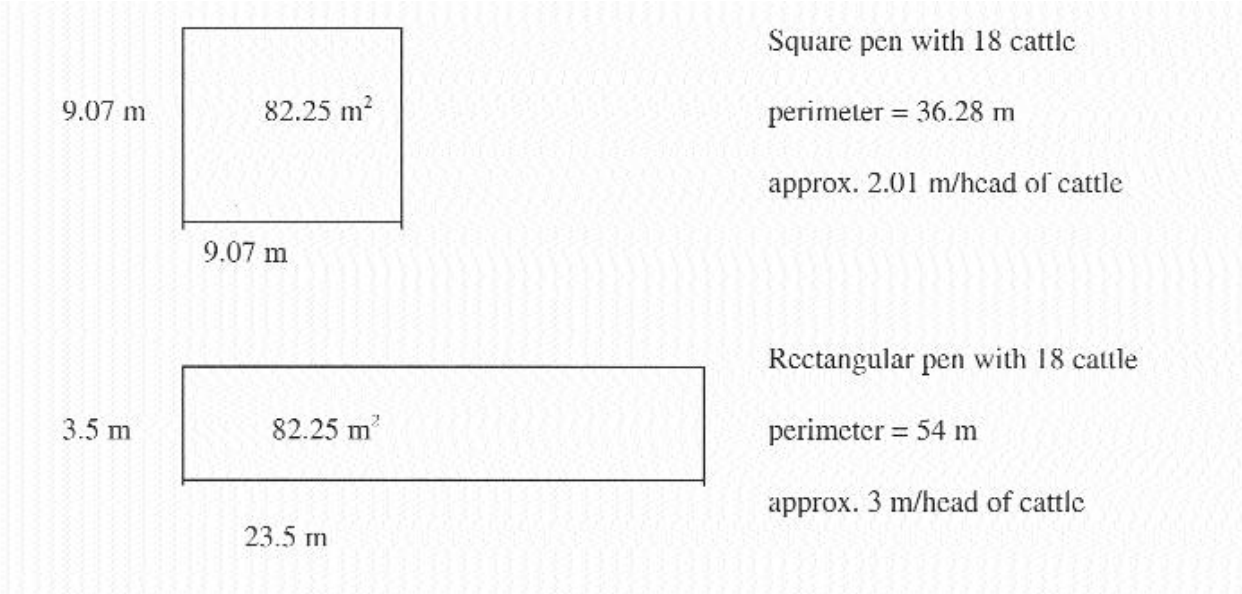
All animals are stressed by noise – banging gates, machinery, people yelling and dogs barking. Cattle appear to be sensitive to the smell of blood and will often refuse to enter a stunning pen if there is blood on the floor (Grandin, 1980).

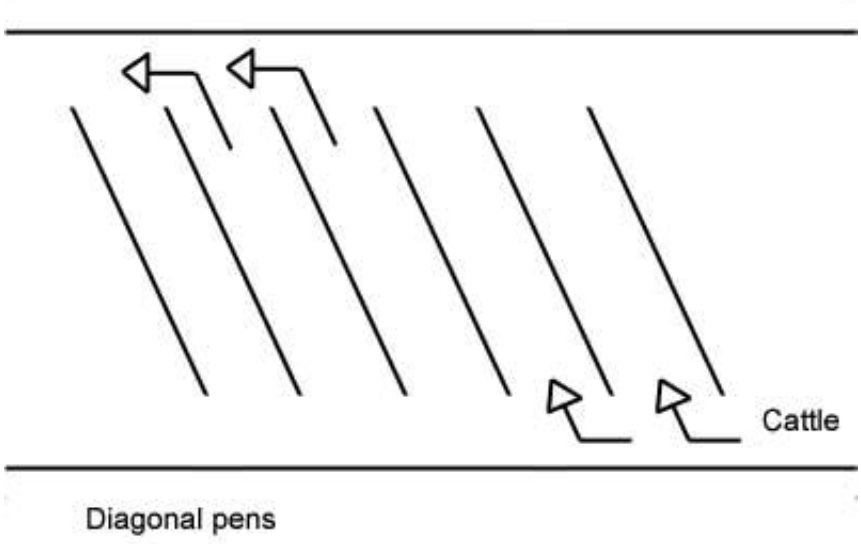
Stress related to noise can be significantly greater in cattle than humans, because cattle can hear sounds of much higher frequencies than humans (Dalton et al., 1994).

It is thought that sudden and unexpected sounds elicit the fear response in cattle (Waynert et al., 1998).

There is evidence that alarm/stress substances exist in the urine and faeces of cattle (Boissy et al., 1997).

Biological sounds arising from another species (e.g. humans shouting) appear to be more stressful for cattle





than mechanical noises (e.g. metal clanging). This is probably because biological sounds would be more significant to a prey species (Waynert et al., 1998).

A simple and economical way to reduce noise levels in handling facilities is to add rubber padding to appropriate areas (e.g. clanging gates) (Waynert et al., 1998).

Cattle may be habituated to noises. This can be demonstrated in the case of dairy cattle at milking time. Music played in the dairy during milking can mask minor foreign noises that may disrupt milk letdown. The level to which cattle become habituated was the focus of a study reported by Albright (1997). The study showed that cows preferred classical music (showing the least reduced or even an increased milk production) to hard rock and country. However, follow-up studies have shown that this response was most likely a function of animal routine rather than the particular music played.

SHEEP

Sheltering activity in pregnant ewes increases dramatically after the birth of lambs. Shelter-seeking is more pronounced in shorn ewes than full fleece individuals (Pollard et al., 2000).

BREED DIFFERENCES

Some sheep tend to bunch tightly as a group, e.g., Merinos, while other breeds, e.g. crossbred Finn sheep, turn to face the handler and maintain visual contact (Grandin, 1980). Romney, Merino-Romney cross and Dorset-Romney cross are difficult to drive. The previous chapter described the mob behaviour of different breeds of sheep.

Different breeds of sheep react differently to handling techniques and systems. The Rambouillet tends to flock tightly together and remain in a group, while the Cheviot is more independent of its flock (Grandin, 1999).

Hansen et al. (2001) has shown that differences of breed affect the anti-predatory response to stimuli (fleeing and bleating), while breeds that are lighter in body weight (such as the Old Norwegian Sheep) flee more readily than heavier commercial breeds (such as the Suffolk).

VISION

Sheep have 360° panoramic vision and binocular vision of 25–50° , and it has been shown that ewes are able to distinguish between a variety of colours and various shades of grey (Alexander and Shillito, 1978). Like cattle, they have poor depth perception so:

1. shadows are important,
2. sheep are reluctant to enter dark areas from lighter areas,
3. any unevenness on the floor can cause sheep to balk,
4. lead-up chutes should have solid walls to prevent distraction.

In general, sheep run faster through races with covered rather than open sides. This seems to be because the covered sides restrict peripheral vision and channel the sheep's sight towards the exit. The sight of stationary sheep will slow down the movement of sheep through an adjacent race (Hutson, 1980). Sheep movement is better on the flat than up or down inclines and so the direction of movement should be across the slope rather than uphill or downhill (Hitchcock and Hutson, 1979). Sheep follow each other and the use of a Judas goat or a trained sheep is recommended to lead the animals into a slaughter plant (Grandin, 1980).

Modern circular and bugle-shaped yard designs are based on the assumption that sheep move more readily around corners but work has shown that in 1.5 m wide races sheep move better straight ahead than around corners (Hutson and Hitchcock, 1978). It is only when sheep move in a single file that corners are superior to straight races.

PERSONAL SPACE

Like cattle, it is important to know the flight distance of your mob of sheep. This is the principle a sheep dog works on when rounding up the sheep.

Sheep tend to move in the opposite direction to handler movement when confined in yards, so long narrow facilities where handlers intrude on the sheep's flight zone provide an effective way of moving stock (Grandin, 1999).

FACILITY DESIGNS

1. One of the most important design criteria for yards is that sheep should have a clear unobstructed view of the exit, or towards where they are meant to move (Hutson, 1980).
2. Sheep move faster through races with covered sides.
3. There are two cases when care should be used with covered sides:
    a. in curved races, where covering the sides may give the sheep the impression of a dead end,
    b. the use of a material such as metal sheeting should be avoided because of the loud noise it makes if sheep bump into it (Hutson, 1980).
4. Shadows can cause sheep to balk, so, ideally, shadows should be avoided or minimised. This is almost impossible unless sheep handling is done in a shed, but a north-south alignment may, at least, minimise them and blinds can be put in trouble spots (Hutson, 1980).
5. Design of shearing shed (Hutson, 1980): most shearing sheds are raised off the ground to allow faeces to fall through. However, sheep movement is better on the flat then up an incline, so ramps should be long with a shallow rise. The ramp should have covered sides so sheep are prevented from looking out, and the floor should allow sheep to get a good grip.

Lighting is important, and sheep will move into a shed more easily if the interior is brightly lit, and where they have a clear view of an escape route or exit.

Flooring is usually made of battens about 16 mm apart and sheep movement is affected by the light intensity below the floor; they are hesitant to step on floors brightly illuminated from below. They also prefer to move at right angles to the direction of the slats as they get a better grip. Pens should be rectangular in shape so sheep are forced to move in only one direction when

a dog or shed hand appears.

Exits for shorn sheep can prevent problems. If sheep return to the shed floor via a return race they have to cross paths with unshorn sheep before leaving the shed. If they leave the shed via a chute to underneath the shed they do not enter readily and usually must be pushed down by the shearer. However, chutes are probably better as they allow greater flexibility in forcing- and catching-pen design, and the flow of sheep through the shed is one-way.

6. Design of sheep yards: sheep move better through a set of yards they are familiar with, and ideally should follow the same route for all handling operations, dipping and shearing (Hutson, 1980).

Modern yards are usually curved or circular, but it is a concept that is quite old (Pearse, 1944). A yard was designed by Mr. H.E. Hoad of South Australia, which gave every satisfaction. The sheep could go from the main yard round the curve to the shed and a small ramp. The same applies to lines coming for dipping and branding (Figure 1). The Dee, and bugle are modifications of the curved or circular yards.

1. Dee: most experts say the Dee yard is best for properties where fewer than 6,000 sheep are run. The handling race is built at the end of the drafting race and provides the straight side of the 'D' with circular yards and the drafting facility forming the curved ends to give the yards their characteristic 'D' shape (Barber, 1977), (Figure 2).

2. Bugle: Almost without exception, a good modern yard will include a bugle-shaped forcing pen leading to the draft and forcing race. Again this was described and built about 1944 (Pearse, 1944) and is basically the same today (Figure 3).

From a welfare and economic perspective, it would be beneficial to provide shelter facilities, as ewes with lambs actively seek shelter in inclement weather (Pollard et al., 2000).

The use of races has been shown to increase in efficiency because animals follow the same route for a number of management practices, such as drafting and dipping (Grandin, 1999).

NOISE AND SMELL

In sheep slaughter plants, noise should be minimised wherever possible, as sudden loud noises are particularly frightening to sheep. Air leaks can cause balking problems, also a stream of air from a valve which hits the sheep's face can cause balking (Grandin, 1980). Sheep exposed to 75dB levels gain weight faster than controls or sheep exposed to 100 dB, and the heart rate of sheep exposed to instrumental music is significantly lower than the heart rate of sheep exposed to miscellaneous noises of roller coasters, trains and fog horns (Ames, 1974). Lambs are also stressed by noise, but they will usually not move away from the source.

Sheep may be disturbed by slaughter plant odours (Grandin, 1980).

PIGS

BREED DIFFERENCES

There is no work reported on breed differences in behaviour when being handled. The most common breeds in Australia are the Large White and Large White X Landrace. Intensively kept pigs tend to be balky to drive if forced too quickly. If they are moved slowly and allowed to investigate as they go along, they can be driven along with the handler holding a solid 'pig-board' behind them (Blackshaw, personal observation).

VISION

Pigs have a 310° panoramic field and a binocular field of 30-50° . They are thought to be able to judge distances and may have colour vision. They avoid shadows, although not to the same extent that cattle do, and sheep so lighting should be even and diffuse. They have less of a following instinct than sheep but will follow an established leader in a group (Meese and Ewbank, 1973).

Visual signs play some role in pig communication. For example, boars will make the hair on top of their necks rise up to make themselves look larger and more formidable (Ensminger et al., 1997)

The degree of environmental enrichment experienced by growing pigs directly affects how they perceive and react to novel situations (Boyle et al., 2000).

Like other animals, pigs are likely to move toward brightly lit areas (Dunkin et al., 1990). This tendency can be used to help correct design faults in an existing pig-handling infrastructure.

PERSONAL SPACE

Flight distance is not quite as important with handling intensively housed pigs as they are used to having people close by. They will often come up to and investigate the person who is handling them.

FACILITY DESIGNS

Pigs have difficulty walking on a steep downward slope as their legs are short and they lose their balance. They prefer to walk up steps rather than inclines. Flooring should be made non-slip by providing cross cleats or steps (Grandin, 1980).

1. Solid fences are recommended where animals are being driven past other animals to the stunning area in the abattoir. Pigs tend to stop and sniff others as they pass.

2. Long narrow pens providing more perimeter per animal are preferable to a square pen. Pigs will fight over a spot near a fence when the central portion of a large pen is empty (Grandin, 1980).

3. It has been shown that young weaned pigs, in cool weather, when provided with a box will use the wall of their box to huddle against, and will show a growth rate advantage (Blackshaw,1980). Further work showed that if given a choice, pigs prefer to huddle against a wall on a solid floor section (Blackshaw, 1981).

4. Flooring material of pens can be important for inten-

sively kept pigs. Rubber mats have shown to be best for sow lying comfort, as an epoxy-painted concrete floor was too slippery (Gravas, 1979). Also, in mating pens it is important to have a rough finish on the floor so it can be hosed out without being made too slippery for the sow to stand for the boar (Blackshaw, personal observation).

5. Intensive piggeries have been criticised from the welfare aspect so research is being carried out on alternative systems. One such system contains four families of sows and their offspring housed in a system which provides for nesting, rooting and rubbing (Stolba, reported in ***Int. J. Stud. Anim. Prob.*** 1981). Preliminary results indicate a good fattening performance.

Suckling behaviour and subsequent piglet survival is positively correlated to nest size, that is, increased nest size results in increased survival rates (Cronin et al., 1998).

Sows provided with sawdust-based nesting material have a shorter parturition period, produce more live-born piglets and are involved in fewer fatal crushing incidents, when compared with sows provided with no bedding (Cronin et al., 1998).

Sows provided with larger nesting areas, perform more maternal 'suckling grunts', resulting in increased nursing time, immunoglobulin intake and subsequent immunity and survival in piglets (Cronin et al., 1998).

An alternative to conventional farrowing crates contains both a farrow nesting region (2.4 m x 1.8 m) that contains features to increase piglet survival, as well as a non-nesting area for feeding and drinking vessels and for defecation (Cronin et al., 1998).

Farrowing nests appear to promote maternal instincts as sows increasingly exhibit 'careful behaviour', such as using their snouts to push piglets aside before lying down (thereby reducing crushing mortality) (Cronin et al., 1998).

Housing production sows in groups is commonly accepted as a means of promoting good animal welfare, although aggression associated with mixing and feeding can result in vulva damage and subsequent diminished production (Boyle et al., 2000).

Trials suggest the reproduction performance of intensively housed sows is superior if they are housed in groups leading up to farrowing. The restriction in area of conventional farrowing crates interferes with the expression of maternal behaviours (Boyle et al., 2000).

The provision of bedding at the time of farrowing not only provides physical and thermal pleasure to the sow but also facilitates recreation and exploration (Arey 1993).

A favoured bedding substrate for farrowing sows was peat moss, which is similar in texture to earth (Beattie et al., 1998).

During mating, space is required to allow courtship. A 3 m square pen has proved the most successful design as this allows the sow to put her head in a corner while being mated (Blackshaw, 1992).

Partial barriers have been employed in group housing systems as an effective means of reducing aggression during feeding (9% of total aggression) (Blackshaw, 1992).

Much criticism of farrowing crate design on the grounds of sow confinement has been observed. However, a 10-year study conducted in Scotland looked at these animal welfare concerns. It was shown that 44% of sows chose these cramped 3 or 4 walled structures over intermediate-sized areas (29%), wide-sized (12%), while the remaining 15% chose to lie elsewhere in the pen. The reason given for the sows' choice was that it possibly satisfied their need for security (Ensminger et al., 1997).

NOISE AND SMELL

Pigs show a frozen alarm reaction when something startles them. Often in an intensive system which has quite a lot of noise in it all day, it is difficult for a human observer to detect the cause of the alarm reaction (Blackshaw, personal observation). In one piggery the telephone bell is a loud horn which does not elicit a response from the pigs but tends to startle the observer. The smell or sight of blood, and other slaughter plant odours do not appear to upset pigs as they have been observed both eating blood and wallowing in it (Grandin, 1980).

DEER

BREED DIFFERENCES

Many components of neonatal behaviour in deer are inherited rather than learned (Endicott-Davies et al., 1996).

Red deer calves exhibit the hiding response in the presence of humans while Pere David deer calves exhibit the flight response. The difference is thought to be connected with the natural migratory behaviour of the Pere David species (Endicott-Davies et al., 1996).

In wild Red deer populations, parturition occurs in comparative isolation, with the hind and calf returning to the main herd after about two weeks (Endicott-Davies et al., 1996).

A fallow deer's sense of smell is poorer than that of Red deer and reindeer. A fallow deer can smell man from about 200 m, while, depending on humidity, Red deer react up to 1,200 m (Reinken et al., 1990).

Fallow deer are more placid than other types of deer and seem to suffer less from a lack of freedom, which makes them the most useful of the wild game for small areas (Reinken et al., 1990).

White-tailed deer are one of the more excitable breeds so their establishment in farming practice has been limited (Haigh, 1991).

Possibly the most timorous species is the Chital deer. It readily panics if not accustomed to the close proximity of man (English et al., 1991).

Between the Fallow and Chital deer, lie the Red and Rusa deer. In comparison to the Red, Rusa deer spend much less time and energy moving and show no tendency to run along fences (Dunning et al., 1991).

VISION

Deer maintain visual contact with each other and should

always be handled as a mob. A single deer, if left alone in a pen, may panic.

Deer do not follow each other like sheep and cattle and if attempts are made to drive them in single file they bunch up and climb on top of each other.

Behavioural disturbance in deer was significantly more pronounced in larger groups (Friend et al., 1981).

Trials suggest that deer are just as comfortable in the presence of sheep as they are with animals of their own species (Abeyesinghe et al., 1997).

Deer react most strongly to visual stimuli, which often cause them to take flight. The distance from effective stimuli was greatest in the morning, fell during the day to 2–3 m and peaked during feeding (Reinken et al., 1990).

PERSONAL SPACE

Farmers who walk among their deer can tame them quite easily and so reduce their flight distance.

For male deer, greater space allowance during transport results in increased aggressive behaviour (Jago et al., 1993).

The current UK guidelines for space allowance when transporting deer recommend 0.5–0.6 sq m per animal for yearling stags and 0.3–0.4 sq m per animal for yearling hinds, with no more than 10 animals being penned together (Grigor et al., 1997).

Greater rises in plasma concentrations of cortisol following transport indicates that transport motion is more stressful than confinement alone (Grigor et al., 1997).

If an unfamiliar individual comes closer than 10–15 m, the animals take flight, with an adult doe as the leader. The readiness to take flight and the degree of tameness were correlated with rank, age and body weight. Calves will often take flight before adults (Reinken et al., 1990).

FACILITY DESIGN (ANDERSON, 1978)

Deer are excitable, easily frightened and cannot be driven, so all facilities should be designed with this in mind.

Deer cannot be driven, but are best lured (with the aid of food/recognised noises) or slowly drifted in the direction they are to go (Yerex et al., 1990).

1. Yards should be solid sided for herding purposes, because if deer see daylight in a panic situation they will charge through anything in an attempt to escape. Recommended height for fences is 2.1 m–2.4 m high.

2. Corners should be avoided because deer always try to crush into a corner when yarded (Figure 4).

3. If the handling area is roofed and darkened it will quieten the deer.

4. Deer approaching yards should have a clear view of their path away from the yards; they should not be presented with a dead end.

5. A curved race is useful (5.5 m diameter) for free movement (Figure 4).

6. Concrete is not a good floor as it can become too slippery. Sand, sawdust or even gravel make good yard basis as deer cannot get a foothold to jump or kick.

7. Two types of handling yards are used at Invermay in New Zealand (Figure 4). The top yard has been used with fairly small groups of deer. The octagonal holding pen has no corners for deer to bunch into and harm themselves. A problem is that the race is too long.

The second yard has a semi-circular perimeter runway, which allows small groups to be shut off as a large mob enters the yard.

If facilities are designed with the behaviour of the animal in mind, not only will handling be easier for the husbandman, but the stock will be less stressed.

Many management practices associated with deer (e.g., physical restriant, visual isolation and human proximity etc) have all been shown to be particularly stressful to the species (Pollard et al., 1993).

Deer have a strong instinct to avoid the central location of a yard/enclosure, and this is thought to be due to cover-seeking behaviour (Chamove 1995).

Solid sides to the race, at least 2 m in height, should extend out from the holding yards, which should also have solid sides (Spiers et al., 1990).

It is also a good idea to leave the gates of the yards open when not in use. This allows the deer to wander in and begin to habituate to its surroundings and so become easier to handle (Spiers et al., 1990).

NOISE

Corrugated iron and tubular steel are used by some farmers, but they are very noisy and tend to upset the animals, so this should be avoided.

While not as stressful as mixing, the placing of groups of unfamiliar animals (and species) in close proximity can cause significant stress (e.g., elevated heart rate and blood cortisol levels). In particular deer find cattle and pigs aversive (Abeyesinghe et al., 1997).

A voice call or a whistle associated with feeding may be a useful aid when handling deer. This use of classical conditioning has been observed in numerous farming situations, although under no circumstances should it be attempted during the deer's annual rut (Anderson, 1978).

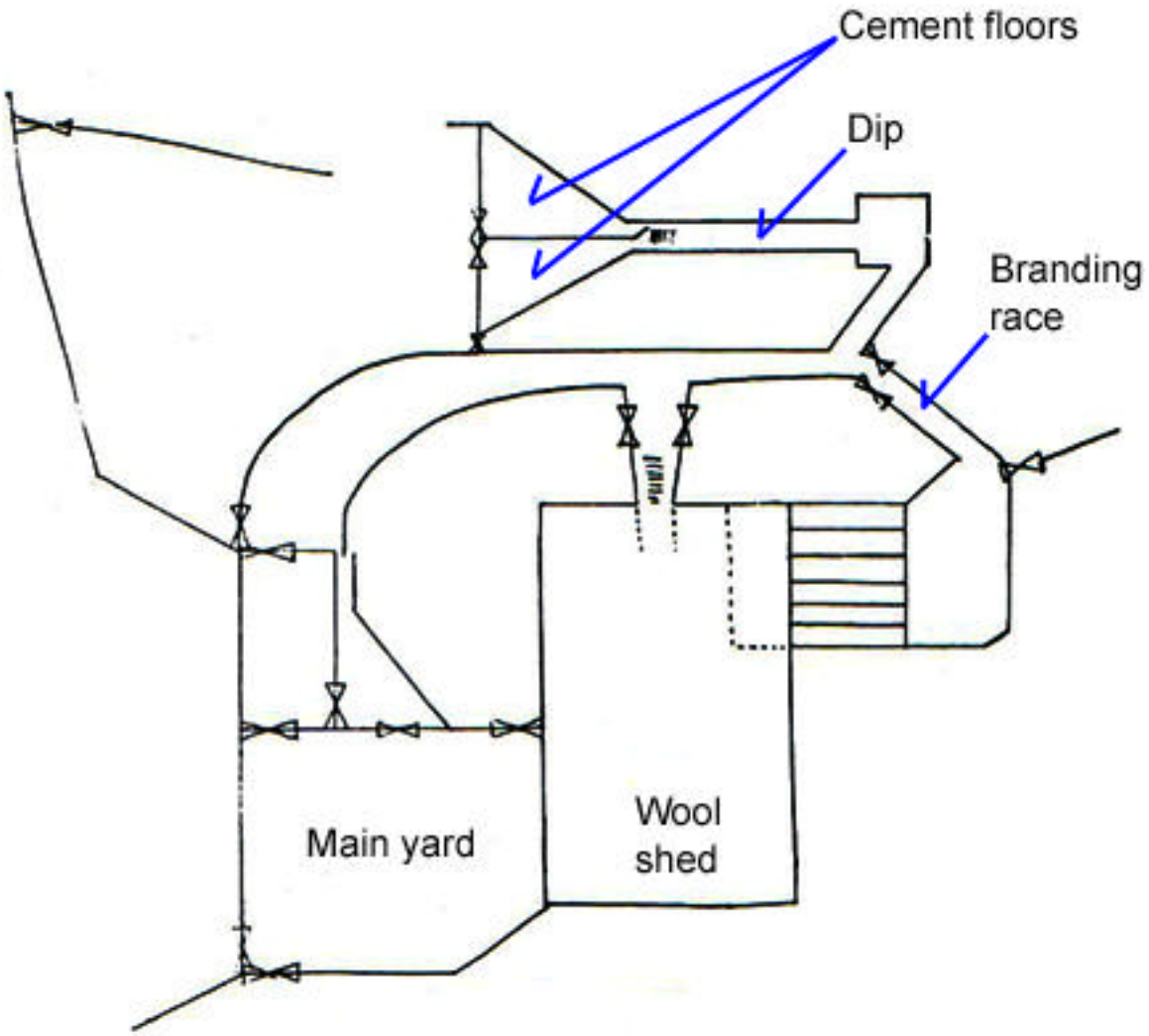


Figure 5.1: A circular yard designed by Mr. H.E. Hoad of ***South Australia.***
(Modified from Pearse, 1944.)

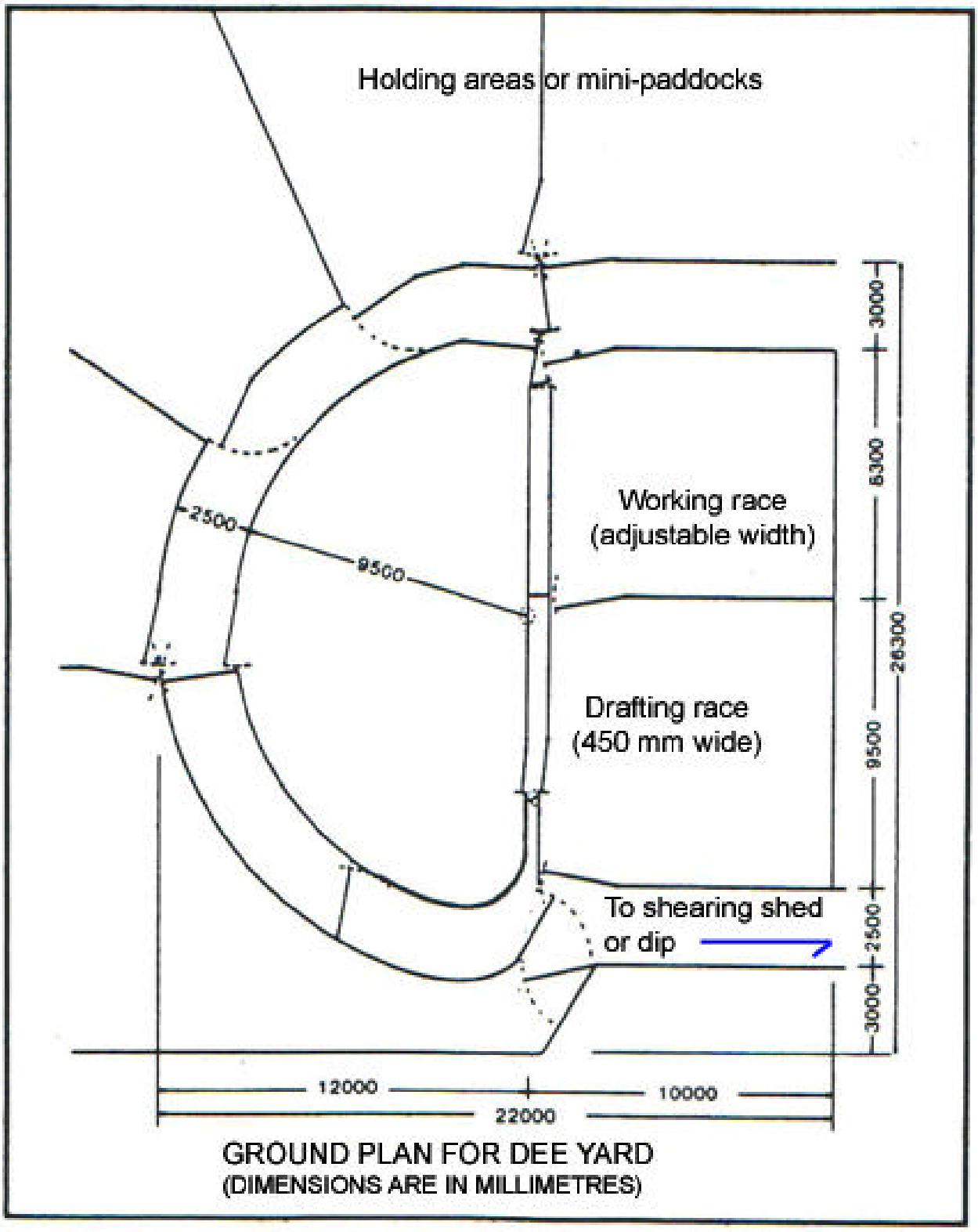


Figure 5.2: The Dee yard.
(Reprinted with permission from the Department of Agriculture and Fisheries, South Australia.)

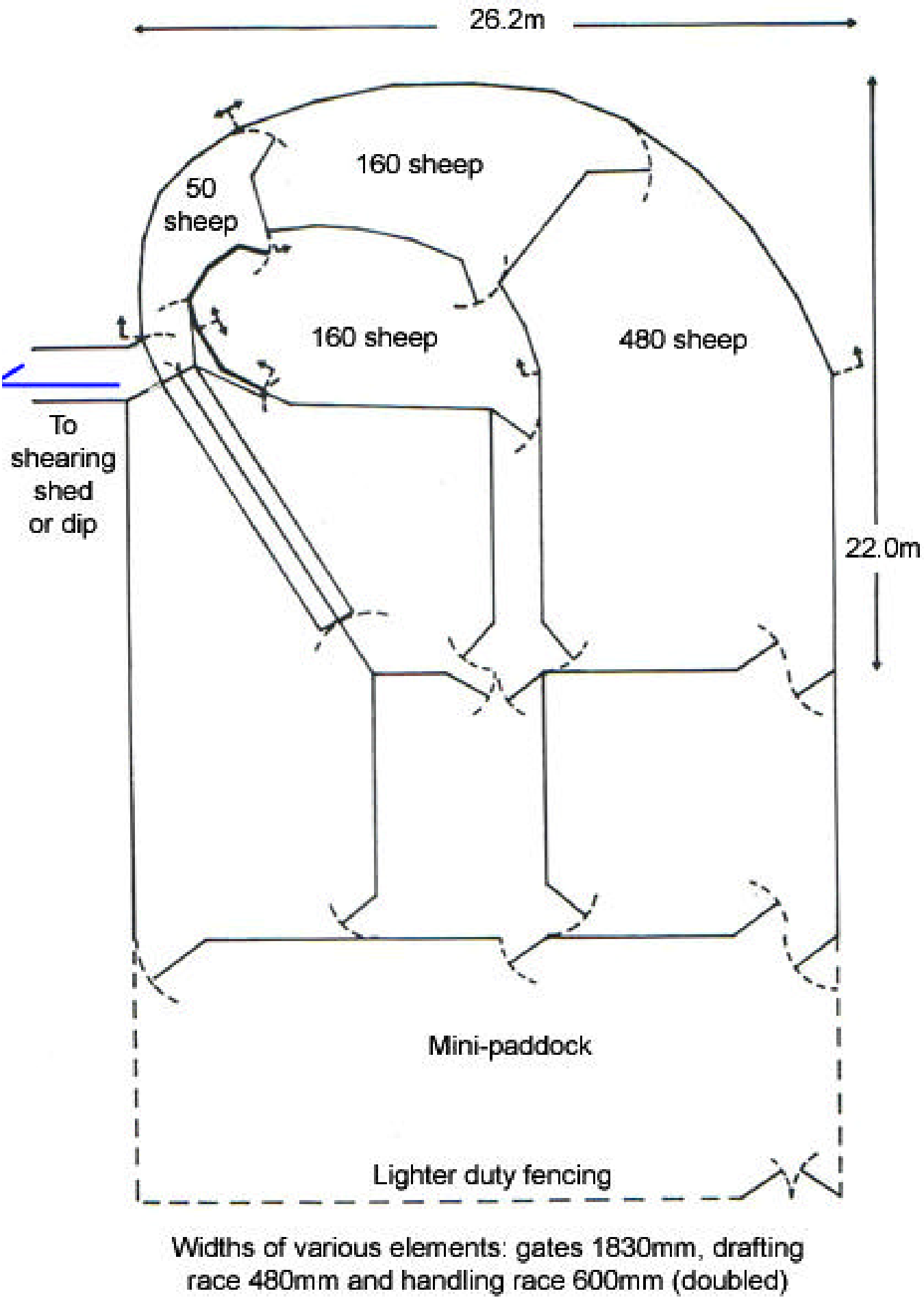


Figure 5.3: The Bugle-shaped forcing pen.
(Reprinted with permission from the Department of Agriculture and Fisheries, South Australia.)

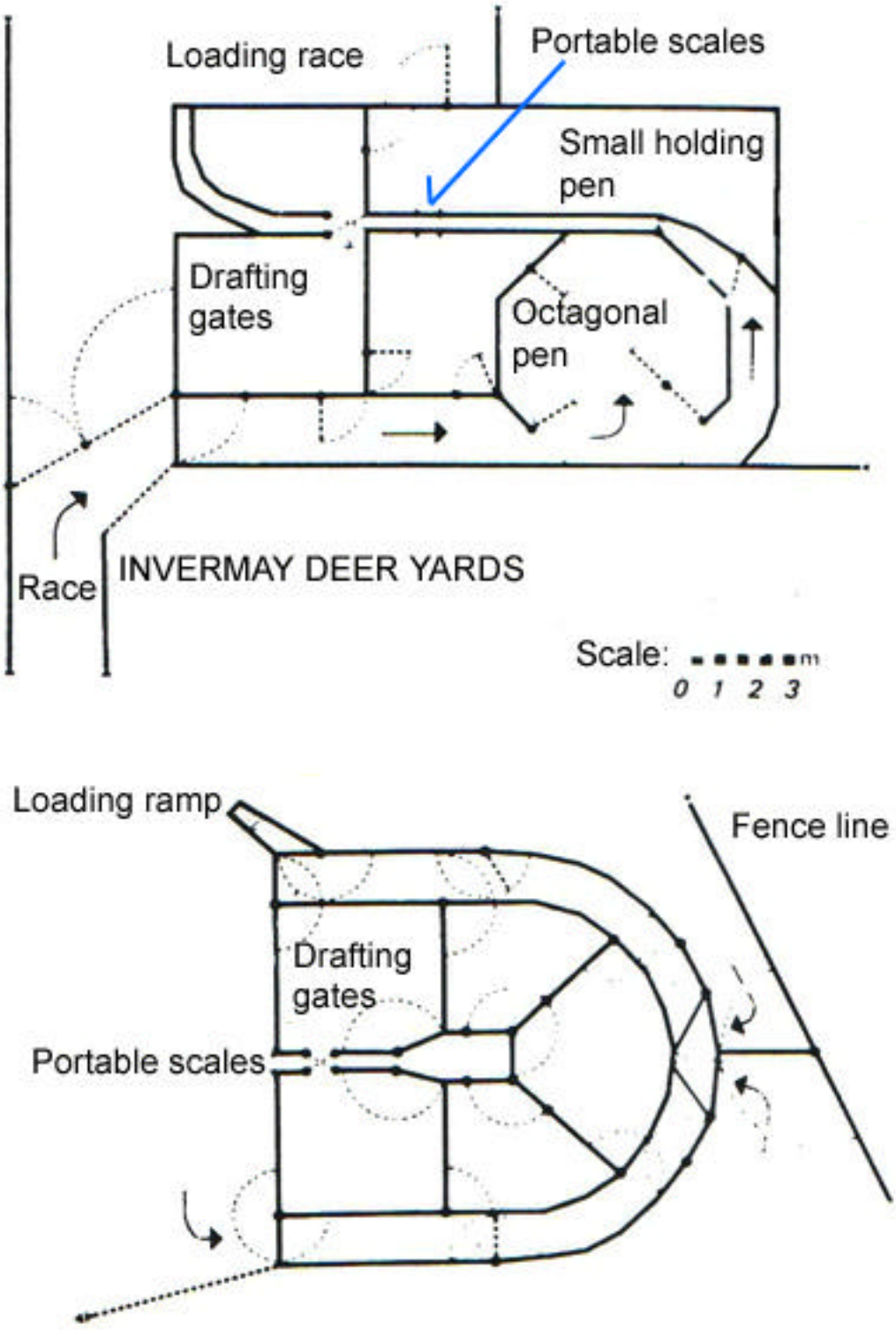


Figure 5.4: Design of deer yards, showing a curved race.
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CHAPTER 6: ANIMAL TRANSPORT AND BEHAVIOUR

It is important to look at the process of transporting animals, as many animals are injured or even die during transport. Also, many carcasses destined for slaughter are bruised, and this represents a huge loss to the livestock industries.

In beef, losses from bruising and losses through death and serious injury of railed cattle are very costly.

Losses from bruising in beef cattle from pasture to slaughter in Australia have been estimated at $42 million per annum (Eldridge et al., 1988).

This chapter will examine the transport of cattle, pigs, sheep and very briefly, deer, under the following headings:

1. Treatment of animals before transport

2. Loading and unloading facilities

3. Transport and adjusting to a new environment

4. Recommendations

The process of transport involves all these factors and all are important to the well-being of the animal as well as to the quality of the slaughtered carcass.

TREATMENT OF ANIMALS BEFORE TRANSPORT

1. Animals are usually handled intensively before transport. They are grouped together, often in unfamiliar groups ready for loading onto a truck. It has been shown that mixing of strange animals will cause restlessness and agonistic encounters leading to bruising (Pearson and Kilgour, 1980). Mixing of unfamiliar animals at any stage results in an increase in agonistic behaviour, poorer welfare and poorer meat quality (Knowles, 1999). Once the social organisation has been established, fighting diminishes. If sheep, cattle and pigs can be grouped together for two or three days before transporting so that they become familiar with each other, the stress of transporting will be much less.

2. Horns account for about half of all bruising in horned cattle (Mieschke et al., 1974), so cattlemen should dehorn calves or breed polled animals. Hornless animals in a mixed group bruise more than those transported separately, whereas bruising is the same for all horned animals (Wythes, 1981).

3. If animals are familiarised with the yards and handling procedures when young, the potential stress will be reduced.

4. Groups of animals should be about the same size for transportation.

5. One of the key factors is the handling by the stockman. If the animals are handled quietly and gently, the stress will be reduced.

6. The design of yards to improve the flow of sheep and cattle is important.

The use of dogs in herding sheep often causes the animals to stand alert as a primary response, often accompanied by a covert increase in heart rate (Baldock et al., 1990).

Drafting prior to transport is more stressful than dipping and drenching, and is represented by a significant increase in plasma cortisol levels (Hargreaves et al., 1990).

The use of a crush can often cause a greater stress response than drafting or penning. The release of red blood cells from the spleen is a common response to handling distress in red deer (Carragher et al., 1997).

Pigs that have had handling experience tend to move through loading facilities more quickly than pigs that have had little handling (Abbott et al., 1994b).

Pigs with previous handling experience have improved carcass quality, as they are not as adversely affected by pre-slaughter handling in lairage (Abbott et al., 1997a).

Pigs with previous handling experience show paler meat, due to enhanced postmortem glycogen breakdown, but, importantly, this is not accompanied by a higher incidence of pale, soft, exudative (PSE) meat (Generink N.A. et al., 1998).

LOADING AND UNLOADING FACILITIES

This is a critical area in the process of transport. Poorly designed loading ramps, over-use of force and lack of understanding of animal behaviour all contribute to both physical damage and stress.

There is a difference in design for chutes used only for unloading trucks to those which are used for both loading and unloading (Grandin, 1980). If at all possible, it is better to have a type of chute for loading and another for unloading. A chute used for unloading any type of livestock should be wide and straight to provide a clear, unimpeded path. In packing plants a wide unloading chute (2.4 m wide) is recommended by Grandin (1978). This type of chute must never be used to load livestock.

A chute used for loading only, should have high solid sides to prevent animals from seeing out, and a narrow curved single-file chute is the most efficient. If the chute is going to be used for loading and unloading, care must be taken not to curve it too sharply. If the chute has too sharp a curve the animals will often baulk and refuse to leave the truck because the chute appears to be a dead end (Grandin, 1978). Either a curve or a 15-degree bend is recommended to prevent the cattle from seeing the truck until they are part way up the ramp. Observations (Grandin, 1980) indicate that the most efficient chutes had solid fences and an inside radius of 3.5–5 m. A radius tighter than 3.5 m is likely to cause baulking problems when the cattle are unloaded. The inside width should be about 70 cm for mature cattle so they are unable to turn around in the chute. If it is used exclusively for loading calves, the inside width can be 50–60 cm. The sides of the chute should be at least 1.5 m high for cattle, but if Brahmans are being loaded, or if the cattle are wild, the sides should be raised to 1.8 m high (Grandin, 1978).

Cattle and pigs prefer to walk up steps rather than inclines, and chutes suitable for both species should

have steps with a 10 cm rise and a 30 cm tread width (Grandin, 1978).

A common problem in poorly designed loading chutes is bunching and jamming of livestock at the junction between the single file ramp and the crowding pen. Bruises are prevented if this transition is smooth and gradual (Grandin, 1978).

Where a wide variety of trucks is going to be used, adjustable chutes are ideal, as they can be raised and lowered to load or unload the bottom or top deck (Grandin, 1978).

Straight raceways cause animals to baulk, because they perceive the truck as a dead end (Grigor et al., 1998a).

There are conflicting data to suggest that loading animals from darkened to illuminated areas reduces stress or increases efficiency (Grigor et al., 1998a).

Initially after loading, urination and defecation is very frequent but declines as transport begins (Fraser, 1980).

During rail transit, cattle rarely alter their position. They align their bodies at right angles to the direction of travel (Fraser, 1980).

In horses, transport by road over short and long distances is found to suppress feeding behaviour, elevate heart rate and lead to unnatural body postures causing weight loss and fatigue (Warren et al., 1995).

Overloading and underloading of trucks increases bruising (Grandin, 1995c).

TRANSPORT AND ADJUSTING TO A NEW ENVIRONMENT

The actual transporting of an animal is probably one of the most traumatic periods of its life. It leaves the security of a known environment and is subjected to motion, changes in temperature, ventilation, noise levels, smells and changes in group size and density. Short transportation periods cause rises in sheep plasma cortisol of moderate to high levels (66 ng/ml) compared to minimal disturbance levels (36 ng/ml). Long transportation periods and a new environment cause complex changes in corticosteroid levels in both directions, which may extend over some months (Pearson and Kilgour, 1980).

Transport can cause various problems apart from physical bruising and damage, including:

1. transit erythema—red skin due to urine soakage;
2. transit tetany—metabolic upset caused by lack of food and water. The animals lie down and coma results. It is common in cows, ewes and ponies;
3. transit or shipping fever—usually a bacterial infection (Pasteurellosis) in fatigued animals, and particularly affects cattle;
4. fatigue and exposure.

BEHAVIOUR OF ANIMALS DURING TRANSPORT AND ON ARRIVAL AT NEW ENVIRONMENT

SHEEP

The effects of different modes of transport on the behaviours of sheep has been reviewed by Kilgour (1976).

1. ***Road transport***. Following completion of a road journey, lambs grazed briefly (2–3 hours) and spent the next 23 hours resting, then returned to their field. Where animals have not been able to lie down, resting takes precedence over feeding or arrival (Ewbank, 1975).

2. ***Air transport***. Little is known of the effects of flight on sheep or lambs, but one study suggests that unshorn sheep in two-tiered crates suffered some ventilation problems while the plane was not in flight (Allsup, 1975).

3. ***Sea transport.*** The main problems seem to be in the handling of the sheep. Sheep must be conditioned to eat pellets before boarding the ship; hand-fed sheep that are used to this type of feed do not have this problem. Ship hygiene and Salmonella losses, poor ventilation with high temperatures and humidity, fluctuating and changing diets can all cause problems.

4. ***Rail transport.*** On a long rail trip, adult Merino sheep seldom lie down in railway trucks, even on a five-day journey. When rested after travelling for two to four days without water or food, no preference for either was shown, but after five days there was a preference for water. In the rest pens, only 0.4 kg of lucerne hay per sheep was eaten in 24 hours; so if the regulation four one-hour rests were given, very little food would be taken (Sutton and Heever, 1968).

During long transportation where a lairage period is allowed, sheep require sufficient time to drink before a subsequent journey is undertaken (Jackson et al., 1999).

If feed is provided during a break from transport, and sheep are not provided with sufficient drinking time, dehydration can result due to consumption of large amounts of dry feed (Jackson et al., 1999).

Sheep require a lairage of more than 8 hours to gain any real benefit (Knowles, 1998).

The behaviour of sheep generally is little changed under conditions of poor welfare, such as injury or overcrowding (Knowles, 1998). Thus sheep seem to be particularly tolerant of transportation compared with other farm animal species.

During transportation of sheep by road, they ate less, ruminated less and lay down less (Ewbank et al., 1990).

Sheep will ruminate while being transported and if they are transported at low enough densities, they will lie down and be able to rest to some extent. However, they do not lie down as much as they would in a static pen at a similar stocking density (Knowles, 1998).

Driving conditions play a role in the behaviour of sheep during road transport. The rougher the journey,

the more likely is bruising and the greater is the increase in cortisol levels (Ruiz-de-la-Torre, 2001).

After a trip lasting 24 hours, slaughter lambs did not return to normal drinking patterns until 14 hours into recovery; normal eating patterns were not resumed until 16 hours later and even after 24 hours of recovery, the lambs were not standing as much as prior to transport (Knowles, 1998).

Sheep that are to be transported by sea on journeys of less than 8 hours should be fasted of water and food (18 hours prior to departure) to reduce the incidence of death or sickness. On longer journeys, the sheep should be fed 2–3 hours prior to the start of the journey (Shupe, 1985).

Ewes introduced to a new flock show minimal grazing and increased vocalising and walking. The newly introduced sheep tend to remain at the edge of the flock (Baldock et al., 1990).

Exposure to a familiar feed (e.g., hay) will increase the food and water consumption (up to 4.9 times) of sheep transported to a new environment (Hall et al., 1993).

CATTLE

1. ***Road transport***. If cattle are allowed to settle down at the beginning of a journey they will travel without difficulty. Several studies take the lowering of the head as a sign that cattle have settled, and this may occur as soon as 30 minutes after travel commences. It has been noted that weaned calves hold their heads high in the early stages of road travel and, where this was not possible, they tend to lie down and be trampled on by others (Kilgour and Mullord, 1973). They also tend to bunch their heads to the centre during road travel and avoid contact with pen walls. They swayed as a group, avoiding the side rails of the truck. During fast, flat land travel with corners, their bodies tended to be side on to travel, but when hilly roads were encountered, they moved in line with the direction of travel. When calves were released to pasture after 25 hours of penned conditions, the prime need was for exercise, with grazing next, and water only a third consideration (Kilgour and Mullord, 1973).

(The most common orientation for cattle is perpendicular or parallel to the direction of travel. These positions may be chosen to improve security and balance on a moving vehicle (Tarrant, 1990).

There is little difference seen between responses of bulls and steers to transport (Knowles, 1999).

At the beginning of a journey, cattle are generally anxious and restless and defecate and urinate frequently (Knowles, 1999).

Cattle do not readily lie down while being transported and this forced standing causes them to become physically tired during transport in a way that is not seen in pigs and sheep (Knowles, 1999).

Loss of balance is a major determinant in injuries in transported cattle. In a study by Tarrant, 1990, it was found that one-third of events where cattle were floored during transport were caused by loss of balance during cornering.

Knowles et al. (1999) also found that when one or more animals lay down (on a 31-hour journey), it became more difficult for the others to remain standing and several animals lost their footing and fell down.

The space allowance for animals during transport can significantly influence carcass weight, level of bruising and welfare of the animals (Eldridge et al., 1988).

It is recommended (Eldridge et al., 1988) that for cattle 350–400 kg live weight, a space allowance within 10% of 1.16 sq m per animal is satisfactory.

Animals on a double-decked vehicle drank less often than those on a single-decked vehicle (Knowles et al., 1999).

2. ***Air transport.*** Hereford cattle were flown from Gatwick (UK) to Shanghai. During the flight the animals browsed at hay and, although water was offered, they did not attempt to drink. There was an increase in the number lying down as the journey went on, and animals appeared unconcerned during the whole flight (Jackson, 1979). The longer the flight continued, the more cattle lay down (Jackson, 1974).

3. ***Sea transport.*** There is a lack of information on the behaviour of cattle during sea transport. Shipping fever can be brought on by a cascade of events initiated by stress (Tarrant et al., 1993).

4. ***Rail transport.*** Cattle are restless in railway trucks for up to five hours after starting their journey. They show muscular trembling, butting of other animals, considerable movement, defecation and urination (Bisschop, 1961). An average of 10% rested at any one time on the journey. The behaviour of Angus and Hereford calves was monitored while travelling in a rail car for a 57-hour journey (Friend et al., 1981). Calves commenced eating and drinking immediately after being loaded. Up to 75% of the calves could lie down while the car was not in motion (14.4 hours of the trip) and they stood at high speeds (80 km/hr) but continued to eat, drink and move about. Self and mutual grooming commonly occurred while travelling up to 40 km/hr, and they ate and drank readily. They were also adept at maintaining their balance and conducting 'normal' activities even when the ride was very rough.

Cattle off-loaded in rest kraals during rail transport showed a preference for either food or water; and after a marked urge to walk around, ate and drank for 40 to 100 minutes, and then lay down (Sutton et al., 1967).

Long-distance road or rail transport can cause an elevation of meat pH, which can be reversed by resting and feeding the animals for two days or longer after the end of a long journey (Tarrant et al., 1993).

Road and rail transport at low and high space densities significantly increases bruising, reduces carcass weight and impacts on the welfare of the animals (Eldridge et al., 1988).

Liveweight decreased with increased travelling time (more than 31 hours). Plasma osmolarity and urea concentration increased, suggesting dehydration (Knowles et al., 1999).

PIGS

It has been shown that pigs subjected to simulated transport for 30 minutes had a rise in heart rate to 150 beats/minute compared with a resting control level of 100 beats/minute. As pigs became familiar with the experimental situation by repeated exposure, the increase in heart rate in response to transport simulation was reduced. There was no significant change in heart rate (Stephens and Rader, 1982). It seems that pigs do get used to transport stress.

1. ***Road transport***. During the whole journey pigs should have light, even if only dim, to facilitate orientation and social contact. Water should be provided at intervals during stops (Van Putten, 1977). The driver's skill is important and as long as lorries are well ventilated and the pigs do not suffer from heat stress, pigs tend not to be restless.

2. ***Air transport.*** A number of short air journeys (1.5–2.5 hours) have been monitored when breeding pigs were exported. Boars in particular are subject to heat stress, and it is also important to transport these animals in familiar social groups to reduce agonistic behaviour (Jackson, 1979). Pigs are reasonably good travellers by air, provided they are not over-fed prior to embarkation. On occasions they need spraying with water to reduce temperatures and when mortality does occur it is usually the result of overcrowding (Scott 1978).

Recommendations for air transport of pigs include: avoid the use of tranquillisers; pre-mix pigs in constant groups one week before shipping to reduce fighting; provide an adequate water supply; keep a dim light on during the entire flight; control dust; avoid heat stress; and instruct the receiving party to avoid post-transport losses by taking jet-lag into account (Lambooij et al., 1993).

3. ***Rail transport.*** Pigs that travelled from England to France and thence to Italy over seven days were only restless when hungry or thirsty. The movement of the train appeared to have little effect, except when violent shunting was being carried out. Huddling occurred on a very few occasions when it became cold at the pig's level, but most of the time the pigs wandered around the pen in apparent contentment. The behaviour in all the pens tended to be synchronised, even though the pens were well separated (Jackson, 1979).

Transport does induce stress in pigs. Climatic conditions, loading density, duration of transport, cold draughts, heat stress, social stress, vibrations and noise all affect the condition of the pigs during transport (Lambooij et al., 1993).

Small rises from the normal pig body temperature of 39–42 degrees proved fatal (Lambooij et al., 1993), so adequate ventilation on transport vehicles and the weather of the day must be taken into consideration.

Pigs try to stay in contact with one another in stressful conditions and this can be seen in huddling behaviour during transport. Pigs in a stressful situation are calmed by the presence of their pen mates (Lambooij et al., 1993).

The transport of pre-pubertal pigs often leads to hypothermia after 30 minutes of travel (Parrott, 1998).

Fasting and transport over various distances in pigs showed no detrimental effects on meat quality. The meat of the animals showed an increase in tenderness with no reduction in juiciness (Becker et al., 1988).

HORSES

1. ***Road transport.*** It has been shown that rear-facing transport provides horses with the physical and psychological security and comfort that is wanting in conventional, forward-facing transport. Once en route, the horse sees objects slipping harmlessly away from it, rather than threateningly towards it. During the rear-facing transit, the horse's rump is at the trailer bulkhead area, rather than the fragile head, and any emergency stop will be received on the rump (Cregier, 1980, 1981).

Rear-facing transport is less stressful than forward-facing, as indicated by the horses having a lower mean HR. The horses rested their rumps on the bulkhead and carried their heads in a lower, more natural position (Warren et al., 1996).

2. ***Air transport.*** Horses are usually accommodated in moveable padded crates, the sides and floor of which are covered with coconut matting, and the front and rear are thickly padded. Some horses are frightened by the engine noise at take-off or landing and are inclined to rear. Adequate restraint is necessary; panic-stricken horses have had to be destroyed during turbulence on an aeroplane, while strapped-in horses were less restless and at the most, spent time stamping their feet incessantly throughout the entire flight (Judge, 1969). Horses should be loaded so that they face either fore or aft, so that they can flex the joints of their hindquarters at take-off (Scott, 1978).

3. ***Sea transport.*** Flooring of the carrying crates should be of antislip material and each box should be provided with a strong head-stall with ropes attached on either side and suitable provision for slinging horses, if necessary. If horses have been fed and watered within one hour of starting the voyage, they need no provisions for a further 12 hours. Horses must not be carried if there are reasonable grounds, at the time of sailing, to expect adverse weather conditions that might lead to suffering (Scott, 1978).

The entrance to the transport vehicle should be wide, well-lit and uncomplicated, to take into account the natural fear a horse has of confinement and eyesight restrictions (Houpt, et al., 1993).

Water and feed intakes during transit and after arrival are critical to maintain normal body functions and this has been recognised as a problem, in particular, for racehorses (Mars et al., 1991).

Compared to experienced horses that load easily and stand normally, naive yearlings are reluctant to enter a vehicle via a ramp and consequently often have higher heart rates (Warren et al., 1995).

DEER

It is suggested that deer be transported in a darkened box or closed vehicle to prevent panic. During transport it is better if deer stand up, as lying down can result in bruising, fractured ribs or broken bones. When deer are about to be released from the boxes, they should be put into the paddock with the release door facing the farthest fence of the paddock so if the deer are frightened they have plenty of space to run without damaging themselves. The farmer should stand well back and out of sight after the door is open. The deer will explore if allowed to be undisturbed for several days (Anderson, 1978).

Deer prefer to orient themselves parallel to and facing the direction of travel, avoiding diagonal orientations (Jago et al., 1997).

Stocking density of deer should be around 0.42 sq m per animal so that the deer can remain in contact with others to help maintain balance around corners (Jago et al., 1997).

On longer trips it is suggested by Jago et al. (1997) that stocking densities should be lowered to allow deer to lie down.

The distance travelled has no effect on agonistic behaviour. When in groups, large animals initiated agonistic behaviour that was usually directed at the smaller members of the group (Jago et al., 1997).

Road surface influences the behaviour of deer during transport but increased distance of travel has no additional effect on behaviour or ultimate pH (Jago et al., 1997).

Bruising due to stress during transport accounts for an average economic loss of 26.9% of the carcass value (Selwyn and Hathaway, 1990).

Pre-slaughter handling (including transport) results in an increase in creatine kinase (CK), aspartate aminotransferase (AST), glucose, cortisol, lactate and a decrease in magnesium (Jago et al., 1997).

Transportation plus prolonged lairage in an unfamiliar environment has minimal effect on venison quality (Grigor et al., 1997b).

RECOMMENDATIONS

From the discussion of transport and associated problems involved, it is apparent that certain management procedures would make the whole process easier both for man and his animals. Recommendations include:

1. Familiarising animals with yards and yard-handling.

2. Grouping animals well before transport so social groups become established and the rate of agonistic activity is lessened.

3. Grouping animals of similar age, size and sex.

4. Dehorning calves or breeding polled cattle will improve welfare during transport and marketing.

5. Appropriate design for animal yards. It is recommended that pens are long and narrow so that animals enter through one end and leave through the other (Grandin, 1990b).

6. Appropriate design for transport vehicles.

7. Appropriate design for loading and unloading facilities. The maximum recommended angle for adjustable ramps for cattle, pigs and sheep is 25 degrees (Grandin, 1990b).

8. Adequate attention must be paid to the transport environment (temperature, ventilation, humidity, food, water, etc.).

9. Adequate rest periods must be allowed.

10. Proper handling by the handlers.

Model Codes of Practice now cover most aspects of animal welfare in Australia, including road and rail transport of livestock. Similar recommendations exist in Europe for the transport of farm animals.

Handlers must treat horses and cattle correctly to prevent memory traces associated with fear developing in the amygdala. This can determine how an animal reacts to future fearful or negative experiences (Grandin, 1999a).

Cattle that are quietly handled have smaller flight zones and are easier to manage in the future than cattle that have been roughly handled (Grandin, 1999a).

Indoor housing pens should have even, diffuse lighting that minimises shadows. Cattle, pigs and sheep have a tendency to move more easily from a dimly illuminated area to a more brightly illuminated area (Grandin, 1990b).

Deer-loading facilities should be wide enough for group movement but narrow enough to stop the animals from turning around (Grigor et al., 1998a).

Cattle should be transported by rail and road at a medium density to minimise weight loss and bruising (Eldridge et al., 1988).

A lairage period of 24 hours should be provided for recovery after a 14–31 hour journey (Knowles et al., 1999).

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CHAPTER 7: THE BEHAVIOUR OF CATS AND DOGS

In this chapter we will look at the behaviour of cats and dogs in order to understand what is normal behaviour for them. Then we will discuss abnormal behaviours and some ways of dealing with these problems.

CATS

VISION AND OTHER SPECIAL SENSES

Cats are quite near-sighted and the eyes are reasonably fixed in position (requiring head-turning to look around) (Raleigh, Scott, Jackson and Jackson, 1976). They are dichromats and can see colour but their colour vision is limited (Beaver, 1992). They can see very well in dim light as they have a high proportion of rods (which have a low threshold for activation by light energy) in the retina. Cats' eyes have tapetum lucidum behind the retina to reflect light and aid in night vision (Beaver, 1992).

The pupil of the cat's eye can change in aperture, opening from about 1 cm in diameter down to a narrow slit that is barely visible. In the dark the cat's pupil opens much wider than ours and collects the light so it can see objects we are unable to (Hart, 1980a). The cat's ability to change pupil size is very important as an adaptation that allows it to hunt at night (Beaver, 1992). Cats have a large binocular vision, 100-130°, and a panoramic field of 250-280°.

The eyes are fully open at about day 17 of life (Beaver, 1992). However, vision is the last sense to develop fully (Thorne, 1992), needing postnatal time to mature (Beaver, 1992). The light blink reflex, which develops at about day 50 of gestation to day 13 of life, disappears around day 21, due to the development of acute pupil control (Beaver, 1992).

Cats have acute hearing and can hear sounds in the range of 10-60 KHz (human is in the range of 18-20 KHz), and can produce ultrasonic emissions. The cat's outer ear can be directed towards the source of sound (Hart, 1980a). The ear pinna can rotate about 180° (Beaver, 1992) and, by using both ears, cats can accurately locate sound (Raleigh et al., 1976).

Bradshaw (1992) states that a cat's ability to hear ultrasonic sounds is probably an adaptation to hunting small prey, such as rats, that emit them, as cats are not known to make those sounds. Queens and kittens may use ultrasound as an identifying contact call. More work is needed to determine the extent of ultrasonic sound emission (Bradshaw 1992).

The cat's ability to hear very small tone differences at high frequencies and at low frequencies decreases with age, especially at higher frequencies (Beaver, 1992). The efficiency of the cat's middle ear decreases at frequencies above 10 KHz due to mass limitations in the ossicles (Bradshaw, 1992).

Hearing becomes fully developed by about four weeks of age (Thorne, 1992).

The cat has a much more acute sense of smell than we have, and in addition to having a larger olfactory system, they also have the vomeronasal organ (Jacobson's organ). It is thought that the flehmen reaction (curling of the upper lip) is a behaviour that exposes the vomeronasal organ to sex pheromones present in the female cat's urine or vaginal area (Hart, 1980a). Flehmen is most frequently displayed by tomcats (Beaver, 1992).

Scents are used for identification and communication in adult cats (Thorne, 1992). Scents are also used to explore and habituate new environments (Beaver, 1992).

The sense of smell is highly developed at birth, and this is very important as it guides the kitten to the mammary gland for nursing (Beaver, 1992). Kittens use smell to orientate themselves and recognise home, littermates and mother. Adults use it to mark their home territory (with urine) and when meeting (Beaver, 1992). Cats that lose their sense of smell because of a viral infection, also lose their appetites, change their toileting habits, and don't indulge in courtship (Bradshaw, 1992).

SOCIAL ORGANISATION AND DOMINANCE HIERARCHIES

Cats are loners and avoid interactions with other cats, except when with a mate, with young, or if several belong to the one household. The area travelled during normal activities is known as the home range (Beaver, 1992. Bradshaw, 1992. Thorne, 1992). It is much larger for males than for females (Bradshaw, 1992). The range may overlap other animals' ranges (Thorne, 1992). Studies on free-ranging cats (Fox, 1975), showed that cats have a home territory and a home range that consists of places for resting, sunbathing and watching. These places are connected by a network of paths and are visited regularly. In a neighbourhood, cats have an order of dominance, which depends on time and place. If a low-ranking cat has already entered a narrow passageway and a high-ranking cat enters, the less dominant animal will sit and wait until the way is clear. Cats go to great lengths to avoid meeting another cat on a pathway, and chance face-to-face encounters lead to fighting and chasing and the development of a dominant–subordinate relationship. Subordinate males can be pushed around in a dominant male's home range and essentially become nomads (Liberg, 1981, cited in Thorne, 1992).

If a group of cats is maintained in colony pens, they should be provided with shelves so they can 'own' one and retreat there from other cats (Hart, 1980a). The cats will work out an arrangement where certain ones use the floor at different times to others. Rubbing may help reinforce social positions, with subordinate individuals generally rubbing more dominant conspecifics (Macdonald, Apps, Carr and Kerby, 1987, cited in Thorne, 1992).

The socialisation period is the time when all primary social bonds are formed and is the most important period during the cat's life (Beaver, 1992). Active social con-

tact with more than one adult cat at some crucial development stage is necessary for an adult cat to adapt later to social living conditions (Bradshaw, 1992).

Primary social contact is between a female and her kittens, and the mother's behaviour is known as epimeletic (care-giving) behaviour (Beaver, 1992). A kitten also displays etepimeletic (care-seeking) behaviour when in a strange environment (Beaver, 1992).

SCENT MARKING

1. *Scratching:* Tree or furniture scratching leaves a visible cue and, at the same time, foot gland secretions give the scratched object a scent that can be detected by an intruder (Ewer, 1963).

This behaviour may be used as a form of stretching and cats are most likely to do it after waking (Beaver, 1992). The longer an object serves as a scratching medium, the more significant it is to the cat (Beaver, 1992) because it will represent greater territorial importance and the cat will have invested more in its territory.

2. *Spraying (scent marking with urine):* This consists of backing up, raising the tail, which trembles, and spraying urine, usually on a vertical object. It is most usually done by tomcats and objects that are sprayed often tend to be located along territorial boundaries. The urine marks left can be identified by other cats, so track can be kept of their neighbours (Hart, 1980a). Spraying serves to bring the male and female together during the breeding season, and is commonly done at a height convenient for sniffing (Beaver, 1992).

3. *Cheek and head rubbing:* A cat often rubs its head or cheek against a chair, a table or a person's leg. We tend to think the cat is being friendly, but since Prescott (quoted in Fox, 1975) found scent glands along the cat's tail, on each side of the cat's forehead and on the lips and chin region, it appears likely that the cat is performing a type of scent marking of its special territory. This behaviour is important as a form of tactile communication in social groups. It also serves a purpose of reinforcing social positions (Thorne, 1992).

The interesting point about the cat's marking behaviour, compared with the dog's, is that a cat marks to warn other animals to stay away, but a dog marks to tell others he is there so they can join him.

The flank and tail are areas of the body more commonly used for cat to cat rubbing (Bradshaw, 1992).

In feral cats, marking is more usually done in front of conspecifics than when the cat is isolated, perhaps because it functions as a display of dominance (Bradshaw, 1992).

Marking is normally helpful in stretching muscles (Schwartz, 1997).

During human interaction it may be an indication of excitement (Thorne, 1992).

Marking can also be performed by any cat in a stressful situation (such as when there is a new cat in the house) (Beaver, 1992).

Head rubbing against a human seems more common once the cat's presence has been acknowledged (Beaver,1992). This reflects the use of head rubbing between familiar cats.

GROOMING BEHAVIOUR

About 30% or more of the waking time of some cats is spent in grooming, which includes face washing, scratching the hair, coat and skin with the claws, licking the fur and pulling at the claws with the teeth. It is suggested that cats turn to grooming when frustrated in an action; this may reduce anxiety.

The most important function of grooming is to maintain healthy skin. It also removes parasites and dander, and relieves tension (Beaver, 1992).

Cats may socially groom if kept in social groups, such as when there is more than one cat in a household. (Turner and Bateson, 2000).

COMMUNICATION

Cats communicate with body postures and facial expressions (Fox, 1974).`There are three basic categories: offensive threat, defensive threat and a passive crouched posture. The offensive threat is a stare, with body poised to attack; the defensive threat is spectacular, with the back arched, fur fluffed up and the tail straight up with the fur fluffed. The cat approaches the enemy sideways with prancing steps — the sideways approach and raised fur make the cat look bigger and fiercer; the passive crouch with tail down is a passive-submission display to appease an aggressor.

The mother and kittens may have an ultrasonic call that acts as a contact call (Bradshaw, 1992).

Olfactory communication is especially important to cat species with solitary habits (Bradshaw, 1992).

Cats also communicate using smell (such as spraying) and leaving visual signs (such as scratching) (Bradshaw, 1992).

Tactile communication (rubbing) may aid scent marking (Thorne, 1992).

Acoustic communication is important, especially when the cats cannot see each other, such as when it is dark, when they are separated (such as two cats on their own home territory), or when blind newborn kittens cry to attract their mother's attention (Bradshaw, 1992)

Sound communication includes a range of call types. Purring is in response to pleasurable contact, developed as a kitten when full of milk and resting with mother and littermates, which continues to adulthood, such as when petted by a human (Bradshaw, 1992). An inaudible purr is common in human presence (Remmers and Gautier, 1972).

The miaow is for greeting, the growl and yowl for aggression and the hiss and spit is a defensive reaction. Sudden, sharp pain may result in the pain shriek (Bradshaw, 1992).

The miaow is generally directed at humans (Turner and Bateson, 2000) and is rarely observed in inter-felid communication.

SEXUAL BEHAVIOURS

A female cat is polyoestrus during the breeding season and shows distinct oestrous behaviour. She is more active and nervous than usual and has a loud mating call to attract males. Ovulation is stimulated by copulation. The male approaches an oestrous female from behind or sideways as she assumes a receptive crouch,

elevates the pelvic region and holds her tail to one side. She also treads with the back legs. The male mounts and thrusts and the female gives a copulatory cry, and as soon as the penis is withdrawn the female becomes aggressive towards the male. There is a display of post-copulatory behaviour as she rolls and rubs on the floor (Hart, 1980a; Fox, 1975).

Females assume the receptive crouch (lordosis) before the male mounts; it is accentuated when the male grasps her scruff (Thorne, 1992).

The queen will display lordosis again several minutes after the initial display. The cycle of events will then be repeated and the repetitions can continue for up to two days (Bradshaw, 1992).

Prolonged contact by the male during proestrus is not tolerated by the female (Beaver, 1992).

Ovulation is stimulated by copulation, and one female may mate with a number of males in one oestrous period (Thorne, 1992).

MATERNAL–OFFSPRING BEHAVIOUR

Cats do not form pair bonds and the male leaves after copulation. When birth is close, the cat retires to a dark quiet place. When the kittens are born and the mother has licked them to stimulate respiration and cleaned them, she rests in a semi-circle around them. If a kitten crawls away she touches or licks it to bring it back. Nursing starts within an hour or two after birth and for the first two days, the mother remains constantly with the kittens. She also initiates nursing and a teat order develops among the kittens (Ewer, 1961) which reduces competition. Defecation and urination is stimulated by the mother licking the anogenital region. She keeps the nest clean by eating the waste, grooms the kittens and begins to play with them. By the fifth week, nursing time declines and the mother begins to teach the kittens predatory behaviour. The relationship between predatory and play behaviours has been studied (Caro, 1981) and it seems that predation develops later than social play; although some of the patterns are similar, others increase in development (e.g. chasing and being chased, or biting), while other behaviours decrease (e.g., decrease in the number of sequences containing three kittens). Fostering is easy and mother cats will readily adopt other young.

To stop her kittens chewing or biting her, the queen will initially growl at them. If this does not work she may hit the kittens on the nose, drag them away or turn and move away from them.

Maternal behaviour is the primary social pattern exhibited by female cats,

Kittens spend almost all their time with their mother or siblings for their first three weeks of life (Beaver, 1992 & Turner et al. 2000).

The queen often licks and awakens her kittens to stimulate them to begin suckling (Beaver, 1992).

The presence of littermates reduces the stress of new environments (Bradshaw, 1992).

There may be early-season oestrus synchrony (Liberg, 1981, cited in Turner and Bateson, 2000) resulting in litters of a few females being born around the same time. This would allow communal caring. Feldman (1993, cited in Turner and Bateson, 2000) found that a queen involved in communal care would move her kittens more frequently. This may be because it would be safer per move than if she was alone, as the kittens at either site (where being moved from or to) would be guarded most of the time.

THE CATNIP RESPONSE

The catnip (a member of the mint family) response (Hart, 1980a) involves the leaves or extract of the plant. Between 50-70% of cats respond by sniffing, licking or chewing the material and head shaking and gazing into space are common. Some cats rub their cheeks and chin over the catnip, others paw or dig it. The response lasts for 5 to 15 minutes; it is triggered by the active ingredient nepetalactone and is mediated through the olfactory system.

The catnip response does not seem to be related to a sexual response or hunting/aggressive behaviour (Bradshaw, 1992).

Catnip is a strong stimulus to stop purring (Bradshaw, 1992).

The response is inherited on a dominant autosomal gene (Bradshaw, 1992).

ABNORMAL AND PROBLEM BEHAVIOURS

Here we'll try to cover most of the common behaviour problems. This is just an overview and the extent to which one can discuss individual therapies is limited.

When a pet displays behaviours that are unwelcome, they are described as behaviour problems. What vets and behaviour therapists have to consider is to what extent these behaviours are the normal responses to early social experiences, management and training. More important, perhaps, we have to distinguish changes in behaviour that have their origins in disease since to leave disease untreated while we go on to concentrate on a training or purely behavioural problem could be negligent and endanger the animal's life.

Behaviour problems are generally not abnormal behaviours. Cats, on the whole, exhibit fewer problems than dogs, although the evidence is less complete. Up to one third of all cats and dogs brought to vets for euthanasia are destroyed because of behaviour problems. This means that behaviour problems are certainly the most common cause of death in young animals.

One should also bear in mind that pets with behaviour problems that are tolerated may drastically reduce the owner's quality of life.

There are a number of things to bear in mind when reading about or discussing behaviour problems with clients. We are only going to cover these subjects very briefly. The idea here is to give some idea of the sort of therapy that can be applied to pets with behaviour problems. Never jump to conclusions about the nature of a problem behaviour. Owners often leave important bits of information out until you have committed yourself to a diagnosis. Don't give these tips as if they are quick fixes. Unless you have investigated the case properly you may well find that the unwelcome behaviours do not get better but instead get worse. This would be suitably embarrassing and can even result in legal action.

1. ***Sexual problems:*** Males may lack interest in copulating with a receptive female. This may be due to several factors: unfamiliarity with breeding environment, lack of experience, sometimes a hair ring develops around the glans penis which prevents intromission, or hormone levels may be low.

Breeding males should be conditioned to breeding activity by frequently copulating with receptive females.

Males that have been castrated may masturbate after being castrated (Schwartz, 1997).

The most frequent abnormal behaviour in females is the queen who appears to be in full oestrus but will not accept the male. Some females show preferences for a certain male so it is advisable to try the female with a different stud male (Hart, 1980a).

Females can experience pseudo-pregnancy if they ovulate but do not conceive. Robinson (Thorne, 1992) reports that a good way of reducing the number of oestrous cycles is to stimulate the vagina with a cotton bud. Because females may lose condition and even cause noise pollution with repeated oestrous cycles, some breeders use this technique.

2. ***Excessive grooming:*** This can cause skin irritation and loss of hair and is more common in Siamese and Abyssinian cats. Emotional problems can enhance the problem and it can be treated with corticosteroids.

Grooming the flanks and back may be a displacement activity displayed when the cat is confused or has been upset. Excessive grooming may occur if the cat is continually stressed (e.g., by a new cat in the house). Self-mutilation, such as grooming to a skin lesion, is very rare (Bradshaw, 1992).

Excessive grooming of her young by an overly anxious mother results in the newborn being less able to nurse because they are constantly disturbed, and they may die due to lack of nourishment and loss of body heat (Schwartz, 1997).

3. ***Prolonged sucking:*** This can become a vice in adult pet cats: tactile stimulation of hair and earlobe while being petted, evoke the nursing response.

Alternate kneading with the front paws typically accompanies sucking (Schwartz, 1997).

4. ***Pica:*** This is defined as an abnormal craving to ingest unusual substances and is said to occur when inappropriate objects (such as wool) are ingested (Schwartz, 1997). It is common in Siamese cats. Ingestion of the material being sucked can result in intestinal obstructions (Schwartz, 1997).

This problem, specifically in cats, can involve a variety of bizarre substrates, including rubber and electrical cable but most commonly it involves the sucking and the ingestion of fabric. It is seen in exotics, especially Siamese, which suggests a possible genetic link. But it has also been linked to a traumatic weaning process, separation anxiety (it can be precipitated by some types of stress), a deficiency of fibre in the diet and the lack of any opportunity to perform natural predatory behaviour. It is a serious problem and can lead to gastric obstructions and impactions, but also to incredible damage, especially when the cat generalises from wool to other fabrics.

Treatment for pica is to increase the fibre content of the diet (sometimes even provide very small quantities of shredded wool if the cat is looking for lanolin, but also give occasional laxatives). Restrict access to garments, and make the fabrics unpalatable, perhaps by sprinkling with eucalyptus oil.

Grass may be a part of a cat's normal diet or be eaten if the cat is nauseous. Grass eating is not a definite indication of internal parasites, as sick cats may not eat it and healthy cats may (Schwartz, 1997).

5. ***Elimination problems:*** Elimination in places other than the litter box is the most common behavioural problem cited by cat owners (Borchelt and Voith, 1981). These include urination, defecation and marking problems. They are usually complex problems which cannot be cured with any one type of treatment, The client and veterinarian have to devise strategies that may include moving the litter box, placement of food in the area where spraying occurs thus converting it into a food area or placing toys in the spraying area to make it into a play area. Castration may prevent spraying by an intact male and synthetic progestogens will often suppress spraying in castrated males or females. Reward and punishment techniques are not very successful for cats.

Elimination problems may include a refusal to use dirty litter. Also, physical elimination problems (pain) may teach cats to avoid the litter (Schwartz, 1997).

If a cat suffers enough social stress or predisposing circumstances it may begin to void outside its litter box (Schwartz, 1997).

In a multi-cat household, separate litter boxes should be provided for each cat so that any territorial conflict can be prevented (Schwartz, 1997).

House-soiling differs from marking in that it involves the deposition of faeces out of the litter tray and is usually a product of poor maternal care and/or poor training. (Persians seem to be over-represented in this problem.)

The cat's ability to discern a litter substrate as being preferable as a toilet site is a product of the cleanliness of the nest in which it was raised. Over-fastidious litter cleaning by the owner can mean that the cat is not easily able to locate its toilet but, equally, most cats prefer the litter tray to be well maintained.

The relative positions of litter trays and feeding sites can be crucial in helping the pet to select an appropriate site. Feed bowls should be in a different room to the tray. Placing small portions of dried food in areas that have been fouled tends to deter further mistakes. Covering the litter box with a dome to make it more private can help some cats, especially those living in a household with nosy dogs. Thorough cleaning, as with marking problems, should discourage return visits to the inappropriate site.

6. ***Indoor marking:*** Indoor marking (scratching, spraying and middening) has to be distinguished in each case from house soiling. Activities such as claw sharpening are normal for cats and only become a problem when the favourite furniture is used. Usually the provision of a scratching post in place of the furniture solves the problem. Extreme cases may require declawing. Marking

generally occurs in an attempt to make the perpetrator feel more secure in its lair and therefore it can include scratching, urination and open defaecation (i.e., where no attempt has been made to cover up the faeces, aka 'middening').

The lack of perceived security in the lair is precipitated by things such as the introduction of a cat flap, a young baby, a new spouse or the arrival of new cats in the neighbourhood.

Sites of elimination tend to include areas that either have a higher concentration of challenging odours, such as door mats, or those that smell particularly strongly of the owner, such as chairs and beds, clothes and even the owners themselves.

Females and neutered males may urine spray – in other words, the behaviour is not confined to tomcats. It is just that the behaviour for the females and neutered males requires a higher threshold than for entire toms.

Treatment revolves around making the cat's world more secure, so any form of direct punishment is contraindicated because it simply makes the cat feel more insecure.

a. If the cat has singled out one new person to be the target of marking, then it really helps to get that person to be the only person who feeds the cat.

b. Similarly, encouraging all humans in a household to use the same soaps, shampoos and scents may help to homogenise the group and stop one human being singled out for attention.

c. Boarding up the cat flap works well but has to done as part of a campaign that includes thorough cleaning with a biological detergent followed by surgical spirit and the placing of dried cat food in favoured sites. This serves to make the marking points less appealing.

d. This campaign can be supported with the use of anxiolytics, tranquilisers ± pheromonatherapy. These drugs should be given only transiently and only in combination with behaviour modification.

7. ***Aberrations during parturition and lactation:*** Some breeds, like the Siamese, may become very restless and verge on hysteria. This is not a common occurrence in other breeds (Joshua, 1968).

Some first-time mothers may find the whole new experience overwhelming. If so, the mother should be separated from the litter to prevent malnutrition or injury to the young (Schwartz, 1997).

8. ***Aggression:*** This cannot be regarded as abnormal, but which can be a problem for cat owners. There are different types of aggressive behaviour in cats (Hart, 1980a).

a. Intermale fighting: this can be sometimes eliminated by castration. Cats are usually extremely flexible socially, but breakdowns in this ideal occur when kittens have been deprived of social learning opportunities between 2 and 7 weeks of age. Intermale rivalry arises and the intolerance of certain individuals can lead to enormous problems of aggression.

In treatment, these cats can be re-educated by frequent controlled exposure to the new cats coupled with distraction techniques, such as feeding, when socialising. Human support of the higher ranking individual can serve to demote the other combatants to the extent that they are perceived no longer as a worthy opponent by the alpha cat.

b. Social-territorial aggression: common aggressive behaviour, which occurs if a cat, intrudes into another cat's territory. It is often difficult for an adult cat to accept another cat or kitten into the household. Synthetic facial gland pheromones have been shown to have a pacifying effect on fearful and territorially aggressive cats.

c. Fear-induced aggression: may be shown when a child pulls a cat's tail or ears or may follow a slap meant as punishment. Aggression may just be redirected fright. If made toward another cat, it may initiate prolonged disagreements (Schwartz, 1997). Do not cut off the retreat of an aggressive cat or offer direct challenges, such as staring.

Some types of aggression may be controlled by drugs but others may only be controlled by changing the situation, e.g., an established adult cat directing aggression towards a new cat.

In a multi-cat household the same cat is always the first victim of aggressive outbursts by other cats. If this happens, the cats should be separated as soon as possible after the first attack to prevent further occurrences (Schwartz, 1997).

d. Aggression towards visitors and owners: this can be a result of insufficient socialisation and gentling, causing a display of defence aggression or predatory chasing, for example, of human feet. Or it can be redirected aggression towards humans by cats that have just seen conspecific rivals through a window.

Treatment is for the owner to make time for some structured play with the cat and, perhaps, consider introducing a less threatening cat, such as a kitten of the opposite sex, into the home.

9. ***Overeating:*** This is often associated with overfeeding by the owners, especially when they have assumed that vocalisation by the cat is a sign of hunger.

10. ***Over-attachment:*** If this is the problem, the cat may follow the owner constantly, be upset in his/her absence and have a tendency to suck skin and clothing.

Treatment for over-attached cats is to keep petting to a short duration and only at the initiation of the owner; in other words, stop rewarding attention-seeking behaviour with petting. Many of these cats quickly learn just how to get attention on demand. Periods of isolation in an appealing room should be increased from a couple of minutes to six hours over a period of two or three months. In other words, a process of habituation.

11. ***Nervousness, phobias and separation anxiety:*** These can result from a lack of early exposure to appropriate stimuli during socialisation periods, a traumatic incident, or old age. Cats in this class often appear withdrawn, have a low crouching gait and are reluctant to enter open spaces. They may also show psychogenic vomiting and diarrhoea, and may over-groom themselves or self-mutilate.

If a specific stimulus is responsible for the behaviour, then systematic desensitisation is indicated. Where there is generalised nervousness, drug support is

sometimes helpful. Specifically, over-grooming and self-mutilation have their origins in stress. When a cat comes up against a confusing or frustrating situation, it will often stop whatever it's doing and groom itself. The stress of isolation for instance can send cats into a grooming obsession in the same way that a flea allergy can. Ultimately, the danger is that trauma to the skin ends up generating endorphins that mediate a form of self-reward to the cat and the cycle tends to perpetuate itself. Treatment must centre on reducing the stressors in the cat's life and, possibly, the use of drug support such as benzodiazepines (valium) or tricyclic antidepressants (amitriptyline).

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DOGS

VISION AND OTHER SPECIAL SENSES

Vision: A dog's vision is generally inferior to that of man but it can see colour, static shapes and does not perceive detail. However, dogs are very sensitive to moving objects and can see a hand waving up to a mile away (Messent, 1979; Mery, 1970). The predominance of rod receptors allows the dog to see much better than humans do at night. Dogs are very sensitive to sudden or unusual movement, an asset made use of in guide dogs, retrievers and hunting dogs. The panoramic field of vision is 250-270° but binocular vision varies greatly in different breeds according to how far their eyes are set in the front of their head, e.g., the Pekinese or Bull Terrier have binocular vision about 85°, or a Greyhound about 75°, man has about 140° (Mery, 1970). Furthermore, the extent to which a dog has peripheral vision depends on its skull shape. A visual streak in the retina is required for peripheral vision, but this has disappeared in short-skulled breeds such as the pug (McGreevy et al., 2003).

Although it has previously been thought that dogs are 'colour blind', recent studies have shown that under bright light dogs are capable of detecting wavelengths within the blue and yellow portion of the light spectrum and are therefore dichromatic. However, they are incapable of distinguishing reds and oranges as they have only a few of the cones sensitive to the red/orange wavelengths (Neitz et al., 1989).

The visual colour spectrum of dogs can be seen in two forms: violet and blue violet, which is seen as blue and greenish yellow; and yellow or red, which is seen as yellow. Therefore, dogs are red-green colour blind and are also better at differentiating between shades of gray than humans (Miller & Murphy, 1995).

Night vision is assisted by a reflective layer of cells, known as the ***tapetum lucidum***, which is located behind the retina and reflects light back through the retina (Plonsky, 1998).

The absolute threshold for the detection of light is about threefold lower than humans, allowing the dog to be three times as capable of detecting low light intensities (Bradshaw, 1992).

Puppies experience difficulty in identifying objects until 4 months of age when visual maturity is attained (Campbell, 1992).

Smell: This is a dog's predominant sense, and it can discriminate between complex mixtures of odours (Fox and Bekoff, 1975). The dog has approximately 220 million scent receptors in the nose, whereas humans have only 5 million (Dodd, 1980). Dogs can be readily trained to select objects associated with an individual and can follow trails of a specific person, although success can depend on temperature, humidity, wind and age of the trail.

The vomeronasal organ is an additional structure to olfaction that can detect pheromones for the identification of sexual behaviour. It is located in the roof of the mouth just behind the upper incisors (Case, 1999).

Anal sac secretions consisting of pheromones differ in the volatiles and constituent compounds between different groups of animals, suggesting possible age, sex and/or genetic differences that individual dogs could use in assessing others (Natynczuk et al., 1991).

Hearing: This sense is highly developed and dogs can hear high notes that the human ear cannot detect. Children can detect notes up to frequencies of about 20 KHz, adults rather less, while dogs are known to be able to hear notes up to 35 KHz, and it is suggested that their limit may be as high as 100 KHz (Messent, 1979). This ability to hear high notes enables dogs to detect the calls of many small mammals, such as mice and bats.

Sounds can be detected up to 40 KHz, but there is no evidence that dogs can communicate at such high frequencies (i.e. ultrasound). Such acute hearing is probably most useful for capturing small prey that emit high-frequency sounds to communicate (Case, 1999).

SOCIAL ORGANISATION AND HIERARCHIES

Unlike cats, dogs are highly social animals and small troops have been observed in various cities. A group of three feral dogs in St. Louis was led by the female of the group but there were very few ritualized displays of dominance (Fox et al., 1975). In a pack the dog expects the presence of a leader and it is appropriate for a family pet to regard its owner as being in this role. Problems can arise when the dog attempts to become or succeeds in becoming the leader (Messent, 1979). If it does dominate a family it will refuse to obey orders and be uncontrollable on walks and may aggressively defend a favourite chair.

Wild wolf packs contain 2–12 members (Mech, 1975), urban dog packs form small groups of 1–3 members (Daniels, 1983) and rural dog packs form slightly larger groups of 2-5 members (Scott & Caisey, 1975).

Group behaviour has an obvious adaptive value in pack hunting and appears early in a puppy's development. Ranks within litters become established in tests of strength and competition during 'play fighting' which begins as early as five or six weeks (Fox and Bekoff, 1975). In previously unacquainted dogs rank is not necessarily dependent on fighting but may be decided on vocalisations and postures. Weight and sex are important factors in determining social status: in male pairs weight is important but in female pairs weight is not so decisive (Scott, 1958).

When breeds are of similar size, the breed temperament is a determinant for rank, for example, fox terriers tend to prevail over beagles and cocker spaniels (Houpt, 1998).

Different postures and facial expressions indicate changes in motivational state. Submission postures in a dog include crouching, tail wagging and rolling over on the back. If a dog is aroused it may become aggressive and put its ears back and tail up and begin to snarl, or it may show play-soliciting behaviour and become submissive.

The presence of large packs of dogs in urban areas is usually due to the presence of an oestrous bitch (Daniels, 1983).

A hierarchy is formed regardless of the size of the pack, and a submissive dog, when approached by a high-ranking dog in a pack, will remain stationary and avoid eye contact in order to avoid an attack (Houpt, 1998).

In free-ranging dogs, inter-group agonistic confrontations are more common than intra-group agonistic confrontations (Pal et al., 1998).

Dogs can identify and show preference for their own breed and litter mates (Hepper, 1986).

Social manoeuvring is concerned with expressing social status (O'Farrell, 1992). The function of hierarchy is to provide stability to the group and reduce intragroup aggression (Serpell, 1995).

Establishment of rank occurs when puppies are 3–4 weeks old, however, pairwise relationships only become stable by the 11th week. During the intervening period there is considerable instability in the relationships between individual littermates leading to a progression towards a stable hierarchy that is not consistent and straightforward (Serpell, 1995).

Individual puppies move from top to bottom of the competitive hierarchy and back again within a number of days (Nightingae, 1991).

A combination of apparently dominant and submissive body postures may be shown in dogs that are extremely fearful and feel threatened (Serpell, 1995).

Communication: Dogs can communicate through body postures, vocalisations, facial expressions and scent marking. Patterns of communication, such as stares, body postures, tail-wagging and social interactions facilitate further social interactions and minimise chances of aggression (Serpell, 1995).

Allelomimetic behaviour is common in dogs and can be seen through vocalisations where one dog will bark/howl and others join in (Abrantes, 2000).

1. Scent marking When a dog goes for a walk it will cock its leg and urinate on bushes and lamp posts. With the urine, scent from the anal glands is deposited. In this way a dog marks out its territory and also indicates its presence to any dogs in the neighbourhood. When a male dog goes for a walk in town he distributes his scent when marking, often excessively. This is because the scent markings become covered and he must continually re-establish his territory (Messent, 1979).

The frequency of urine marking is related to status seeking as more assertive animals demonstrate raised-leg urination (RLU) more frequently than subordinate individuals. Therefore, if this becomes a problem, solutions should involve reducing the dog's status seeking in the household (O'Farrell, 1992).

Urine marking in females, increases during oestrus as the urine contains pheromones capable of attracting male dogs from great distances (Serpell, 1995).

There is no evidence that faecal droppings in domestic dogs have a function in communication, unlike in wolves where faeces marks the periphery of their territory (Serpell, 1995).

Males coyotes tend to be more responsive to the urine of other males then to the urine of females when maintaining and establishing their territory (Wells & Bekoff, 1981).

2. Scratching When a dog scratches the ground he is leaving a visual cue as well as · scent cue from the sweat glands in the toes and footpads.

3. Rolling A dog will sometimes roll vigorously in a foul smelling substance. Wild dogs, especially alphas will also do this, and it seems that by making themselves strong smelling they may indicate to other dogs that they are high ranking (Messent 1979).

4. Tail wagging The role of tail wagging when dogs meet is not completely understood, but may serve to distribute odours for recognition. It may also function as a visual cue signaling peaceful intentions (Fox and Bekoff, 1975).

Tail-wagging is a context-specific behaviour, which signals excitability or stimulation, such as friendliness/confidence, anxiousness/nervousness and even a threat of aggression (Serpell, 1995).

The secretions of the ears are sometimes sniffed when dogs meet; this is believed to aid in the identification of an individual (Houpt, 1998).

SEXUAL BEHAVIOUR

Male puppies as young as five weeks old may show sexual mounting even with pelvic thrusting. This can be considered a normal part of play behaviour and is necessary for development of sexual response in adults (Hart, 1980b). A problem may arise if older puppies, stimulated by play, mount and clasp inappropriate objects, including children and other animals. If this is not prevented it may become a behavioural problem (Fox and Bekoff, 1975).

Individual males show great variation in intensity and degree of ‘courtship’ behaviour. The male is continually checking scent posts for evidence of an oestrous female and if he finds one he remains in the area or tries to follow her trail. When he finds a receptive female he investigates her head and body and then her anogenital region. The female responds by elevating her rump and lifting her tail to one side then standing while the male mounts. The male grips the female's thighs and copulation occurs with pelvic thrusting. Sometimes the male mounts several times before intromission is achieved. Then the male turns and lifts one hind leg over her back so that they stand tail to tail. This is the tie or lock, and may last for 5-60 minutes (Hart, 1980b). Ejaculation begins at about the same time as locking and continues until nearly the end of the lock.

The first portion of the male dog's ejaculate (within 1 minute of intromission) contains sperm-free prostatic fluid, with the sperm-rich portion of semen ejaculated during the first five minutes of the animals being locked together in a tie (Serpell, 1995).

Most bitches accept the approach of the male and will stand to breed several days prior to ovulation (Serpell, 1995).

Bitches are promiscuous and tend to mate with more than one male so that litters usually have multiple paternities to increase the genetic diversity. Young

adults copulate more successfully than old adult males (Pal et al., 1999).

The very first proestrus and oestrus of a bitch is shorter and levels of lutenising hormone and oestrogen are relatively low (Ghosh & Choudhuri, 1984). Males are more attracted to the second or later oestrous periods in bitches (Pal et al., 1999).

During proestrus, which occurs just before oestrus, the bitch will exhibit more play behaviour to the male but will bark and growl and not allow the male to mate (Houpt, 1998).

The urine from an oestrous bitch is more attractive to a dog than vaginal secretions (Dunbar, 1990).

The alpha female is usually more aggressive to other females in her pack. This is believed to be an attempt to reduce or inhibit the mating of other females. Males not preferred by the alpha female also experience agonistic responses (Bradshaw & Nott, 1995).

MATERNAL-OFFSPRING BEHAVIOUR

Just before parturition the bitch often becomes restless. At birth the mother breaks the sac and begins to lick the young. She consumes the waste and nursing begins. During the first few days after birth the mother leaves the nest only for feeding or defecation. By about five weeks the mother's milk supply is beginning to decrease and she restricts her nursing to a few short periods daily (Fox and Bekoff, 1975).

A common occurrence in females is false pregnancy in which there is mammary development and, in extreme cases, characteristic behavioural changes and lactation. It has been suggested that this behaviour is one of the ancestral behaviours seen in the wolf. The alpha female wolf may be the only one in a pack to breed. The male plays a part in protecting and caring for the young, and the females in the pack that have not bred, may go through pseudo pregnancy and produce milk at the same time as the bitch with offspring. These are wolf ‘aunts’ and can serve as nurse maids (Hart, 1980b), thus contributing to the survival of the young.

The mother feeds the puppies with regurgitated food for about four weeks after birth and teaches the young to hunt.

The bitch regurgitates her food to the puppies in order to wean them (Malm, 1993).

In domestic dogs, lack of regurgitation can occur and complicate the weaning interaction between mother and pups as well as the transition from milk to solid foods for puppies (Malm, 1995).

Play behaviour develops in the young puppies about five to six weeks after birth and they communicate their intentions by crouching on the fore-limbs and elevating the hind end. Play sequences are important, so the young can learn to control the intensity of their bite (Fox, 1977) and also to maintain social relationships within the group.

Unless dystocia occurs during parturition, the bitch is usually silent. If males are present during this process they may whine. The length of parturition is normally 15 minutes to one hour (Houpt, 1998).

A bitch will commonly lick her puppies, which encourages them to eat (Houpt, 1998)and, in the first three weeks of life, the mother licks the pup's genitals and anus to stimulate elimination in the pup (Campbell, 1992).

Dogs are an altricial species, which means that they are born in a relatively helpless state. Maternal care is needed in early development as newborn puppies are unable to see or hear, and their motor capabilities are limited to a crawl (McGreevy, 2001).

When puppies suckle there is no set teat order or preference and they tend to suck for as long as possible. No consistency in milk intake occurs over weeks within a litter (Malm & Jensen, 1996). In contrast to this, piglets have a set teat order/preference and milk production in various teats differs greatly (Boe & Jensen, 1995).

If the puppy is removed from the litter at six weeks or earlier, it is deprived of social interactions, which can lead to disordered behaviours towards other dogs later in life (O'Farrell, 1992).

Primary socialisations in puppies require not only exclusive access to the desired bonding partner in order to achieve correct socialisation, but also interactions with the entire litter and exposure to the social hierarchies (Serpell, 1995).

Puppies between the ages of 4 and 16 weeks experience a crucial developmental period, whereby exposure to many different people, places, animals and environments will enable them to more readily accept changes in later life and be less fearful, defensive and aggressive (Voith and Borchelt, 1996).

BEHAVIOURAL PROBLEMS AND ABNORMAL BEHAVIOURS

Most dogs display at least some form of undesirable behaviour and as many as 25 per cent engage in activities that constitute a severe nuisance.

1. Problems in pregnancy. Inhibition of labour has been noted, failure to attend to the first-born puppy, and the bitch who refuses to eat the afterbirth. It is difficult to determine what factors in the environment cause these problems.

Abnormal nursing behaviour may result if the bitch has had a difficult birth or has caesarian-born puppies, or if the puppies cannot suck strongly. Also, if the puppies' vocalisations are abnormal and continuous the bitch may become distressed (Freak, 1968).

2. Flank sucking. Seen almost exclusively in Dobermans and difficult to treat (Hart, 1980b).

3. Feeding problems. In a group of puppies the higher-ranking animals may get more than their share and the subordinate animals may suffer from malnutrition. Some dogs over-eat and become very fat; the problem is often due to the owner offering excessive amounts of highly palatable food.

4. Coprophagy. Dogs eating their own faeces can be a problem and one suggested remedy is to place a foul-tasting or smelling substance such as kerosene or tabasco sauce on the faeces (Hart, 1980b).

New treatments for coprophagia involve addition of various enzymes to the diet to break down more of the

nutrients in the dog's food to provide a proper influx of nutrients. Veterinary prescribed chemicals such as Forbid (powder supplement) or Deter (pill) can also be added to the dog's food to make the faeces distasteful. Both these methods should be used in conjunction with positive reinforcement when the dog leaves faecal material alone (Hofmeister, 1995).

5. Destructive behaviour when owner is away. This may take many forms such as chewing furniture and rugs, tipping over garbage cans, stealing things, defecating or urinating in inappropriate places (Voith, 1980). This misbehaviour may be due to boredom, fear of abandonment, loneliness, lack of attention or other factors. To treat the problem may take a long time and involve the owner in a program, which includes play sessions, exercise, planned short departures and returns, and rewarding the dog for good behaviour.

In separation-related disorders, fears are adaptive behavioural responses that are learned and so can be extinguished by gradual exposure to the fear-inducing stimulus using non-associative learning (desensitisation) in conjunction with therapeutic drugs such as anxiolytics to relieve the symptoms (Mertens, 1999).

Separation anxiety develops over time, through negative experiences. It has been postulated that it is a result of a distancing from the social partner (Mertens, 1999).

Destructive behaviour that occurs when an owner is away is known as separation anxiety and other behaviours of this type include aggression when an owner is leaving, constipation, diarrhoea and vomiting. Drugs may help in treating these problems but they do not cure them (McKeown, 1994).

6. Sexual problems. Mounting activity directed towards humans may reflect lack of opportunity for the dog to play with other dogs, or over-attachment to people in early life which has not been corrected. Punishment may eliminate the problem but is not always effective. Castration may reduce the behaviour. Sometimes a male will only mate with a certain female, and a female may prefer a special male.

7. Aggressive behaviour. This is one of the most common problems encountered in dogs. There are different types of aggressive behaviour and to treat them requires identification of the different types. Hart (1980b) gives a review of the types.

a. Competitive aggression may occur over food and if one dog is clearly of higher rank than another; actual fighting does not occur and conflicts are resolved by threats and submissive gestures.

b. Intermale aggression is an innate tendency and in some cases may be reduced by castration.

c. Fear-induced aggression (Voith, 1980) occurs in males and females and is seen in situations where an animal would escape if possible, e.g., in a veterinary clinic.

d. Pain-induced aggression.

e. Territorial aggression — this may be directed towards other dogs, people or both. It can become a serious problem when directed towards postmen or meter readers and the only solution may be tying the dog up when these people arrive.

f. Predatory aggression may involve attacking sheep, cats and other small mammals. It may occur when a pack of dogs runs together or with an individual dog.

g. Maternal aggression is believed to be due to the hormonal state of the female during lactation, as well as the presence of the young.

h. Learned aggression is the type of aggression seen in guard dogs that have been trained to attack.

i. Aggressive behaviour (Voith, 1980) is often seen in dogs that are seeking status. They frequently threaten submissive individuals to maintain their position. In a household, a person may be the object of threats by the dog and if the person backs off, the dog's status is affirmed. A dog should never be allowed to assume the alpha role as the aggressive behaviour is reinforced and continues to occur.

Threshold levels for dogs displaying aggressive behaviour are influenced by environmental and genetic factors. These levels can be raised using medication and/or behavioural modification techniques, such as counter-conditioning and desensitisation to teach new non-aggressive responses (Borchelt, 1998).

The value of the resource (food, toy or attention from the owner) will determine the amount of effort and risk (the cost) the dog is prepared to make in order to gain and maintain the desired resource (Voith and Borchelt, 1996).

Status-related aggression toward humans occurs when the dog perceives the human as a threat or challenge to its social status (Serpell, 1995).

Poorly socialised dogs often show territorial aggression motivated by fear and the need to drive off intruders (Serpell, 1995).

Dogs that display territorial aggression towards a postman seem to believe they have been successful in chasing him away. Treatments include systematic desensitisation or distraction followed by a commanded alternative response, which should be positively reinforced (O'Farrell, 1992).

8. Training dogs not to roam is another problem. It is natural for dogs to roam away from the house (Hart, 1980b). They can be induced to stay close to home by:

a. castration

b. making home attractive by providing company

c. if all else fails, some dog owners may resort to confining their dog to a pen or kennel.

Dogs can have fears and phobias, including fear of new places or situations known as agoraphobia, fear of unfamiliar people and/or dogs. The most common fear-related problems are noise phobias, involving thunder, gunshots and fireworks (Case, 1999).

The majority of dogs that express status-seeking aggressive are either male and/or purebred dogs (Reisner et al., 1994).

9. Self-inflicted wounds, known as psychogenic dermatoses, can result from licking, scratching, biting and rubbing. Possible causes include stress, social isolation, fear and loss of a companion animal or human (Young & Manning, 1984).

DEALING WITH SOME PROBLEMS OF AGGRESSION: DOG/HUMAN

More than 30% of dogs in animal shelters are abandoned because of behavioural problems (Wells, 1996). The chances of a dog developing a behavioural problem are increased by many factors, such as breed, sex, age, diet, relationship with owner and castration status (Jagoe, 1996).

Nervous aggression

This usually begins as a reflection of the dam's behaviour, which is why breeders will never let you see a nervous bitch with her pups when you go to buy one. Since this sort of aggression is defensive in nature, it is worse when the dog detects that its means of escape is threatened, for example, when it is restrained on a lead or when visitors try to enter the room or the house. The dog will be reasonably good in crowds but will become very different when approached by a single person, such as the vet.

Treatment. Therapy for these dogs should:

1. Present the dog with examples of its perceived threat without any of the associated preludes that have, in the past, alerted it to be challenged.

2. Eye contact and attempts to pet the dog should be avoided at all costs.

3. When receiving visitors at home, the dog should be fitted with a long trailing lead and kept in a separate room until the visitors are seated. When the dog can be let in to see the visitors, he will come and sit beside the owners. One visitor can pick up the lead and slowly pull the dog towards him without engaging eye contact or trying touch the dog. This should be done slowly so that eventually the dog is sitting beside the visitor and therefore becoming habituated to the presence and proximity of the perceived threat.

Be careful that the dog is taken out of the room before any visitors leave – if you don't, he may show aggression and associate that with the rewarding departure of the threatening visitors.

Remember that if you can control the games you can control the dog. Keep a prized toy beside the front door. The dog should soon learn to expect to play with it every time you open the door.

From the vet's point of view, these are dangerous dogs and, as such, they must be allowed time to become accustomed to the clinic. 'Dummy runs' that involve no challenge may help, as well as counter-conditioning by the owner offering a palatable supplement tablet once the dog is on the table or when a procedure has been carried out.

Rank related aggression

This initially presents as the threatening of family members by a young dog. It is usually a confident or even over-friendly dog and is typically described as a Jekyll and Hyde character. This dog wins most games of possession, sleeps in the bedrooms, usually eats before the family and tends to go through doorways first. The owner will complain that there are lots of things that the dog dislikes him/her doing, such as getting up to answer the phone, changing gear in the car or switching the gas fire on. The dog also dislikes being groomed, is affectionate but only on its own terms (for example, likes its chest and head to be tickled but when it feels a hand move on to the back of its neck or shoulders it emits a menacing growl), resents visitors going upstairs and, as it matures, it will often allow only certain people into its house and territory. The effects of fear in these dogs may be important in understanding the motivation for and treatment of aggression problems.

Treatment. If owners challenge the dog, the moment they back away, perhaps because they have been bitten or because they think they have made their point by rousing on the dog, they send a dangerous message to the dog – that it is a worthy adversary and that they have backed down. Therapy is aimed at changing the dog's rank without it ever having to actively defend its status, i.e. without the owners ever having to 'enter into combat'. Why would a dog want to defend its position in the pack? Well it should be clear that in evolutionary terms the position one holds in a pack is not just a source of pride – it can also mean survival. The wolves that carry the genes that put up a fight for rank are the ones that survive in times of food shortages. Since domestic dogs are descended from the wolf, they share the same genetic traits that led to success in their ancestors.

The treatment strategy is to get the dog to see its owners as having higher rank. It can be:

1. dragged off furniture with an extra long lead,
2. made to go through doorways after the humans,
3. denied access to the bedrooms,
4. tied up short to be groomed,
5. made to lose all games of possession, and
6. fed to an adjusted regime, eating after the family has been seen to eat, with no titbits, poorer quality food and no bones.

Territorial aggression

This occurs only if the dog prevails in rank-related exchanges in that area, i.e., when the dog, not the owner, 'owns' the territory.

Treatment. Therapy is angled at making the dog more submissive relative to the owner as with the rank reduction program. It can be:

1. pulled off furniture with an extra long lead,
2. made to go through doorways after the humans,
3. denied access to the bedrooms,
4. tied up short to be groomed,
5. made to lose all games of possession, and
6. fed to an adjusted regime, eating after the family have been seen to eat, with no titbits, poorer quality food and no bones.

Also the owner should try to reduce the area that the dog perceives as being its territory by exercising it in different areas every day, pulling the dog off marking points and accompanying the dog on all its excursions into the garden.

Sexual aggression

This is aggression that is adopted as a strategy for coping with sexual frustration ie., aggression that spills out

in the company of sexual precursors or in a sexual context.

Treatment. Treatment in all cases is castration.

DEALING WITH SOME PROBLEMS OF AGGRESSION: DOG/DOG

Rank related aggression

This is more frequently seen in males, dogs that are also pushy with their owners, dogs that make a characteristically cautious approach with a number of ritualised advertisements of status, such as exaggerated tail carriage, dogs that inflict the worst sort of bites on their combatants, and dogs that behave the same regardless of the presence of their owners or the use of a lead. Such dogs often indulge in frequent urination and scent-marking.

Treatment. This will be effective only if it can be applied by a human who is perceived as a leader by the dog. The first step is the introduction of a rank-reduction program. Then the dog can be obedience trained to perform a stay in the presence of other dogs, which will send submissive signals to the would-be protagonist. Castration is also known to help in these dogs (this may be because the reduced testosterone not only makes the dog less aggressive in itself but that other dogs perceive him as being less of a threat). However, spaying a bitch who shows rank-related aggression is unlikely to have this effect.

Nervous aggression

With this type of aggression the dog is likely to react similarly to any dog regardless of that dog's gender. The behaviour is worse when the dog is on the lead or is cornered. These dogs have sometimes been attacked as pups, often while on a lead and unable to escape. (This is why exercise off the lead during the socialisation period is particularly important. Being on the lead can trap a pup and stop it being able to express its innate submission signals.) In some cases the dog barks a lot in an attempt to warn approaching dogs rather than actually snapping. The dog's behaviour is, to some extent, a product of whoever is on the other end of the lead. For example, the dog may be better behaved with a stranger because it cannot be certain of that handler's ability to protect it from the threat of other dogs.

Treatment. This involves the use of stooge dogs that can tolerate aggressive advances by the nervous animal. The most common response to this sort of aggression, tightening the lead, is possibly the worst. Unfortunately, it serves to warn the dog that something unpleasant is going to happen and that there is limited chance of escape. The aim is to make the presence or approach of other dogs appealing. This can involve the use of either food or toys but either way it will be necessary to heighten the dog's need for whichever resource you have selected. This means that you will have to deprive the dog of all toys for a week before the program or of food for 24 hours before the program.

Strangely, owners often object to these periods of deprivation. They seem to forget that if their dog were orthopaedically (e.g. with an anterior cruciate ligament rupture), rather than mentally, compromised, they might have to limit not just its access to toys but also its exercise for up to eight weeks. Equally, 24 hours of food deprivation is no more than the time a dog goes without food before coming round from a routine anaesthetic. A properly motivated dog can be trained to associate the appearance of another dog with the onset of a game or the presentation of the food it had been looking for during the previous 24 hours. Results with this sort of strategy are very rewarding.

Chase or predatory aggression

This behaviour is usually being worse when the dog is off the lead, with the outcome of the incident being highly dependent on the behaviour of the dog being chased. The dog is also badly behaved in the car when it sees other dogs through the side windows. The behaviour is the same regardless of the identity of the dogwalker.

Treatment. This problem is treated by establishing reliable retrieve and recall obedience, i.e. the dog must be taught to return when called and bring a ball back every time. In the best of all possible worlds, the recall in pet dogs would be much better than it is – if they could reliably be called back from a busy road, it could save their lives. The retrieve in pet dogs could also be much better– the payoff would be heaps more exercise for them, making them generally happier and less likely to develop unwelcome habits, such as barking when left.

A chase-aggressive dog can be taught to expect a game only when the appearance of its prey (e.g. another dog) signals that a ball will be thrown in the opposite direction. This game can be introduced on a long line or flexi-lead so that the new command can ultimately mean, 'Stop, turn around and prepare to chase this ball.' Obviously the attractiveness of the ball has to offset that of the free-moving dog. (Remember, the relative value of the toy as a resource can be exaggerated by limiting the access the dog has to the toy.)

Chase aggression can be made less rewarding if stooges are armed. For example, other dogs owners can be enlisted to use water-pistols; joggers can be persuaded to use starting pistols, rape alarms, and so on. It is very important to give the dog the command to come back before the deterrent is used.

For a dog that chases joggers, one of the worst outcomes is that the jogger does not run away or, worse still, runs away with the dog being made to come along. This can be set up with a stooge jogger who runs toward the owner and then takes the lead from the owner when the dog starts to chase. The chase will be rewarding until the dog realises that he is being taken away from the owner as a result of his predatory behaviour.

Sexual aggression

This is diagnosed in a dog that tries to mount dogs and bitches alike, and is totally oblivious to its owner when doing so. It may make squealing noises and 'high step' on the spot with its front legs. The behaviour is unaffected by being on or off the lead, and the dog is likely to deliver bites to the back of the other dog's neck or nose area when the recipient refuses to be manoeuvred into a position that could allow mounting.

Treatment. For such frustrated individuals, treatment should revolve around eliminating the cause of the frustration, not the frustration itself. So castration is more likely to work than allowing the dog to copulate to 'let off a bit of pressure'. If owners are reluctant to agree to this (and many, especially male, owners are, you can give an anti-androgen injection, which mimics the effects of castration and lasts for about a month. This is also a useful way of checking that a surgical approach to the problem will provide the desired result.

Separation anxiety

Here we have to consider the whole question of what it is like to be a dog that is left alone. Dogs are pack animals and as such they need to be active together. As pups, dogs tend to investigate things readily on their own. As juveniles, dogs become rather passive in that they rely on the initiation of experimental activities by the pack leader. This is because in a wolf context, juveniles are expected to assume a role in hunting parties, and so on. So when the leader rests, the rest of the pack does, too. (Contrast the activity of hamsters at night to that of dogs!) When the leader is active, so are the other members of the pack. As you observe a dog maturing, you will see that it may become more reliant on you for initiation and follow you from room to room, waiting for coordinated activity.

Ultimately this room-to-room following seems to subside if the dog arrives at the point where he finds that indoor activities are not very interesting and he waits until he is allowed outside before he lets off steam. So we have a dog that is accumulating energy. These are the dogs that are over-energetic or hyperactive when given the chance to go outside – a perfectly normal response to modern canine management. These are often also the dogs that are over-energetic or hyperactive in response to minor activities at home, for example, particularly sensitive to the doorbell or visits from the postman.

Do dogs know that their pack will return? How does this impact on short-term stays at a clinic or boarding facility? Anxiety about this is most commonly encountered in rescued dogs and dogs that have become dependent on the company of their owners. Incidentally, if they are told that this is a sign of the dog's affection, owners are better able to cope with the damage these dogs do. And they are capable of enormous destruction when left. For example, a rescued terrier owned by a member of my undergraduate year destroyed eight car-seat belts during the vet's first year in practice at a cost of $200 each. A Great Dane I saw recently effectively trashed an entire kitchen, chewing handles off drawers, pulling the cupboards off the walls and emptying the freezer. Luckily, it cheated death while chewing through an electricity cable.

Along with barking, defecation and urination (often in several different spots, i.e. not through a real need to eliminate waste) are the other main symptoms of separation anxiety. The main point to remember here is that this is not the dog's way of punishing the owner. When an owner reports that the dog appeared to have known that it had committed a crime and therefore meted out what they considered to have been a suitable punishment, they were only serving to confirm what the dog had suspected:

Me + Damage + Owner = Imminent thrashing

The power of association dogs have does not stretch far enough to remember that they personally chewed the article in question two hours previously. In fact, powers of association are thought to be effective only within a time-frame of about four seconds. This should be borne in mind when any negative or, for that matter, positive association is built up with a given behaviour.

Treatment. Therapy must revolve around getting the dog used to being on its own and to behaving in an acceptable fashion while on its own. So again, the owner should wind down, but only very gradually, the attention the dog can successfully demand. Departures should be swift and not protracted with lots of attention being given to the dog – this only accentuates the fact that the owner is good to be around. Arrivals should not be stressful for the dog. If he thinks he is going to be hit after every period of isolation, his stress levels will rise every time he is left.

Next, teach the dog to spend five minutes by itself confined to a room adjacent to where the owner is sitting. This room can be used as the room in which the dog can be left. When whimpering occurs, an aversive response can take the form of a check chain flying into the room to impact on a metal tray. Only when a full five minutes has been achieved is the session over, so generous time budgeting is obligatory on the first day. The dog should have three of these treatments per day. When the five minute period is easily relied upon, it can be gradually lengthened to 30-minute sessions performed only once a day.

The associations that the dog may have built up with the owner's imminent departure from the house, such as picking up the car keys, or putting on a coat, must next be broken down. The owner should go through this ritual having left the dog in the room in which it has become accustomed to being left. The idea is then to make the sound of the door being shut without the owner actually leaving. This technique breaks down associations with the sounds while still allowing the owner to administer the aversion treatment.

Leaving a piece of recently worn clothing OUTSIDE the door of the room in which the dog is left may help to maintain a feeling of normality. Leaving the radio on outside the room may also help.

The use of indoor kennels for these dogs also has a place in therapy. However, such a den must be introduced into the dog's life very positively, so that the kennel is where the dog gets tickled, receives its food and can find its toys.

Phobias

What we think of as irrational fears are often related to particular noises, such as thunder, fireworks or hot-air balloons. But as you may be able to guess, it's not the actual sound that has hurt the animal to the extent that it will do virtually anything to escape. Rather, it is the associated stimulus.

Taking thunder as an example, the first time this noise was encountered it may have been associated with dramatic changes in lighting but also the presence of humans. The majority of phobic dogs have been 'comforted' during an episode of the fear-eliciting stimulus and so have been rewarded for their fearful response.

Treatment. Breaking down these associations can be done by flooding, habituation or counter-conditioning. Flooding, as the name suggests, is a process of saturation where the dog is exposed to a concentrated form of the challenge in the hope that it will learn to cope. An example would be taking a gun-shy dog out and tying it up to a tree and leaving it to experience a really busy day of duck shooting. Then taking it home when it had 'sorted itself out' and expecting it to behave completely passively the next time you took it out to work on a shoot. As you may have worked out, this approach is outdated and probably inhumane.

Habituation is a better version of the same thing, and involves the dog living with unaffected companions and being played quiet tapes of the sound of gun-fire. Systematic desensitisation is achieved by slowly increasing the volume. Once the dog exhibits no response to the sound at a certain level, the volume can be very gradually increased. If the panic response is shown then one can presume that the step being taken was too large.

Counter-conditioning would involve the dog being given a liver treat every time it heard the sound. Obviously, the dog's need to stick around for the reward would have to outweigh its need to escape and, in this instance, we would have to be talking about a very hungry dog. However, there is no reason that habituation could not be combined with counter-conditioning, so that the dog begins to look forward to quiet versions of the noise as a prelude to a treat.

The use of anxiolytic drugs has a place in therapy only if they allow learning to occur. This is not possible when the dog has been given valium, for instance.

Food aggression

This can lead to appalling injuries if the human recipient is a toddler who happened to have walked too close to the food bowl.

Treatment. Effective strategies should involve making the food less worth guarding and should be attempted in combination with a general rank-reduction program. It is equally important to break down previous associations that may have built up over time by moving the feeding site and changing to a really bland diet, e.g., mutton and rice or a complete dried diet. To teach the dog that when you are taking the bowl away is actually to its advantage, start feeding the dog at head height so that you do not have to lower yourself into its personal space to retrieve the bowl. Have two identical bowls the first containing just a spoonful of food, the second containing two spoonfuls. An accomplice is required to top up the bowls as they are partially emptied while the dog is feeding from them. The sight of the second bowl should accompany the handling and subsequent removal of the first.

House-training problems

Fundamentally, housetraining a pup has to be a process that makes him actively want to empty his bladder and bowels outside. This means that he must know what praise is and that indoor elimination is not praiseworthy. He must also know that he must be outside when he is likely to eliminate and that his owner must be present to praise him when the event occurs. Failure to achieve this ideal is compounded by the fact that scent from previous eliminations tends to encourage voiding in the same sites. The temptation to leave a pup out in the garden to do its own thing is an invitation to problems in later life, since the pup cannot be praised for getting it right if the owner is absent and the isolation of the garden makes it an aversive rather than an inviting place in which to off-load. The pup will often spend all its time loafing outside the door in a bid to be reunited with its pack.

Training in established cases of adults that soil indoors often necessitates the introduction of an indoor kennel or den. Since one of the earliest behavioural traits in a young pup is to crawl away from its sleeping area to evacuate, the dog will be unwilling to make a mess near its nest, the kennel. Once it can go overnight without making a mess, the pen facility it lives in can be extended until the dog is eventually living in the entire room. During any attempts to re-educate a dog with this sort of problem, it should be receiving a great deal of exercise and it should certainly be accompanied on its missions outside last thing at night.

Barking

Dogs bark for numerous reasons, including out of excitement, distress when left, stereotypic response and territorial defence. History-taking should be designed to identify the most likely of these motivations and therapy should be designed to meet the behavioural needs they point toward. For an excellent approach to the barking dog check out:
http://www.apbc.org.uk/ARTICLE1.html

Food stealing

This activity can have dangerous repercussions for the dog if it is ever exposed to baited food, or considerable amounts of fat, chocolate or cooked onions. Training around food can teach the dog to eat only when told to (Food refusal training). Meanwhile, the booby-trapping of items that have not been given will tend to punish uninvited investigation. Booby-trapping can include taste-deterrents and even cap-gun detonators if the dog is particularly bold and has no history of heart problems.

Coprophagia

The cause of this behaviour could be purely attention seeking, or it could indicate a dietary deficiency (cat poo is high in protein). The solution is to lace the turds with chilli or mustard, or booby trap them with spring-loaded caps under cardboard. If the dog eats its own rather than other animals' faeces there are techniques that seem to increase the repugnance of digested food. Add some pineapple chunks to the food - these taste terrible to dogs after they have been digested. Dosing with

cythioate, a systemic flea treatment, has the same effect.

Car travel

There are several problems that arise with car travel. Barking has territorial components that can be difficult to treat because overexcitement linked to the car is often the precursor to the reward of a walk in the park. This is similar to the reward offered by the postman, who reliably walks away after the dog has barked at him. A process of extinction is called for whereby trips in the car become shorter and much more boring.

If the dog is fearful in the car, don't comfort (i.e. reward) it when it shows fear.

To accustom the dog to travel in a separate part of the vehicle to humans, e.g. behind a dog-guard, feed the dog in this part of the vehicle when it is stationary. When the dog is accustomed to that, start feeding in the vehicle after short journeys. When the dog responds to being in the car without showing fear, you can begin to make the journeys longer and longer.

Car sickness is often linked to fear so the approach will be the same as we have just discussed.

Stereotypies in dogs

These include barking, tail-chasing, especially in Bull Terriers, Staffordshire Bull Terriers and German Shepherd Dogs, flank-sucking, especially in Dobermans, acral lick dermatitis (lick granuloma), especially in Labradors and Golden Retrievers. Bear in mind that environmental factors can lead to these behaviours. Therefore, look for and rectify any attention-seeking components in tail-chasing and the role of boredom in lick granuloma cases.

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CHAPTER 8: PETS IN SOCIETY

This chapter discusses the role of pets in society and then looks at the veterinarian-client-pet relationship. It also comments on the importance of taking a good behavioural history and the steps involved.

In our society we often need the companionship of other animals, so a pet is a natural part of many households. One in seven Australian families owns one or more birds, hundreds of thousands of children and adults keep guinea pigs, rabbits, white mice, fish or more unusual pets such as snakes. Also more than 1.5 million dogs and well over 1.5 million cats are kept as pets. The main reason given by 60% of pet owners for owning the pet was 'companionship' (Petcare Information and Advisory Service 1976). Perhaps some of the reasons for human attachment to pet dogs may be related to two prominent qualities of many dogs:

(i) their ability to offer love and tactile reassurance without criticism;

(ii) their dependence, which may stimulate our natural tendency to offer support and protection (Corson et al., 1975).

The factors we will look at are:

1. Importance of pets to children

2. Importance of pets to family life

3. Importance of pets to the elderly

4. Problems for pet owners

5. Responsible pet ownership

IMPORTANCE OF PETS TO CHILDREN

The child's pet is an aid to the child's physical, social and emotional development. Owning a pet can help the child face and meet many situations throughout his/her childhood:

1. provides company

2. can help a child to feel worthwhile when everything has gone wrong

3. develops a sense of caring and responsibility to another animal

4. gives the child first-hand knowledge of animals and exposes him to experiences of mating, parturition, care by mother

5. teaches sharing, communication; children may learn to love by cuddling an animal

6. it may also give the child a sense of importance within the child's peer group (Petcare, 1976; Levinson, 1968).

Children are sometimes deliberately, or accidentally, cruel to pets. Veterinarians sometimes see this problem and feel that some of the blame rests with irresponsible parents, who often feel that phases of antisocial behaviour may pass more quickly if the child has a scapegoat.

As well as the advantages a pet gives to normal children, the handicapped child might receive extra advantages, e.g.,

a. extension of the range and quality of his/her social relationships

b. an aid to settling into a new environment

c. a softening of the harshness of his/her reality, especially where the atmosphere has institutional overtones. In some institutes for the handicapped the clinical and teaching staff use pets as part of therapy (Petcare, 1976).

Migrant children, who may have difficulty in communicating, can use their pets as an emotional outlet, as companions, and also as a topic of conversation at school.

So for children, pets may aid their emotional and social development, provide a companion, friend and confidant. They can also introduce a child to the more adult emotions concerned with love, separation and death.

IMPORTANCE OF PETS TO FAMILY LIFE

Interviews with sociologists, social workers, and pet owners suggest that in our modern, high pressure society, pets are important in a family for companionship, protection, strengthening group identification or as a substitute for unfulfilling interpersonal relationships.

Companionship

Eighty eight per cent of cat owners state companionship as the main reason for having the pet. In the case of dog owners, 48% state companionship; 33% companionship and protection; 5% companionship and work (Petcare, 1976).

Protection

Only 3% of pet owners state that protection is a major function of their pet and 29% say it is onlya secondary function.

Strengthening group identification

Pets may help keep a family together either as a safe topic of conversation or as something several family members can work on without dispute.

Substitutes for unfulfilling interpersonal relationships

This can often apply to an elderly person or a person within a family that fails to meet their basic emotional needs.

In a childless household pets may be a child substitute. A Melbourne survey showed 30-40% of people said their dog was a child to them (Salmon, 1980). Family responsibility for the pet is usually taken by the head of the household who meets all costs associated with pet ownership in 91% of households even if the head is not the owner of the pet. Most pet owners (94%) do not consider pets a financial burden.

IMPORTANCE OF PETS TO THE ELDERLY

The elderly, especially those on fixed incomes, often find it difficult to keep up with inflation and the rate of change in the urban environment. Often a pet will be their only security and emotional buffer, as everything

around them changes (Petcare, 1976). So their pets fill needs for esteem, social needs and often safety needs. The loss of a pet can be a serious upset and in many cases old people die soon after losing a pet.

An interesting study (Mugford and McComisky, 1975) looked at the possible therapeutic role of animal companionship for old people. The experiment was set out as follows:

1. 12 old people (average age 75 years) were given a budgerigar to look after
   a. six of these people had a TV set
   b. six had no TV set

2. 12 old people (average age 76 years) were given a begonia (a pot plant)
   a. six had a TV set
   b. six had no TV set

3. Six people were selected as the control group
   a. three had a TV set
   b. three had no TV set

A comprehensive survey of these people was carried out using a questionnaire which was concerned with attitudes towards other people and self esteem. The begonias and budgerigars were unconditional gifts to selected people and the study went over five months, when another questionnaire was used. Some of the subjects had moved or died, but the results showed some interesting points:

1. TV had no effect on questionnaire responses.

2. The ownership of a budgerigar produced a significant difference from the control and begonia groups. The self-awareness showed that the 'budgerigar' people had become more socially aware and they generated more social contacts. The birds gave them something to care for and to talk about.

The results of this study show how important a pet can be to its elderly owner. This puts a special responsibility onto the veterinarian to minister sympathetically and expertly to the needs of both client and pet.

The use of pets in treating the mentally ill is becoming common. Pets can be used in residential treatment centres or in the home. Levinson (1968) has used this technique with children who are afraid of human contact because they have been hurt so much and so frequently. It requires careful preparation if used in a family situation and the choice of a suitable pet that responds quickly and enthusiastically to a child's timid approach is essential.

PROBLEMS FOR PET OWNERS

Accommodation may be a problem for the aged and the poor. Public housing tends to give low priority to the problems of accommodating pets. Legislation is being considered at the moment in America to try to overcome this problem (Bustad, 1980) and Australia may eventually have some provision also. When elderly pet owners go to a home there is usually a 'no pets' rule. This often deprives them of a loyal friend. Usually people in these homes have resigned themselves to the loss of the pet before they enter the home.

Unplanned litters of young can be another problem and a survey showed that the pets of 22% of dog owners and 28% of cat owners had unplanned litters and only a very small proportion euthanased the resulting pups or kittens (Petcare, 1976).

RESPONSIBLE PET OWNERSHIP

Unless owners are responsible for their pet's behaviour, society can suffer in many ways:

1. Damage to property and wildlife can occur if dogs are free ranging. Gardens can be dug up, bins of garbage upset, stock lost in semi-rural areas, e.g., sheep, poultry, calves.

2. Unwanted litters can cause uncontrolled population growth which may lead to increased zoonoses (i.e., diseases transmitted from animals to man). Fortunately, Australia is free from rabies, which is carried by infected dogs.

Some of the more common zoonoses are ringworm, leptospitosis, dog round worm, hydatids and toxoplasmosis which is carried by cats and is a potential hazard to pregnant women.

3. Cat and dog bites.

4. Road traffic accidents caused by, or involving pets.

5. Pollution - this can be caused by noise, smell of excreta, fouling of public places.

6. Interpersonal friction between members of a family over whose responsibility the pet is and also between neighbours if a pet is a nuisance.

The solution to these problems is often difficult and the veterinarian can help in educating people to be responsible for their pets. Responsible pet ownership is something to be carefully considered, not impulsively and carelessly assumed (Joshua, 1975).

THE VETERINARIAN–CLIENT–PET–RELATIONSHIP

Besides educating owners to be responsible for their pets, the veterinarian has other functions. No longer can veterinarians limit themselves solely to looking after the physical health of the family pet. They must be aware of the complex dynamics of the interplay of personalities between pets and their families (Levinson, 1968). The veterinarian may be asked to advise on the suitability of getting rid of an old pet, when a young child may be specially attached to it.

Another area in which the veterinarian may be asked to advise is in the choice of an animal for a family pet. The veterinarian must bear in mind the functions of a pet:

1. companionship
2. something to care for and touch
3. something to keep one busy
4. as a focus of attention
5. to give the owner exercise and protection.

Almost any animal can serve the first four functions, but a dog is the usual pet to satisfy the last function. The veterinarian should be able to help the client make decisions about the type of dog best suited to his special needs. Large breeds are expensive to maintain and controling them requires physical strength. Space is another consideration. Also large dogs are often inap-

propriate for old people.

Building up a good veterinarian–client–pet relationship is important and often simple measures can aid this process. Clear communication of information and fees, asking permission to muzzle, clip, etc., knowing the breeds, and setting up a practice to consider the working schedules of the families in the area are important factors.

A recent study in Brisbane, Australia (Chamala and Crouch, 1981) showed that clients felt that knowledge, compassion for animals, professional approach (listening and explaining during consultation) and regard for owners and their feelings were the major qualities of a 'good veterinarian'.

HISTORY TAKING AND BEHAVIOURAL PROBLEMS IN PETS

Each veterinarian who works with animals that have behavioural problems has a different approach. It takes a great deal of time to deal with such problems properly (see Beaver, 1981). There are four basic questions that should be asked:

1. ***What happens?***
The exact nature of the behaviour must be determined as well as why that behaviour disturbs the owner, e.g., does the cat scratch indiscriminately on any furniture or on a favourite piece? Does the dog growl only at certain people?

2. ***When did the behaviour start?***
Did it start with a specific event such as the introduction of a new animal into the household, a new baby, visitors? This may prove to be a coincidence, so care must be taken in interpreting this information. Also it is important to know for how long the behaviour has occurred.

3. ***When does the behaviour occur?***
This means also how often, is it regular, is it erratic, can it be associated with an event?

4. ***Where does the behaviour occur?***
It may occur only in a certain location. Other questions will follow these main ones, and things like: remedies owner has tried, if any; did they have any effect; how does the owner feel about the pet? - all will be important.

It is important to determine if the behaviour is a normal one for the animal, and if the only thing that makes it a problem is that the owner does not like the behaviour, e.g., a cat or dog making loud grooming noises.

After considering the answers to the questions the veterinarian must determine how motivated the client is to work on the problem. Some solutions may take a prolonged treatment program requiring the client's careful co-operation. If the client is not willing to put in the effort there may not be a solution to the problem. Other clients may not be emotionally capable of following such a treatment program.

This area of behavioural problems in pet animals is becoming recognised as an important area for veterinary involvement.

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CHAPTER 9: THE BEHAVIOUR AND MANAGEMENT OF PEST SPECIES

Before we can discuss the behaviour and management of pest species, we must formulate a definition of 'pest'. A pest is a troublesome or destructive animal; so a pest species can be defined as any animal that causes destruction or is a problem in an area.

Different species have very different potentials as pests. Some may become:
1. widespread, e.g., rabbit
2. localised, e.g., dingo, emu, donkeys, goats, pigs, various kangaroo species.

Often the pest species is a feral animal. Currently there is no standard definition that is accepted by all parties who are interested in this subject (Report on Feral Animals in the Northern Territory, referred to in this chapter as F.A.N.T., 1979). Feral means 'wild, untamed, uncultivated' (Oxford). Taken literally, feral animals would include:
1. native fauna, e.g., dingoes
2. introduced wild animals, e.g., rabbit, fox
3. feral livestock, e.g., buffalo, pigs, cattle, horses (brumbies) donkeys, camels, goats, cats, dogs.

In some states there is legislative declaration of pest status. For example, in NSW rabbits, feral pigs and wild dogs are proclaimed as Noxious Animals under the Pastures Protection Act, 1934, and the legislation requires landholders to control and destroy such pests. (Robards, 1986).

Recently, some writers have narrowed the term 'feral' to include only feral livestock. In certain localities any of the animals in the above three categories can be a pest.

Pests have a direct effect on man and his domestic animals. They can:

a. compete with domestic livestock for food and water;

b. carry exotic diseases. Also, the control of any introduced diseases could be hampered by wild herds or groups, acting as reservoirs for disease, e.g., foot and mouth, blue tongue, rinderpest;

c. damage man's crops (e.g., wild pigs) and fences;

d. contaminate water needed for stock;

e. have a deleterious effect on lambing percentages.

Management and control of pest species

There are several ways to control pest species. Reduction, control and elimination where possible, are the key factors, although elimination may be almost impossible. During the process of reduction and control of pest species they should be utilised to the maximum extent by:

1. bringing them back under domestication, if possible;

2. harvesting and converting them to useful products, unless this is quite impractical.

At the moment, the usual ways of attempts at control are being used: shooting, trapping, poisoning and fencing, but commercialisation has begun in some species, e.g., pigs, camels, kangaroos, goats. C.S.I.R.O. (Commonwealth Scientific Industrial Research Organisation) has an incentive scheme for export development and the Northern Territory is fostering an ox and buffalo market in S.E. Asia and the Middle East.

However, once a pest species is a commercial asset, it becomes 'farmed' and will not be eradicated. There are many factors to consider in the harvesting and using of wild animals:

1. moral aspects of the conservationist, who fears extinction of native species;

2. aesthetic aspects - people do not like seeing animals hunted, e.g. deer, rabbits, and kangaroos. Cultural traditions provide each society with a set 'table of animal values' and in our society snakes, wolves, foxes and bats are judged to be ferocious, cunning and dangerous. On the other hand, deer, rabbits and seals are spoken of as gentle and sweet. Like all prejudices, fixed ideas about animals tend to be accepted as truth (Cohen, 1978).

3. sporting aspect - the hunting and trapping of animals for sport is opposed by some groups of people;

4. commercial aspect.

Before effective control measures can be taken of any pest species, an estimation of population size and localities where they are found to be causing problems is needed. The localities of the Australian pest species have been mapped but an accurate estimation of population is more difficult.

Population size depends on:

a. births and deaths;

b. immigration and emigration.

There are several methods used to estimate the population, and these include:
1. a direct count of all animals present in an area. This is very difficult, especially in a wooded area.
2. sample counts, which can be done by aerial counts or shooters' counts. This can be done at different times of the year but is expensive and inaccurate.
3. indirect counting. This can include counting faecal pellets in an area and estimating the number of pellets per animal. The number of pellets produced by any animal can be influenced by age, sex and diet, so it is an inaccurate method. Another method is to count the number of animal calls (e.g., bird calls) within a certain locality.
4. trapping. Animals can be trapped, counted and marked, then released and later retrapped.
Using the formula:

$$\frac{\text{number of marked animals trapped}}{\text{total number trapped}} = \frac{\text{total marked}}{\text{population size (N)}}$$

$$\text{e.g.} \quad \frac{5}{35} = \frac{20}{N}$$

Therefore, N = 140 = population size. However, there

are several problems using this method:
1. one must assume all animals are equally trappable;
2. one can get animals that are 'trap-happy' and get caught many times, or the animals that learn to avoid traps.

It can be seen that estimation of a population is a difficult problem. Apart from the estimation of population, an understanding of the pest animal's behaviour (which includes reproductive behaviour) is needed before effective controls can be implemented.

The National Feral Animal Control Program (NFACP) is a program put in place by the Commonwealth Government with the specific aim of reducing the impact of feral animals. It is funded by the National Heritage Trust program and managed by Environment Australia and the Bureau of Rural Sciences. The program aims to develop and implement projects to reduce the impact of feral animal pests on native species and the natural environment. It also deals with agricultural damage caused by feral animals. (Environment Australia 5/9/2001a)

BEHAVIOUR OF PEST SPECIES AND SOME CONTROL METHODS

The following pest species will be discussed:

1. Feral pigs
2. Dingoes and feral dogs
3. Feral goats
4. Feral donkeys
5. Kangaroo species
6. Rabbits

FERAL PIGS

Feral pigs (***Sus scrofa***) are now in such numbers, and are creating such havoc in the rural industry that they rival dingoes as a major pest. In Queensland alone the population is estimated to be between 1.6 million and 2.3 million (Courier Mail Report 4.3.82).

More recent estimates put the probable population size in Australia between 3.5 and 25 million (Mason and Fleming, 1999).

They are found through Queensland, New South Wales, the Northern Territory and parts of Western Australia, usually along the watercourses. The colonies derive from domesticated stock brought in as a food source for settlers. Some of these subsequently escaped or were deliberately let go (F.A.N.T., 1979).

There are two types of feral pigs derived from European breeds, e.g. Saddlebacks, Tamworths and Large Whites, and the Chinese or Asian type, with horizontal stripes and a ruff on the neck. The total number of feral pigs is unknown throughout Australia and there is a need for an accurate estimate.

Feral pigs are found from western Victoria, through New South Wales into Queensland; and across northern Australia from Cape York in the east to the Kimberley region in the west (Environment Australia. www.ea,gov.au/biodiversitv)

Feral pigs are simultaneously perceived as a vector of diseases that could cause a potential national disaster (*In terms of exotic disease) by some, and as an export commodity and hunting asset by others (O'Brien, 1996).

Habitat

Generally pigs tend to concentrate near watercourses and billabongs, but during the wet season they range further through the open forest country. Because they are water-dependent there can be huge die-offs in time of drought (Squires, 1981).

Feral pigs are highly mobile and non-territorial. (O'Brien 1986).

Behaviour

1. The pig is omnivorous, with a diet ranging from roots, grass and the shoots and leaves of edible species such as Pandanus palm, to the dead carcasses of animals. It predates on fauna when the opportunity arises (F.A.N.T. 1979).

2. Its rooting habits can cause holes which provide hazards to vehicles and horsemen, as well as destroying whole pastures. The pig's habit of wallowing and rooting around the edges of watercourses and swamps destroys the vegetation that prevents erosion and provides food and nesting sites for native wildlife. (Environment Australia 5/9/2001b)

3. Breeding - pigs are prolific breeders capable of two litters per year so that they can rapidly colonise an area, even after partial eradication. A four-year study showed there was no seasonal pattern of breeding (Giles, 1978a). Young sows commence breeding at between 6-12 months of age, providing live weight exceeds about 30 kg. Mean litter size of sows shot in New South Wales, who were eight months or older, was 6.29 (Giles, 1978b). Sows often exhibit an infertile oestrus after farrowing, but lactating sows can be successfully rebred. A fertile heat occurs after weaning (Graves 1984). Several males may mate with one female. This may play a large factor in genetic variability of pigs, especially when oestrus is synchronised (Delcroix, Mauget and Signoret, 1990).

4. The feral pig has learnt to stand still and drop into the grass, making it difficult to see. It moves and feeds in the evening and early morning which adds to the difficulties of control.

5. Problems caused by pigs include damage to fences, bores, roads, pastures; the killing of lambs and predation on fauna. Wilson and O'Brien (1989) suggested that in the event of Foot and Mouth Disease epizootic in Australia, feral pigs may act as a major amplifying host for the disease. In its initial year, a Foot and Mouth Disease outbreak could cost Australia about $5 billion in lost export revenue.

Piglets are prone to a high mortality rate, depending on food supplies and weather conditions.

Sows (female pigs) will aggressively protect their young from any threat.

Feral pigs are highly mobile and non-territorial (O'Brien, 1986).

Feral pigs kill and eat up to 40 per cent of lambs born in some areas, costing the sheep industry millions of dollars each year (Environment Australia, www.ea.gov.au/biodiversity

In addition to the direct losses associated with predation, there are indirect losses to sheep farmers, including decreased production as a result of harassment, increased of mis-mothering, and a decreased rate of genetic gain (O'Brien, 1986).

Control measures

• The dependence of the feral pig on water means some control measures will succeed by poisoning around water holes.

• Poisoning is most commonly carried out by the compound 1080 (sodium monofluroacetate) in grain. It is the only toxin recommended for use by the NSW Department of Agriculture. There are some disadvantages of this compound: it is highly toxic to canids; there is no antidote; and it is relatively quick acting and may result in bait shyness. It causes frequent vomiting in feral pigs. Equally important, mortality after poisoning has been unacceptably low in some field situations (O'Brien 1986).

• Alternatives may include anticoagulants, for example Warfarin, which is highly toxic and acceptable to feral pigs, relatively slow acting and there is an effective antidote (O'Brien 1986).

• When accessibility is limited, poisoning may be possible by utilizing aircraft to distribute the baits (Mitchell 1998).

• Trapping, shooting and baiting pressures could be increased in known problem areas.

• More intensive campaigns, of say 2 months' duration, towards the end of each dry season, involve station cooperation and all available techniques (F.A.N.T., 1979).

• Commercialisation, to sell feral pig meat to the European market has already commenced in Queensland.

• In 1990, Australia exported in excess of 1500 tonnes of wild pig meat to European countries (Environment Australia 5/9/2001b).

• Hunting dogs were successful on 88% of occasions of catching and cornering solitary pigs when encountered (Caley and Ottley 1995).

• The 'Judas goat' method can be adapted for use with pigs (McIlroy and Gifford 1997).

Control is an enormous problem which involves high cost and is likely to need very well organised campaigns as feral pig populations can increase at 80 to 110 per cent per annum, depending on the area and seasonal conditions. (Environment Australia 5/9/2001b)

DINGOES AND WILD DOGS

The dingo (***Canis familiaris dingo***) is the main carnivorous species affecting sheep and cattle. Many are hybrids with red kelpie and blue heeler. The dingo population extends over very wide areas; in Victoria and New South Wales it is confined to the eastern portion of the states; and in Queensland dingoes occur towards the periphery of the sheep country that extends in a broad tongue up through the centre of the state. In South Australia, Western Australia and the Northern Territory dingoes occur throughout the low-rainfall country, and they extend into the high-rainfall country in the north (Fennessy, 1970). In Queensland and South Australia, areas 'outside' the dingo barrier fence have the highest densities of wild dogs/dingoes (Fleming and Robinson, 1986).

Behaviour

1. Carnivorous, and will gang up to kill calves, sheep and kangaroos. The type of prey available, the relative abundance of the various species of prey and the nature of the environment (stable and fluctuating) influence the foraging strategies of dingoes (Thomson, P.C. 1992b).

2. Breeding. There is a well-defined seasonal reproductive cycle in both male and female dingoes. Bitches breed once a year and mating takes place between April and June;e males produce very few sperm in summer (Newsome et al., 1973). Gestation is about 63 days and there may be four to six pups in a litter. They can live for eight to 10 years but many die younger. Alloparental behaviour is exhibited in which both parents regurgitate food for pups. Pack members may also provide for bitches confined to the den with very young pups. (Thomson, P.C. 1992a)

In undisturbed social groups usually only the dominant female's pups are raised each year. When group hierarchies are disrupted, for example, by control measures, more females raise litters, leading to increased numbers of juvenile dingoes (Thomson, 2000).

3. Movements are generally quite localised, within a 7 km range, with the furthest observed about 34 km (Newsome et al., 1973). There are two patterns of movement: a reconnaissance pattern, which takes in visits to scent posts, and maintains communication between animals; and a hunting pattern, which is a zigzag pattern (Figure 9.1, Sheehan, personal communication). Dingoes are equally active day and night, spending about nine hours resting and 15 hours active. Packs will move within their territories in response to movements of their prey (Ballard et al. 1987).

4. Problems caused by dingoes include: damage to sheep, cattle and other fauna, carrying disease (especially distemper and an array of parasites e.g. hydatids).

5. Some livestock producers consider wild dogs to be beneficial as wild dog predation may control macropod populations and hence reduce competition for herbage between macropods and cattle (Fleming and Robinson 1986).

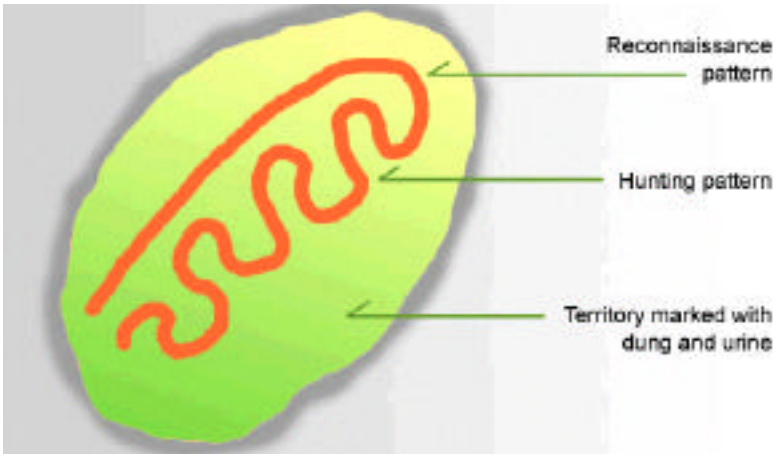

Figure 9.1: Patterns of movement of a dingo in Queensland.

6. Dingo predation has had a significant effect on feral pig populations in Queensland (Woodall 1983).

Macropods are dominant in the diet of dingoes, domestic livestock comprising only a small proportion of their food intake. However, the activities of wild dogs/dingoes are not restricted to killing to satiate hunger and most stock kills are not consumed (Flemning and Robinson, 1986).

Stomach analyses of dingoes have revealed diets containing insects, carrion, rabbits and some relatively rare native species (Thomson. 2000)

Other direct costs of predation by dingoes include dog-proof fence erection and maintenance, veterinary costs for injured stock, and control costs, particularly labour (Fleming and Robinson, 1986).

Dingoes are highly sociable animals. They live in a well-defined home range in groups of 2–10 or more, but members of the group are seldom seen together at any one time. Most of the time they form small, flexible sub-groups (Thomson, 2000).

Dingoes usually attack rams from the rear, most probably to avoid the ram's horns, which are used for defence. Sometimes the testicles are bitten off live rams (Thomson, 2000).

Control measures

• With poison, using the sodium salt 1080.

• Shooting and trapping.

In the regions of Australia where eradication has been accomplished, this has been primarily due to the pressure of settlement and has first involved erecting a dog-proof fence and then killing the dingoes inside the fence by trapping, shooting or poisoning. In 1954, a dingo fence was built in Queensland, 6,000 km long and 1.85 m (6 ft) high, around the sheep area but it is costly to maintain.

The steel-jawed leg trap is also used, especially when dealing with dogs that will not take baits and in areas in which baits are not permitted (Fleming and Robinson 1986).

A number of ecological and social issues complicate the task of dingo control, including the conservation of pure dingoes and non-target wildlife species, problems associated with hybridisation, and conflicts of interest caused by the proximity of agricultural land to National Parks and vacant Crown land (Fleming and Robinson, 1986). The aim of dingo control is to prevent livestock losses rather than to eliminate all dingoes. This can be achieved by creating a dingo-free 'buffer' zone between grazing land and dingo populations (Fleming and Robinson, 1986).

FERAL GOATS

The goat (***Capra hircus***) was introduced to arid areas as a source of fresh milk and meat in homesteads and mining camps. Feral herds are now established in Western Australia, Queensland and western New South Wales and in the Flinders Ranges of South Australia. There are no permanent colonies in the Northern Territory mainland but some of the off-shore islands have colonies.

Behaviour

1. Animals graze off green shoots and most non-woody dry material for about 1.5 m (5 ft) above ground level. They are selective grazers.

2. Breeding. The female feral goat gives birth in isolation in a secluded spot, selected before parturition. Twinning is common (52%) but 1-5 kids may be born. Breeding occurs throughout the year providing that favourable nutritional conditions prevail. Male goats exhibit urine marking, resulting in the synchronising of oestrus among females. Males court females with a series of increasing contact patterns culminating in copulation. Dominance relationships between males are strongly exhibited in the wild, where an individual's social rank is determined by horn size, age, weight and behaviour (Shackleton and Shank 1984).

3. Feral goats show a strong inclination to home range, with males moving over several home ranges of the more restricted female. Female kids tend to adopt the home range of their mothers but males move away at weaning (Harrington, 1982). Furthermore, studies of movements showed that feral goats would move out of their home range, sometimes by over 100 km, and while this seemed to be prompted by low nutrition or lack of water in some cases, in others the reason was not apparent.

These characteristics make feral goats almost impossible to control because it is considered uneconomical to maintain the standard of fences required to restrain them or to keep out wild bucks (Harrington, 1982).

4. Problems caused by feral goats include a disease risk, damage to vegetation, competition for food with sheep and cattle, competition with native animals for food and shelter, and accelerated soil erosion.

Australia has an estimated 2.6 million feral goats, distributed in all states and territories, except the Northern Territory (Parkes, Henzell and Pickles, 1996).

Estimates of goat densities range from two (average density in all states during the early 1990s) to five (estimate in more preferred habitats) per square kilometre. At these densities feral goats would be contributing from 10% to 25% of the total pressure on sustainable grazing (Parkes el al., 1996).

Feral goat populations survived and proliferated in many environments for reasons such as high levels of fecundity, lack of predators, freedom from disease, high mobility, and diverse diet (Henzell, 1992).

Feral goats could facilitate the spread of exotic diseases (such as foot-and-mouth disease) should such diseases enter Australia.

Feral goats can carry many internal and external parasites, some of which (e.g., foot rot) can affect sheep.

Goats become sexually mature at an early age and have a gestation period of 150 days, so feral goats are able to produce up to two litters per year.

Control measures

• Shooting is the main means of control.

• Commercialisation has the potential for up-grading feral goats to become good cashmere producers. Also, female feral goats are greatly in demand for up-grading to Angora bucks. However, the bulk of feral goats are exported as carcasses.

• Trappers operate by erecting traps around the watering points that are used when mustering the animals (Axford, G 1/8/2001).

• The dingo can adequately control feral goats in some areas. In the eastern rangelands, goats can shelter around steep rocky outcrops giving them protection from dingo attack. In pastoral regions, dingoes are heavily controlled by pastoralists or have been removed (Environment Australia 5/9/2001c).

The feral goat has not been eradicated from any extensive mainland environment in Australia. Eradication from island habitats, however, has been successfully achieved in Australia (Allen and Lee, 1995).

Complete removal or feral goats from Australia is well beyond the capacity of available techniques and resources because the species is well-established across a vast area (Environment Australia, 1999a).

Although mustering feral goats for slaughter or live sale is labour-intensive and limited to relatively flat terrain, it is worthwhile, especially when goat densities are high (Harrington, 1982b).

The success of mustering in reducing the population can vary greatly, with reduction rates of 26% to 80% having been reported (Henzell, 1984).

Trapping groups of goats around watering, points can be an effective and efficient control technique and is most effective during dry periods when goats are obliged to find water and there is limited access to alternative water sources (Harrington, 1982b). However, some-concerns have been expressed about the use of traps at water points and the potential deleterious impacts on non-target species and animal welfare (Environment Australia, 1999a).

Fences will not permanently stop the movement of all goats and should, therefore, be used only as a tactical technique in a management program (Parkes, 1990). Fencing is also expensive to establish.

Ground-based shooting is not commonly used as a control strategy for feral goats in the pastoral areas of Australia due to its labour-intensity and its variable efficiency. However, volunteer shooters have been successfully used to conduct ground shooting (Environment Australia, 1999a).

Aerial shootings are used to control inaccessible populations, manage low-density populations or remove survivors from other control campaigns (Parkes et al., 1996). This method is costly, but allows difficult terrain to be covered quickly and gives culling rates far in excess of other control methods (Lim, Sheppard, Smith and Smith, 1992).

The 'Judas goat' technique involves attaching a radio collar to a feral goat and releasing it in the expectation that it willl meet up with other goats. The goat is then tracked down and the herd it has joined is killed. 'Judas goats' are generally used where there is a low-density population or to locate survivors of other control programs. However, this technique is expensive as it requires costly equipment and skilled staff (Parkes et al., 1996).

The only poison that has been trialed for feral goat control is 1080 (sodium monofluoroacetate). The main risk of this technique is the consumption of baits by non-target species.

Three baiting techniques have been reported: pelletised grain bait (Forsyth and Parkes, 1995); foliage baiting (Parkes., 1983); and poisoning of a water supply (Norbury, 1993). The poisoning of the water supply was the only technique that was successful in Australia.

FERAL DONKEYS

NB These animals are no longer regarded as pests

Feral donkeys were introduced for draught animals during the early exploration and settlement of much of inland Australia and in the Northern Territory.

Habitat

They favour river frontages, where forage types are more varied and water is more often available. However, to avoid man who is their only predator, donkeys often retreat to broken, rocky hill country (F.A.N.T., 1979).

Behaviour

1. Donkeys are gregarious and tend to cluster in large

mobs. They are adept at digging for soakage water in dry stream beds and will apparently drink saltier water than horses or cattle.

2. They eat any plant that grows.

3. A study of the Victoria River, Kimberley area (McCoot et al., 1981) it was noted that donkeys walk along well-defined pads radiating from waterholes. When shot at, they flee along these pads.

4. Jennies (females) were found in groups of up to 15, accompanied by their foals and a mature jack (male). Most males were found in bachelor groups of up to 10 but a few were solitary. The family group male was the leader of the group and if the jennies were shot, the jack brayed toward the shooters and then led the remnants of the group away.

5 Breeding has a marked seasonality and over 50% of conceptions occurred before the onset of the wet season. Reproductive rate was high.

Control measures

The economics of harvesting donkeys for pet-meat are tenuous due to the rugged country causing extensive damage and limited access to freezer facilities (McCoot et al., 1981). It is suggested that Northern Territory pastoralists be granted a subsidy on ammunition used in the control of feral animals. Optimal impact would be achieved by ammunition provision accompanied by organised 'donkey drives' over large areas, perhaps using helicopters. Water-traps can also be useful in less-favoured areas (McCoot et al., 1981).

KANGAROOS

There are four major kangaroo species in the inland that might become problems in areas at some times. These are the grey kangaroo (two species eastern and western greys), the red kangaroo and the hill kangaroo or euro (Squires, 1981). There are conflicting views about kangaroos; many farmers regard them as direct and serious competitors with their stock and insist that numbers be reduced. Some people feel they should be harvested for meat and furs, and others feel they should be protected because they are unique to Australia. Discussions on these views are complicated by there being several species of kangaroos (Fennessy, 1970).

*Euro (***Macropus robustus*)

The euro occurs in pest numbers in the north-west of Western Australia. They are found in rocky hills and ranges and, being sedentary, are vulnerable to shooting. Studies have shown that they are not in direct competition with stock all the time, and in areas where the euro population increased it was due to the sheep eating out the original pasture and it being replaced by spinifex species which euros eat but sheep find unpalatable (Fennessy, 1970).

*Red Kangaroo (***Megalteia rufa*)

This kangaroo lives in the open plains, grassland and lightly timbered country, characteristic of the arid and semi-arid regions. It is the most mobile of the species and is in some danger of extinction as it is easy to shoot in its open habitat. It inhabits much of the inland sheep area and competes with sheep for living space and food in some areas of western New South Wales and south-west Queensland (Fennessy, 1970; Squires, 1981).

Grey Kangaroo (eastern grey, **Macropus giganteus***; western grey,* **M. fuliginosus***)*

There are two species, one in eastern Australia and the other throughout southern to western Australia. Their distributions overlap in western Victoria and southwestern New South Wales, and they are regarded as pests in Queensland, and are locally troublesome in New South Wales, Victoria and Western Australia. Grey kangaroos favour coastal forests and denser inland scrubs; they feed on open plains within range of suitable forest shelter (Fennessy, 1970).

Problems

The most important factor is the possible competition between livestock and kangaroos grazing the same area. When food is readily available they rarely compete directly, because although sheep and kangaroos eat the same classes of plants, they often prefer different species in different proportions.

Control measures

In the areas where the kangaroo is thought to be a pest, shooting is the usual control method used. Commercialisation of kangaroo meat and the skin industry has absorbed at least one million animals each year, in recent years. The kangaroos, almost entirely red and grey, were collected mainly in western New South Wales and southwestern Queensland (Fennessy, 1970).

The potential supply of kangaroo meat in Australia is 57,000 t/year. The total national production of regular meat (eg beef, lamb) in 1992–93, totalled 2,807,000 t. Therefore, the potential kangaroo meat supply amounts to only 4% of the total current red meat production (Hardman, 1996).

At a retail price of $6.00/kg, the potential value of kangaroo meat is approximately $340 million per year (Hardman, 1996).

The current situation in Queensland and most other states is that 75% of kangaroos are shot for their skin only, (carcases not utilised). The remaining 25% are shot mainly for pet food at a retail price of $0.85–$l.05/kg (Hardman, 1996).

RABBITS

Rabbits are found in the southern half of Australia and have never extended far north of the Tropic of Capricorn or to the subtropical coastal belt receiving summer rainfall. The mainland populations originated from a small shipment liberated in Victoria in the 1850s. The rapid spread and growth of the rabbit population caused per-

manent degradation of pastures, erosion and a marked reduction in stock-carrying capacity. Rabbits also ringbark and kill trees and dump subsoil on the surface.

One rabbit can consume 200-500g of vegetation nightly causing serious loss of ground cover, which leads to erosion as well as the loss of stock feed and seed supplies for future years. (Croft, D. 1/8/1998)

Damage by wild rabbits in Australia, including the annual cost of control and production losses, has been estimated at $600 million (Environment Australia 5/9/2001d).

The introduced European rabbit (***Oryctolagus cuniculus***) is one of the most widely distributed mammals in Australia. and, except for the house mouse, the most abundant (Williams, Parer, Coman, Burley and Braysher, 1995).

It is estimated that rabbits now inhabit an area of 4.5 million square kilometres or about 60% of Australia.

Rabbits breed in response to a combination of environmental factors, including an increase of green grass in their diet and cool temperatures.

Female rabbits become sexually mature at three to four months and can produce litters of four or five young every month.

The impact of rabbits on native animals and plants is becoming increasingly recognised and includes competition with many native animals for food and shelter, and damage to native vegetation through ringbarking, grazing and browsing.

The decline and extinction of many of Australia's terrestrial mammals that weigh between 35 and 5500 grams, particularly in the arid and semi-arid zones, was associated with the introduction of the rabbit (Calaby, 1969).

Rabbits/0.25ha	Sheep live-weights (kg)	Fat depths (mm)
0	44.9	1.7
6	45.4	1.8
12	42.0	1.2
18	41.6	0.8

Table 9.1: Mean sheep liveweights and fat depths for each of four rabbit densities (Croft, 1986).

Agricultural production losses due to rabbits in South Australia alone are estimated to be around $20 million each year (Environment Australia, 1999b).

The key to the success of the rabbit in Australia is the ‘warren’, which provides protection from weather and predators and enables rabbits to inhabit semi-arid and arid country (Williams et al., 1995).

There are indications of an inverse relationship between rabbit numbers and factors such as liveweight and fat depth of sheep (see Table 9.1).

Control measures

A combination of methods is used to control the rabbit:

• destroying warrens through ripping, ploughing, blasting and fumigating;

• poison baiting;

• shooting and hunting with dogs;

• releasing predators, for example, cats and foxes;

• rabbit-proof fencing;

• biological control, for example, myxomatosis and rabbit fleas (CSIRO 17/9/1996).

Myxomatosis was introduced in late 1950 after a long series of field trials, and was spread rapidly through the rabbit population by mosquitoes and sand flies. Within three years the population was reduced to 10-20% of its level before the spread of the disease (Fennessy, 1970). Poisoning, fumigation of burrows and destruction of warrens by ripping them up, and the use of steel traps and dogs are all control methods used to keep down the surviving rabbit population, which has become increasingly resistant to the myxoma virus.

The kill rate today is often less than 50 per cent, as rabbits have gained increasing resistance to the myxoma virus (CSIRO 17/9/1996).

In 1990 a team from the South Australian Animal and Plant Control Commission imported a new species of rabbit flea from Spain. The flea has been released into rangelands in South Australia, New South Wales, Queensland and the Northern Territory. The Commission anticipates that the flea will assist the spread of the myxoma virus in drier areas of the continent where mosquitoes are not present (CSIRO 17/9/1996).

Scientists believe that it is now possible to modify the myxoma virus to include genes that will prevent conception in rabbits. (CSIRO 17/9/1996)

Initial results of Myxomatosis were promising, with mortality rates well over 90% in rabbits that contracted the disease. Because some rabbits developed limited resistance to the disease, the virus currently affects no more than 60% of rabbits exposed (Environment Australia 1999b).

Eradication of rabbits on the mainland is not possible but there are effective ways to reduce rabbit numbers and to lessen the impacts of competition and land degradation on wildlife in significant areas (Environment Australia, 1999b).

Schedule 3 of the Commonwealth Endangered Species Protection Act 1992 requires the preparation and implementation of a threat abatement plan, and this was conducted in June 1999 by Environment Australia under the National Heritage Trust.

Rabbit Calicivirus Disease (RCD) was first noticed in China in 1984. In March 1995 field investigations began on Wardang Island, South Australia. In October 1995 the virus escaped onto the mainland, possibly as a result of windborne vectors (Cooke, 1996). It spreads through direct contact with other rabbits and does not need an insect to spread it (Environment Australia 5/9/2001d).

The rapid spread of RCD in Australia, more than 400 kilometers per month, suggests that windborne insect vectors may play an important role in its transmission in Australia (Cooke, 1996)

Little information has been published on mortality rates in wild rabbits, however, in South Australia mortal-

ity rates exceeding 95% were observed in populations not previously exposed to RCD (Cooke, 1996).

The Cooperative Research Centre for the Biological Control of Vertebrate Pest Populations is researching a method, called immunocontraception, to suppress the fertility of rabbits. It is possible that the contraceptive agent will eventually be spread using a genetically altered form of the Myxoma virus (Environment Australia, 1999b).

It appears that 60 to 80% of female rabbits would need to be prevented from breeding to achieve a sustained reduction in rabbit numbers (Williams and Twigg, 1996).

Control of pest species: Research

Apart from the control measures already mentioned, research is progressing on methods of biological control for various pest species.

1. Pest repellents and attractants: the use of pheromones as an attractant for insects has been successfully used. They are lured by the pheromone to mate with sterile insects.

2. Use of naturally occurring plants: for example, if wild ginger is ground and mixed with food, elk and captive deer reject it. By trial and error, plants can be extracted and tested with various species.

3. Introduction of a virus or bacterium that will affect only the pest species: this is how myxomatosis was used on the rabbit population, and while it was very successful in the early stages, gradually immunity towards the virus developed. It is also a method which requires exhaustive testing as it must be pest-specific.

4. Closer study of the target animal's life cycle and behaviour to find at which point control is maximised.

The control of pest species has great importance not only for individual farmers, but also for the economy of the country's primary industries.

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CHAPTER 10
WILD ANIMALS IN CAPTIVITY

Man's first efforts to keep wild animals in captivity date back to prehistoric times, and for many reasons humans are attracted to non-human animals.

The animals people expect to see in zoos are those they have learned about in books as children, and those seen in television specials. People will usually stop, at least momentarily, for

1. animals that beg

2. animals that are feeding

3. baby animals

4. animals that make sounds

5. animals that are mimicking human behaviour, or playing

They pay little or no attention to nesting, sleeping or hiding animals (Ludwig, 1981). Many people dislike zoos and many people enjoy them. Yearly, more than 100 million Americans visit zoos and people are fascinated by wildlife in captivity (Eaton, 1981).

In the past, some zoos paid little attention to the welfare of the animals, and some zoos today have poor environments for the animals. But zoos are undergoing a revolution that is providing better physical and social environments for animals. Progressive zoos are engaged in education, research and conservation, with the aim of maintaining healthy animals that behave in a natural way.

Hediger (1964) was the first person to document biological and ethological principles important for the welfare of captive animals in zoos. By understanding an animal's behaviour, facilities that cater for the animal's needs can be designed.

CATCHING AND MOVING ANIMALS

In Africa, the catching of large wild animals in sufficient numbers for stocking or restocking game farms, reserves and parks is a frequent occurrence. Many zoos today obtain stocks of animals bred in captivity, so the trauma of capture is no longer necessary, although the transport of animals will cause some stress.

Wherever possible, animals that need catching for movement or treatment in Safari Park-type animal reserves should be fed or driven into transporting crates. These methods can be used successfully, particularly for giraffes, elephants, and some of the antelope, as well as for cheetahs and young lions (Tennant and Chipperfield, 1972). The design of the buildings and enclosures in which the animals are kept contributes to the success of these methods. Funnel-shaped rails leading into a crush that the animals are used to are invaluable for loading animals like giraffes and antelope. Doors to houses for big cats should be of the sliding or trap kind to facilitate loading and unloading travelling crates.

Giraffes are usually moved in groups of two to seven in very large crates, and antelopes are usually crated individually. Male animals are never mixed because of the risk of fighting. Zebra should be crated individually. Many animals (elephants, rhinoceroses, hippopotamuses, lions, etc.) are more easily moved if they are immobilised or tranquillized and a dart gun may be necessary (Tennant and Chipperfield, 1972).

BEHAVIOURAL PRINCIPLES TO CONSIDER FOR THE MANAGEMENT OF CAGED ANIMALS (HEDIGER, 1964; BRAMBELL, 1972)

1. Space and environment

2. Food

3. Social structure and breeding requirements

4. Animal-man relationship

5. The effect of caging on behaviour

SPACE AND ENVIRONMENT

Good management should provide conditions that substitute beneficial factors which influence the species in the wild, and remove factors that have an adverse effect. It is not possible to give an animal an exact replica of its environment but animals have the ability to adapt to a wide range of conditions. For each particular stress factor each animal has a range – the Normal Adaptive Range – which it can tolerate and react to normally. The limits of this range vary for each animal, its age and sex, and are never precise. Outside these limits the animal becomes uncomfortable and at greater extremes it may become so stressed that it is susceptible to disease and injury and is unable to adapt. Death may eventually result.

The goal of a zookeeper is to provide an animal with an environment similar to its natural environment in which it can survive and reproduce. To do this, it is necessary to understand how a species occupies space in a natural state. There are some important questions to answer:

1. What is the geographical range of the species? There are definite limits to this range which may be physical (mountains, rivers, seas), or environmental (temperature, humidity, rainfall). These limits, in turn, determine the type of vegetation the animal inhabits and the food it eats.

2. In what local habitat does the animal live and how does it use its limbs to move about in this habitat?

3. Each species has its own territory or habitat, which supplies particular needs. This habitat may be occupied by more than one species using different parts of the habitat. Sometimes the same part is used by another species but at a different time. Leopards are cats that habitually lie up in trees, while many other carnivores and most ungulates live on the ground. Within the habitat is the living area for a family – and this contains the personal space of each individual. However, the animal is not free but is spatially bound to its territory, which it marks and defends. If a space falls vacant, it is at once

seized by a member of the same species.

The normal sleeping pattern and sleeping place of the species should be known. Some animals sleep in protected places, others sleep in the open. The place of refuge from danger is also important. Some animals flee in danger, others become immobile, some run up a tree, others run underground.

The concept of habitat or territory has important consequences for the correct handling and design of environments for animals in captivity. Their cage or enclosure must be arranged so that the animal accepts it as its personal property and consequently marks it and defends it. Different sized animals have different sized territories and many predatory carnivores have far bigger territories than their prey, often herbivores.

FOOD

On what does the animal feed and how much of its time is spent searching for food? This is an important question. There are three aspects to consider:

1. The animal must have an adequate diet nutritionally to maintain a healthy and thriving condition.

2. The food must be of the correct bulkiness for the digestive system.

3. Food should be presented in such a way that the animal spends as much time eating as it would in the wild.

This question of feeding behaviour presents difficulties. Carnivores normally hunt and kill their prey, but this cannot happen in a zoo as the welfare of the prey is as important as that of the carnivore and also most of the public would find it unacceptable. However, the carnivores, after eating, spend most of their time sleeping, so do not have a problem of filling in time.

On the other hand, plant-eaters present more of a problem as they normally spend much of their day feeding (cows spend about eight hours/day grazing, sheep about 10 hours/day). It is very difficult to provide these animals with a substitute diet that would take them most of their waking hours to consume.

SOCIAL STRUCTURE AND BREEDING REQUIREMENTS

Some animals are solitary, except when the female comes into season. Polar bears and giant pandas are in this group. Some animals form single male bachelor groups, except during the breeding season, and many matriarchal groups consist of the older females and their offspring. In any group of animals a social organisation evolves, often an elaborate hierarchical structure, especially in male groups, involving ritual behavioural displays. It is important to understand the social structure and breeding requirements if the animal is to reproduce in captivity. Many species do not come into breeding condition without the stimulus of introduction to the opposite sex. Cheetahs kept together in pairs do not breed, but when reunited after separation they may do so. Some species rely on the stimulus of daylength to come into season or rut. Others do not need this stimulus and are able to breed throughout the year.

An example of a problem of breeding that was solved by studying the animal's social structure and behaviour, was seen in a small herd of Father David's deer (Crowcroft, 1978). Two males and three females were in the group, in good health, but not producing young. One summer a group of students studied the social behaviour within the herd. It was eventually concluded that the behaviour of the dominant stag was a major obstacle to breeding. He covered only one female, an elderly hind beyond breeding age. He did not show any interest in the other females, but he would not allow the younger stag to mount any of the females. The following season, by locking up the old stag and letting the younger one remain with the females, a birth was achieved.

MAN–ANIMAL RELATIONSHIP

When an animal is moved from its own environment into captivity, it must reconstruct a whole new world and this is an enormous task. Two types of behaviours emerge:

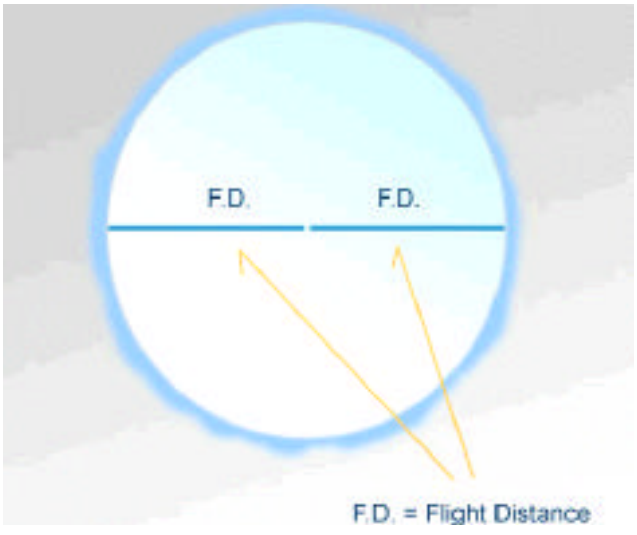
1. The animal may settle down in its new environment. This is often seen in the undeveloped, still adaptable young wild animal.

2. The animal may never settle down, even if kept in captivity for a long time.

In man's mind, the amount of space at an animal's disposal is often regarded as the most important consideration. It has been mentioned already that a free animal has a specialised and limited territory, so the quality of the space for the animal is more important than the quantity.

When an animal is in captivity there are both primary effects and secondary effects of space restriction. The primary effect is the restriction of movement and the secondary effects include lack of diversion and occupation, no food choice, impossibility of avoiding its own species at will, possible unsuitable differentiation of space, anti-social behaviour.

Then there is the problem of deciding what amount and design of space is necessary for an animal. The flight reaction is the most significant behaviour pattern of the wild animal's life in freedom so it should be of prime concern in captivity. In theory, the smallest cage should have a diameter twice the flight distance (F.D.), e.g.



In this way, an animal could retreat to the centre of the cage away from man, who appears as an enemy. This is often impossible to accommodate so the solution is to reduce the flight distance and so neutralise the animal's desire to escape. This is possible by taming. Zoos now often receive animals bred in captivity, whose flight distances are greatly reduced from their wild ancestors.

EFFECT OF ENCLOSURES ON BEHAVIOUR

It is important to ask the question: Is the behavioural limitation that caging imposes necessarily harmful?

1. One effect of moving an animal from the wild to a cage is to remove it from a rich and varied environment, this may cause it to indulge in one activity to an abnormal degree to compensate for other activities that are no longer possible.

2. Another effect may be over-grooming behaviour of a mother towards a new-born. She may continue to lick after the afterbirth has been removed and the young is clean, so damaging the skin. This may eventually lead to wounding and biting young to death.

3. Caging removes the necessity to hunt for food, but elaborate hunting sequences may still be carried out which are now inappropriate, e.g. wild racoons kill their prey from the river by shaking it. Captive racoons may carry bread to the water bowl and re-enact the killing of the prey.

4. When natural behaviours are frustrated, increased aggression to cage-mates, and sometimes self-directed harm, may result.

These are all important factors when considering the welfare of captive animals.

HOW CAN CONDITIONS BE IMPROVED IN ZOOS?

The layout of many zoos is dramatically changing – gone, or at least going, are the inner-city animal slums, and new zoos are trying to approximate the open condition of the wilds. England's Whipsnade Park became the prototype for open-range exhibits in 1932 and many zoos now house animals in similar conditions to their wild state.

Other suggestions include teaching animals tricks so they can perform, training them to work for food and environmental comforts; all this helps fill in time and provides activity.

More common now is the philosophy that different zoos should become specialist centres for certain groups of animals, rather than every zoo keeping just one example of a species. In this way certain zoos could specialise in rare species both for replenishing their own exhibits and for replenishing wild stocks. These centres could be financed by zoos, conservation societies, and the general public.

There is the question of zoo animals living to old age and suffering various complaints. This is actually unnatural in the wild where survival of the fittest is the rule. The ethical question arising is – should man, who is responsible for lengthening the life of the animal, put the animal painlessly to death in old age or because of disease? Also, what happens to animals that are reproducing at too great a rate? Over-production may occur in lions, brown bears, the males of some species of antelope, deer and cattle. It is difficult to release them to the wild after they have been bred in captivity; they would be harassed by their own species, lack the skills to hunt and may die of starvation. The ethics of killing these animals due to lack of space should only be a last resort.

The final question asked by many people is: Is it really necessary to keep animals in captivity? Certainly it is necessary in some cases to carry out experiments under laboratory conditions on pest species so it can be determined the most effective and humane means of controlling excess populations of these animals in the wild. But what about zoo animals? Many believe that television provides us with a close-up account of these animals but does it take the place of studying the animal at close quarters?

Progressive zoo management should promote animal behaviour as a scientific field with the study of wild animal medicine and management and perhaps the study of environmental design.

People will probably always go to zoos for recreation to see the animals, so in the process they should be educated also, and it is the behaviour of the animals that provides the education.

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CHAPTER 11
THE TRAINING OF ANIMALS

To train any animal, be it a dog, cat or horse, the behaviour of the animal must be understood. Successful training involves two aspects:

1. The animal being trained, and

2. The trainer.

A bond between trainer and animal must be developed so that the reponses of each become predictable. The animal learns that the trainer will respond predictably when it offers certain behaviours, i.e. the trainer will offer rewards. Similarly the trainer learns that reinforcing the desired response makes them more likely to be repeated in the future. Some people never make successful trainers and it is very difficult to describe and measure the quality that makes someone a successful trainer. That said, the merits of timing and consistency are clear.

Most good trainers work on two principles:

1. Positive reinforcement, whenever possible, rather than punishment – however mild.

2. The animal is taught to perform a natural motor pattern even to an exaggerated extent. This is easier than trying to teach an animal something alien and means that the trainer must have a knowledge of the animal's natural behaviour as well as its likely responses to different situations.

Reinforcement is a reward for desired behaviour and gives the trainer a means of control over the behaviour of the animal. Whenever a particular activity is reinforced, the chances of that activity being repeated are increased. To be effective, a reinforcement must be given almost simultaneously with (and certainly never before) the desired behaviour.

This section will look at various training methods and discuss:

1. Training cattle to lead

2. Training sheep and cattle dogs

3. Training guide dogs

4. Training pet dogs

5. The Jeffrey method of horse training

The approaches published here are offered as an historical record. For a comprehensive analysis of training principles, readers are directed to the 'training' section www.animalbehaviour.net.

TRAINING CATTLE TO LEAD

This is useful when leading cattle in a show ring.

Dairy heifers, although commonly used to man, may be frightened of halters and resist being led (Craig, 1981). After becoming habituated to the halter and lead rope by being tied, they can be led about by using some force if they are small.

Another method, the Australian bullock method (Craig, 1981; Wilson et al,1975) involves tying heifers together in pairs matched for similar size. One heifer wears a leather collar and the other a halter; the collar and halter are attached by a short chain (about 50 cm long). The animal wearing the collar determines where the pair goes, and during the first two days the leader-following pairing is reversed twice a day; thereafter reversals are made daily. After seven or eight days of training most heifers can be easily led by a person. A few animals need longer training and occasionally an animal may never learn to be led by a person. After learning to respond to a minimum pull on the lead rope, the heifers are as easily led by a person as by another heifer.

The use of a donkey to teach stud cattle to lead has been reported in the press (***Country Life***, 1 July, 1982). A donkey was tied to a Brahman calf (5 months old) by attaching a strong, short (30 cm) chain from the calf's headstall to the donkey's neckband. The pair were led for a short time and then allowed to move on their own. This method is claimed to be very successful. The welfare of either species in this model should not be overlooked and therefore it is not a technique that is recommended unless the pair can be kept under observation.

TRAINING SHEEP AND CATTLE DOGS

The training of stock dogs begins with the selection of the right dog. Breeding qualities are of paramount importance and the dog must be selected for the type of work it is suited to. By selective breeding farmers have been able to develop breeds and strains that find working stock intrinsically rewarding .

Training a Sheep Dog (Austin, 1973, 1982).

This discusses one successful method of training a sheep dog. Trainers are encouraged to build early training around the dog's natural abilities and to encourage its interest in working sheep.

1. Exposure: This means putting the pup down in the presence of sheep and noting when he starts to work the sheep. The age could be six to 12 weeks or more, and once a pup has started to show interest it rarely stops, provided it is not overworked. One to 1½ minutes exposure is long enough to leave the pup on the ground with the sheep. When a command is given to the dog it must sound authoritative.

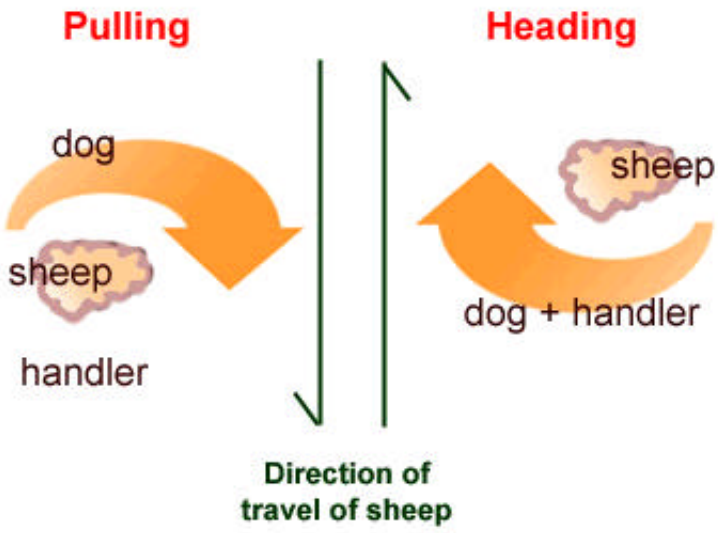
2. Teaching basic commands: 'Come' and 'sit' are taught first. Most dogs learn 'come' if used at feeding time and problem dogs can be put on a training rope (about 10 m long) and restrained from running away. 'Sit' can be taught by pulling down gently on a cord attached to the collar. A kind word rewards the dog and each lesson should be short. 'Heel' can be taught by leading on the left hand side; if the dog gets in front direct him with the training cord and command 'heel'. If he runs around, swing a stick (about 2m long) from left to right in front of your own legs as you walk and as the dog bumps into it he will learn not to walk ahead. 'Stop' is commanded as you stop walking and a training stick

can help.

'Here' and 'behind' are two valuable commands; the former moves the dog in an anti-clockwise direction and the latter in a clockwise direction. The lesson can be taught with or without sheep present. 'Behind' – having taught the dog to sit, sit him about 2m in front of you while you hold the training cord in the right hand and the training stick extended to your left. Take a step to the left and command 'behind' and pull gently on the cord to indicate direction. 'Here' is the opposite. Stick in right hand and cord in the left hand. As the dog learns the commands he will move from left to right and the position of the sheep will not affect whether he moves clockwise or anti-clockwise.

'Get up' can be taught by showing the dog that you want him to climb up on a bale of wool, for example. You may be able to encourage a dog to bark on a command of 'speak', but some sheepdogs may be silent when working sheep.

The training procedure then involves directing the dog's heading instinct into a pulling exercise and allowing the dog to work sheep with the least amount of discipline. This develops a dog's self-confidence, requires the dog to make its own corrections, and helps to develop balance and control. As the dog becomes proficient at pulling, the distance from the handler to the mob can be increased.



In pulling, the dog is on the opposite side of the stock from the handler, wherever the handler goes. As the distance increases, the dog learns to look more into the distance for his master.

In driving, the dog is on the same side of the stock as the handler and requires more commands than pulling, so this is left until a later stage in a pup's development.

A dog, after training, may be able to cope with 500 to 2,000 sheep, depending on the sheep, the terrain and what he has to do with them. The important thing is to build up a close relationship with your working dog and to be consistent.

Training a Cattle Dog (Scanlon, 1981)

K. Scanlon is an Australian Cattle Dog breeder and trainer. This is a brief outline of her method. As with the sheep dog, selection of the right dog is important. Some dogs are more physically suited to take long distances and others are more suited to yard work and loading.

The cattle dog bites by nipping behind the heel of the foot that is carrying the weight and immediately drops flat to the ground, letting the hoof sway over his head. The cattle dog has a flat head between the ears to aid this ducking exercise and also has acute hearing. A powerful jaw and clean scissor bite are essential. The best method of getting young pups (about eight weeks of age) to be work-minded is to run them with older dogs – if this is not possible, the pup will copy you so let it watch how you work the cattle.

First, the pup should be acquainted with the work environment; the noises and smells. Scanlon (1981) suggests the use of a leather collar, as choker chains can be dangerous for working dogs. Basic obedience exercises should be taught first, similar to those for the sheep dog. Praise is an important reward.

Start the dog on a long lead in a small yard with one or two cows. Drive the cows from one yard to the next allowing the pup to follow you and guiding him with the lead. He will not take long to learn as his instincts will do part of the job. If the pup will not move toward the cows on his own accord, use a long stick and herd them around the pen, but do not let them threaten the pup. Tell the pup in an excited voice to 'get the cows' and praise him when he does. Always teach the pup to get to the cows from behind so that he is in a position to nip from behind, if necessary. Do not let him start off by coming to the front of the cow, as he will get hit very quickly. Any tendency to swing on the cow's tail should be curbed immediately. Barking should be discouraged while working and you should always have control over your dog. Gradually get the pup used to different areas and varying sized pens, as well as different sized herds. This will develop his concentration. The whole training process requires a mixture of tolerance, firmness and fairness with praise for work well done.

TRAINING GUIDE DOGS

(Holdsworth, Royal Guide Dogs for the Blind Assoc. of Aust.; Conron, 1981; Lane, 1981; Pfaffenberger et al 1976)

Guide dogs are bred mainly for their temperament and initiative. Australian guide dogs are Labradors bred by the Royal Guide Dogs for the Blind Association (Australia).

The first part of the training program begins at six weeks when pups are placed in private homes to encounter multiple novel environmental stimuli before

the end of their socialisation period. This is called the 'puppy walking' scheme and has been one of the most successful ways of producing a dog of the right temperament to train as a guide. The pup is provided with as many contacts as possible, e.g., children, adults, other pets. Once house trained, the pup is allowed to sleep in a bedroom or on a landing, since guide dogs are never far away from their owners.

Discipline is very important and is taught right from the beginning. The dog is conditioned to as many situations as possible: it is walked on the pavement to accustom it to pedestrians and motor traffic, taken on trains, buses, in cars to get it used to transport, taken to noisy railway stations, busy shopping centres and conditioned to lifts, swing doors and escalators.

The ordinary pet dog trots to heel, but the future guide dog must be encouraged to lead the way and walk on the left because the blind owner holds the harness with the left hand. It is encouraged to walk with the head held up looking out for obstacles and potential threats.

At 12 months of age, the dog is returned to the kennels to commence Guide Dog Training. After about three weeks in the kennels it can be predicted which dogs will make suitable guide dogs.

The training period establishes routines of basic obedience such as walking down the middle of a pavement and sitting at every kerb. Praise and repetition are the basis of training, and the dog will usually be worked for half to one hour periods over familiar routes, twice a week, until it is consistent in its responses. The dog is trained to ignore distractions such as food, balls being thrown and other dogs in its vicinity. Only when the dog is completely at ease working in harness on the open street will it be trained in traffic.

Traffic training consists of teaching the dog that an approaching vehicle is a signal for it to stop or refuse the command from the owner to go forward. A stationary vehicle is a signal that the dog may go forward.

Training also includes avoidance of all obstacles that would impede a blind person's progress and is carried out in both quiet residential streets and busy shopping areas. The dog is taught to cope with any unusual obstruction on the pavement such as a parked vehicle and taught to respond to potentially dangerous traffic situations.

The qualities of a good guide dog include:

1. Stand about 48 cm at the shoulder to maintain the necessary balance between dog and owner.

2. Must be physically fit and able to walk up to 20 km per day at the normal pace (although in reality very few visually impaired handlers undertake this sort of journey with any regularity).

3. Must be reasonably bold and free from nervous suspicion and have no aggressive tendencies.

4. Must be intelligent with a personality that makes it willing to please, and it must not respond to pats.

Considerable effort and time is taken to match the blind person with the guide dog and they are then trained together.

TRAINING A PET DOG

The obedience training mentioned for sheep and cattle dogs is similar to that for a pet dog. Two theoretical approaches are used to train dogs in the desired obedience behaviours (Vollmer, 1980).

Inducement Training

Inducement training shapes and reinforces behaviours that at first approximate the desired goal behaviours. Through further selective reinforcement and shaping, the dog's behaviour eventually meets the handler's expectations. Psychologists identify this process as a form of operant conditioning. Teaching a dog to lie down on signal is an example of an inducive or operant procedure. The procedure could be as follows: the handler places the dog at his left side in a sitting position, with a food treat or special toy in which the dog has shown interest, in his right hand. The handler places his left hand over the dog's shoulder and simultaneously moves his right hand onto the floor in front of the dog's nose while saying 'Down, Rover'. The left hand puts gentle pressure on the shoulder while the right hand provides a visual signal, while also eliciting a response from the dog. As soon as the dog is lying down, the treat or toy is presented while verbal praise is given by the handler. This provides the reinforcement for the desired behaviour.

Inducement training has also proved to be very reliable for training whales, dolphins and circus animals.

Force Training

NB: Advances in animal training are such that inducements are now generally accepted as the most effective and humane means of shaping any animal's response. Certainly pet dogs are most readily trained using this approach, although it is now usually called reward-based training or training based on positive reinforcement. Again this account of training is offered as a historical perspective and readers are advised that more current discussions of best practice in animal training are available online at www.animalbehaviour.net

Force training or escape/avoidance learning is characterised by setting up the learning situation so that the animal must show a preselected behaviour to avoid an unpleasant or aversive stimulus. At first the animal learns only to escape the aversive stimulus but after several trials should learn to avoid it by performing a specific action desired by the trainer. Teaching the dog to lie down on a signal could follow these steps: the handler places the dog on his left side in a sitting position. The training leash, attached to the dog's training collar, is run under the instep of the handler's left foot, then held by the handler with both hands, waist high. A verbal signal 'Down, Rover' is given while the hands snap up hard on the leash (aversive stimulation) forcing the dog down to the floor. The dog is then petted and verbally praised as soon as it is lying down (reinforcement). After several trials the dog may begin to lie down as soon as the verbal command is delivered and before the leash is snapped up (avoidance). This method usually leads to fast acquisition of the desired response. While

it may be a quick method it can produce undesired stress reactions such as body tremors, depressed body postures, tucked-under tail, flattened ears and dilated pupils. These indicators are significant since they suggest that the handler is causing a fear response in the dog; such an outcome is contra-indicated since it undermines the human–animal bond and reduces the dog's likelihood of offering novel (e.g. more complex) responses in the future.

THE JEFFERY METHOD OF HORSE TRAINING: TO BREAK IN A HORSE FOR RIDING

(Blackshaw et al.,1983; Kirk, 1978; Wright, 1973)

This is an old Australian technique that makes use of several behavioural principles, including the understanding of horse behaviour, the reinforcement for desired behaviour and the use of flight-distance principles. Significantly it is a technique that incorporates the advance and retreat method often attributed to the current wave of horse whisperers. Clearly, because the Jeffery Method employs considerable aversive stimuli in the form of a stricture around the neck and 'bucking out' (see below), it should not be used by novices and demands that the horse is never left unsupervised. It is important that the trainee horse is taught one item at a time so the procedure follows:

1. Teaching the horse to stand still using a rope (about 7 m) that is a free-running or slip noose around the horse's wind-pipe right under his jaw. Once this is on, the trainer can begin to control the .horse with the Jeffery Lunge. The handler is at right angles to the horse's front legs and makes the lunge forward of that point. This pulls the horse off balance and the rope noose pulls tight for a second and is immediately released. The horse is lunged alternately right and left, and the Jeffery Lunge teaches a horse that relief of pressure on its wind-pipe and neck occurs when it turns and faces the handler.

2. The second step is to approach the horse and gain his confidence. As the handler approaches the flight distance of the horse, the horse begins to feel pressured and may start to rear. As soon as this happens, the handler should retreat and take the pressure off the horse. By the gradual process of advance and retreat, and talking gently to the horse, it will finally allow the handler to come close.

3. The next stage is to climb on the horse's back, and again the advance and retreat method is used. By hooking the elbow firmly over the horse's wither, body weight is applied. This prepares the horse for mounting. Firm rope discipline must be applied if the horse moves away.

4. The horse is then acquainted with the saddle, and if the handler is mounted on a quiet coacher horse, this will reduce any nervousness.

5. The horse can then be bridled so he can become used to the bit.

6. Saddling the horse follows and he is left in a pen by himself and encouraged to move by throwing a clod of earth into the pen. He can 'buck out' under the saddle, but must realise that the saddle is there to stay. Once this is accomplished the horse rarely bucks with a rider.

7. The trainee horse is then ridden, still using the lunge rope around the horse's neck for control.

8. The next step is to use a running rein to mouth the horse and teach him to back. A neck rope (about 5 m) is kept on the horse throughout this training, so that the handler can restrain the horse at all times. This eliminates the flight instinct that would occur without the rope, and relaxes the horse.

9. Riding with reins follows and within several days the horse can be ridden in the paddock.

Throughout the whole process, horse and man are developing a bond built on confidence and not fear. Probably one of the most useful things about this method is that it is easily taught and easily learnt.

No matter what animal is being trained, it will be successful only if the bond between the trainer and the animal is close and the trainer understands the behavioural cues of the animal.

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CHAPTER 12
AN APPROACH TO BEHAVIOURAL AND WELFARE PROBLEMS IN DOMESTIC ANIMALS

INTRODUCTION

Behaviour has evolved by natural selection and a knowledge and understanding of it has always been a practical matter for trappers and hunters, traditional shepherds and herdsmen. It is a sequence of movements with appetitive and consummatory elements, and involves understanding not only what an animal does but how, when, where and why the behaviour occurs.

In recent years the teaching of animal behaviour has become important to veterinary and agriculture students for several reasons:

1. By understanding an animal's behaviour, facilities and management strategies can be designed with consideration for the behavioural needs of the animals. Features of a farmed animal's environment that merit attention include intensive housing systems, holding pens, loading and unloading ramps, transport vehicles and provision for special operations such as slaughtering, shearing and dipping.

2. An understanding of behaviour allows the management and movement of stock to be achieved without causing undue stress to the animals.

3. When an animal or group of animals is showing inappropriate or changed behaviour, it becomes obvious that an upset in the homeostasis of the animals has occurred.

A change of behaviour is usually the first indication that the health and welfare of an animal are at risk, so it should be the aim of those responsible for animals to quickly detect problems and correct them.

This chapter outlines an approach to animal behaviour and welfare problems by using a simple scheme, that ensures the major factors will not be overlooked.

METHOD

The behaviour of an animal is influenced by:

1. structure and function of the animal, and

2. the interaction of the animal with the external environment.

If these factors are examined in more detail, we can evolve a system of logical thinking that allows a person to describe, investigate and better manage behaviour and welfare problems.

The approach requires three activities to be completed (DIM):

a. Describe
b. Investigate and list problem(s)
c. Manage

Describe

Describe the presenting problem(s) as accurately as possible by considering both the animal and the environment.

Investigate and List Problem(s)

The origins and the effects associated with the presenting problem(s) can be determined by investigating the animal and the environment.

1. The Animal

Investigation of the animal involves consideration of the structure and function of the organ systems. These can be listed by the mnemonic CRAUN LESH. If any of these systems suffers an upset in homeostasis, the first sign is often an alteration in the animal's behaviour. All the body systems can be quickly checked.

C Cardiovascular
R Respiratory
A Alimentary
U Urogenital (urinary and reproductive)
N Nervous – C.N.S. (Central nervous system)
P.N.S. (Peripheral nervous system)
A.N.S. (Autonomic nervous system)
Special senses – sight, touch, smell (including pheromone detection), taste, hearing
Innate behaviour, such as nest building and suckling behaviour
L Locomotive (musculo-skeletal)
E Endocrine
S Skin (fur, hair, hooves, sweat glands)
H Haematological (blood, lymph, immune system).

A problem in behaviour or welfare may involve one or more of these systems so a quick run through ensures that no system is overlooked.

2. The Environment

The interaction of the animal with the environment may be examined under three headings:

a. the physical environment,
b. the chemical environment,
c. the biological environment.

a. The physical environment includes:

• temperature, light, humidity and ventilation;

• husbandry designs, which include walls, feeders, types of flooring, position and type of drinker, mating pens.

b. The chemical environment includes:

• the nutritional environment and additives, such as antibiotics, probiotics, growth promotants, vitamins and flavourants;

• toxic chemicals that may be used in sprays, dips, etc., and their effects;

• poisonous plants.

c. The biological environment includes:

• disease organisms;

• social environment;

• reproductive environment.

Disease organisms: Pathogenic microoragnisms and parasites may affect any of the systems mentioned and this, in turn, influences the behaviour and welfare of the animal.

Social environment: This can be considered as:

i. the effect of man on his animals, which includes transport and movement of animals, husbandry procedures, and design of facilities for animals.

ii. the effect of different species, for example, predators.

iii. the effect of other animals on the same species, including crowding and over-crowding.

Crowding has a physical (i.e. density/m^2) and a social element. This social element, which is often neglected, consists of:

Who is being crowded?

Is it the dominant animals in the hierarchy or the more subordinate animals who are suffering from being crowded?

When is crowding occurring?

It may occur only at a certain time of day, for example, at feeding time.

Where does the crowding occur?

There may be plenty of floor space but inadequate feeding or drinking space.

Reproductive environment: This includes the mating environment and the actual animal to be mated. Some males prefer certain females and females may refuse to mate with a certain male. The mating environment must be acceptable, and in groups of animals, a dominant male can affect the whole reproductive behaviour.

Sight, sound and smell form an important part of the reproductive environment.

Following the description of the presenting problem(s) and the detailed investigation of the animal and the environment, a list of problems should be formulated. The problem list should include:

a. specific animal problems, and

b. problems involving the external environment.

This problem list forms the basis for planning the management of the animal and/or the environment.

Manage

a. problems in the animal,

b. environmental problems.

a. Problems in the animal

The welfare of the animal is of major concern so management of problems in the animal is immediate and preferably short term. The treatment of animal problems can be approached by considering three S's:

Specific treatment where there is a known cause, e.g. an appropriate antibiotic for a bacterial infection.

Symptomatic treatment, e.g. analgesics for pain.

Supportive/prophylactic treatment, e.g. fluid and electrolyte therapy, vaccinations.

b. Environmental problems

Where the physical, chemical or biological environment have contributed to behavioural and welfare problems, short-term management should be directed to the immediate removal of these problems. Modification of the environment has become a major public issue. Long-term management may be required to solve some environmental problems.

This is the area of animal-welfare legislation, codes and recommendations that may involve selective animal breeding programs, changing or modifying husbandry designs, husbandry procedures, animal transport and slaughter facilities to ensure optimum conditions for the animal's production and welfare. It also involves the prevention, if possible, of the same problem from recurring.

In each practical situation where a behavioural and/or welfare problem arises, application of this scheme allows all factors to be considered and the problem area to be accurately defined. This ensures complete management of the animal and the environment.

Summary

Animal behaviour and welfare problems in domestic animals may be approached using a simple scheme, describe, investigate, manage (DIM), as illustrated below: