COURSE CODE:	ABG 503
COURSE TITLE:	Animal Behaviour
NUMBER OF UNITS:	2 Units
COURSE DURATION:	Two hours per week

COURSE DETAILS:

Course Coordinator:	Dr. Martha N. Bemji
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COURSE CONTENT:

Features of Animal behaviour, Causes of onset of behaviour (Motivation and animal welfare), Types of behaviour: Learned behaviours and Innate behaviours (Aggression, Dominance status, Broodiness, Reproductive behaviour etc.), Effect of behaviour on animal management and productivity, Practical on agonistic behaviour and reproductive behaviour.

COURSE REQUIREMENTS:

This is a compulsory course for all students in the College of Animal Science and Livestock Production. In view of this, students are expected to participate in all the lectures and practical and must meet up with a minimum of 75% attendance to qualify for the final examination.

READING LIST:

1. Bemji, M.N., R.Y. Fajuke and O.A. Osinowo. 2003. Social dominance in goats: Effects of Breed and horn size. Proceedings of the 28th Annual Conf. of the Nig. Soc. for Anim. Prod., Inst. of Agric. Res. and Training, Obafemi Awolowo University, Ibadan, Nigeria, 16-20th March, 2003. Vol. 28, pp 141-143.

2. Blackshaw, J.K. and Allan, D.J. 1986. *Animal Behaviour. Third Edition.
http://animalbehaviour.net/AppliedAnimalBehviourTopics.htm

*Updated by McGreevy, P. 2003. Faculty of Veterinary Science, University of Sydney.

3. Mendl, M. 2002. http://lang-dl-srv.lang.bris.ac.uk/tweb/srand/AnimalBehaviour/groupliving/group_notes.html

4. Taylor, D.J., Green, N.P.O. and Stout, G.W. 1998. Biological Science. Third Edition. Cambridge University Press. pp 984.

LECTURE NOTES

Introduction

Behaviour can be defined as an expressed course of action produced in organisms in **response** to **stimulus** from a given situation. It could simply be considered as what the animal does. The fundamental explanation of behavioural activity must begin with a stimulus and end with a response.

Stimulus: Any change in the biotic and abiotic environments capable of eliciting or causing some sort of reaction or response in a living organism. E.g. temperature, pressure, radiation, gravity, or activities of other organisms within the immediate environment.

Ethology is the scientific study of animal behaviour. It explains responses observed in the field in terms of stimuli eliciting the behaviour. This was pioneered by Lorenz, von Frisch and Tinbergen. Ethologists have so far tried to answer questions about animal behaviour from four major areas:

1. **The evolutionary history:**
   - How did various forms of behaviour evolved? i.e. (Innate/instinctive/genetic or learned?)
   - How does the behaviour compare with similar behaviour in related species?
2. **Development:**
   - How does behaviour change with age?
   - What are the early experiences necessary for the behaviour to be expressed?
   - e.g. How does courtship behaviour develop during the individuals's life?
   - Does the male in domestic fowl learn the waltz dance?
   - Does he practice dancing?
   - Is he successful in directing the female?

3. **Causation:**
What are the stimuli that elicit the response?
How has it been modified by recent learning?

4. **Function:**
How does the behaviour impact on the animal's chances of survival and reproduction?

2. Causes of onset of animal behaviour

2.1 Motivation

The concept of motivation encompasses a variety of factors that modify the extent and nature of any behavioural response. At any given moment in time, an animal usually has a range of behaviours which it could exhibit. What is it that determines which behaviour an animal decides to conduct? The study of motivation is interested in determining what the casual factors (or driving forces) are behind a behaviour. No animal exists in isolation from its external environment. The environment in which the animal lives may change, for example, food may appear or disappear, a predator may attack, the temperature could fall, or offspring may start begging for food. These may all cause changes in the animal's behaviour. The same stimulus does not always evoke the same response in the same organism. The difference is always circumstantial and may be controlled by either internal or external factors. e.g Presenting food to a starved animal will produce a different response from that shown by an animal that has been fed. In between two extremes, responses of varying strengths will be produced depending on the degree of hunger experienced. However, if the act of feeding will place a hungry animal in danger of being attacked by a predator, the feeding response would be stopped until the danger is passed.

Many behavioural responses associated with reproduction have a motivational element. E.g. Many female animals are only receptive to mating attempts by males at certain times of the year which coincide with the period of oestrus and have the adaptive significance of ensuring that mating coincides with the optimum time for fertilization, and therefore the production of offspring at the most favourable time of the year. These behavioural patterns are known as biological rhythms. In many species, the degree of motivation or drive coincides in males and females, but in other species, some system of communicating between sexes is essential to express the degree of motivation. In many primates, the timing of oestrus is signaled by a swelling and change of colour of the genital area of the female and this is displayed to the male. Such behaviour reduces the likelihood of a male attempting to mate at the time when the female is not receptive. The signals used to bring about a change in behaviour are known as sign stimuli. Depending on their origin or function, they are classified as motivational, releasing or terminating stimuli.

Motivational stimulus may be external, e.g. increasing day length induces territorial and courtship behaviour in birds, or internal, e.g. depleted food stores in the body results in seeking for food. **Releasing stimulus** may be a simple stimulus or sequence of stimuli produced by a member of a species which evokes a behavioural response in another member of the same species. E.g. Young herring gull chicks normally peck at a red spot on the yellow lower mandible of the parent's bill to signal the parent to regurgitate fish which the young then swallows. **Terminating stimulus** completes a behavioural response and may be external or internal. e.g. External visual stimuli of a successfully completed nest will terminate nest building in birds, likewise, a full stomach will terminate feeding.

It is likely that both internal and external factors often have an effect at once (they interact). For example, chickens will normally forage throughout the day. However, when a hen is brooding eggs, she will be much less likely to feed, even if food is available in the environment. Thus, there is a subtle interplay between current internal factors, and external ones.

2.2 Motivation and Welfare

Welfare is a measure of how well an animal copes with its environment; If the animal fails to cope or its coping efforts have detrimental effects on the productivity, then the welfare of that animal is poor. Welfare can also be considered as absence of suffering. ***How can an understanding of motivational systems be important to our understanding of animal welfare?*** In some cases, they can give insights into the causes of behaviours that are potential welfare problems. Many housing systems for husbandry restrict space and foraging ability. In essence, they do not permit animals to perform natural behaviours and contribute to the development of abnormal behaviour patterns, which develop in captive animals housed in inadequate environmental conditions and can cause health problems. Some abnormal behaviours are indicative of reduced welfare in that they act as a 'coping mechanism' to allow the animal deal with a stressful environment. E.g Dust bathing is an activity that increases in intensity with an increased period of deprivation. However, in some instances, chickens will go through the process of dust-bathing in the absence of dust. This is called a vacuum activity which could be likened to a 'build-up' of motivational energy (Lorenz's model), eventually triggering a behaviour without the correct stimulus being present. A similar example occurs in pigs, which usually build nests prior to giving birth, and the day beforehand is spent rooting up straw etc. to form a nest. If no straw is present, the pigs will nonetheless root, which can lead to facial damage. Understanding the casual factors behind these behaviours may allow us to either stop the behaviour from occurring, or else supply the animal with the correct environment, so that its behavioural repertoire is not compromised. Another issue where welfare becomes important in the study of motivation is that of rebound activities. If a behaviour is prevented, or the animal is unable to conduct it for a period, when given the opportunity, the behaviour will be performed at a much greater intensity - which again can be likened to the build-up of 'motivational energy' in Lorenz's model. Rebound is seen in a number of situations, such as exploration behaviour in pigs, maintenance behaviour in chickens, social play in rats, aggression in fish, and sleep in humans. By attempting to understand the motivational system behind a behaviour, we can have an influence on the welfare of the animal. Animals may be strongly motivated to conduct a behaviour, but unable to do so. Or, animals may be able to perform a behaviour, but be prevented from reaching the functional consequences of that behaviour. Two models give very different predictions when we examine them from a welfare perspective. *Lorenz's model* states that it is the performance of the behaviour itself that is important. *The homeostatic model*, however, suggests that the goal of the behaviour is important. By understanding the motivational system, we can alter our husbandry systems so that the behaviour itself can be conducted, or so that the goal can be reached. These all have effects in maximizing the productivity and profit of the livestock farmer.

Summary:

- The study of motivation looks at how internal and external causal factors interact to produce behaviour.
- Motivation must be considered as we do not know the exact mechanisms as to why a behaviour occurs.
- Animal welfare and hence productivity is likely to be compromised when highly motivated behaviours cannot be expressed, or when a functional goal is not achieved.
- An understanding of motivation allows us to make predictions about when welfare will be compromised.

3. Types of Animal behaviour

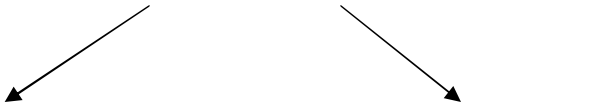


Table 1. Differences between inherited and learned behaviours

Inherited (innate) behaviour	*Learned behaviour*
1. Set at birth	Acquired after animal is born
2. Species characteristic behaviour	Individual characteristic behaviour
3. Largely influenced by genes (inborn)	Largely influenced by environment
4. Inflexible (stereotype patterns of behaviour)	Flexible

3.1 Learned behaviours

Learning can be defined as adaptive changes in individual's behaviour as a result of experience. **Learning alters the range of behaviours shown by an individual, and allows it to adapt to and control its environment.*

Types of learned behaviours

1. Imprinting
2. Non-associative learning - Habituation
   - Sensitization
3. Associative learning - Classical conditioning
   - Operant conditioning
4. Latent or exploratory learning
5. Insight learning

1. ***Imprinting***

Imprinting is said to occur when innate behaviours are released in response to a learned stimulus. It is a simple and specialized form of learning occurring during receptive periods in an animal's life. Imprinting involves young animals becoming associated with, and identifying themselves with another organism, usually a parent, or some large object. E.g. Chicks hatch with an innate tendency to approach and follow their mother. They have already imprinted on her vocalizations. After hatching (24 - 36 hours) they imprint on her visual appearance. Geese and ducklings form social attachments shortly after birth. Lorenz found that goslings deprived of their parents would follow him and use him as a

substitute parent. Pet lambs or kids bottle fed show similar behaviour. This may have a profound and **undesirable effect** later in life when the animal finds it difficult in forming normal relationships with others of the same species as exemplified by sexual imprinting. Individuals raised by another species (cross-fostered), recognizes foster species as its own when sexually mature and will attempt to mate with foster species.

Adaptive significance:

- Enables offspring to rapidly acquire skills possessed by their parents such as learning to fly in birds, song learning.
- Promotes survival of newborn and shapes future breeding activities.

Characteristics of imprinting:

1. Occurs during critical sensitive period.
2. Imprinting is irreversible because the imprinted knowledge is retained for life.
3. It establishes an individual animal's preference for a certain species since individuals will prefer to follow a learned stimulus rather than a member of their own species.
4. Some behaviours are affected by imprinting more than others. E.g. It may have effects upon the animal's future choice of a sexual partner.
5. Stressful stimuli fortify imprinting.

2. **Non-associative learning:**

i. ***Habituation***

Habituation is said to occur when *repeated presentations of a stimulus cause a decrease in response*. i.e. *Continuous repetition of a stimulus not associated with reward or punishment (reinforcement) puts off any response to the stimulus.* E.g. birds learn to ignore scare crow. The animal learns not to respond to irrelevant stimuli such as movements due to wind, cloud, shadows, wave action etc.

Significance:

Helps animals to recognize important cues or signals and adapt to constantly changing environment.

ii. ***Sensitization***

It is the opposite of habituation in that *repeated presentations of the stimulus cause an increase in response*. The stimulus has to be unpleasant or aversive. Take for example a rat that has just experienced an aversive stimulus (e.g. a very bright light). Immediately after this event, the rat may be extra sensitive to other cues (such as noises or lights) that it would not normally respond to. In farm animals, increased responsiveness follows a reward or punishment (or 'reinforcement') mainly associated with predator, food and mates.

3. ***Associative learning***

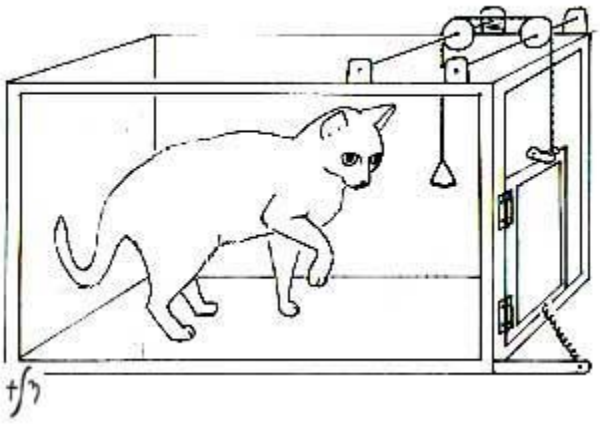
Associative learning simply means that an *animal learns to associate an event with a result*. There are two types of associative learning: classical (Pavlovian) conditioning, and operant or trial-and-error conditioning.

i. *Classical (Pavlovian) conditioning*

Classical conditioning is the *acquisition of a response to a new stimulus by association with an old stimulus*. It involves the association of events over which the animal has no control. It is able to gain prediction of events in its environment. E.g. Pavlov's **dog** associated bell with the arrival of food and begins to salivate at the sound of a bell. At first, the dog didn't react to the stimulus alone, but after a few repetitions the stimulus was able to cause salivation before the arrival of the food being given to the dog. The animal learns to associate a conditioned stimulus (e.g. a bell), with the onset of an unconditioned stimulus (e.g. the arrival of food). An unconditioned response (e.g. salivation) would only occur in response to an unconditioned stimulus prior to learning.

ii. Operant conditioning (trial-and-error learning):

An operant response is *a voluntary activity that brings about a reward*. Trial-and-error activities give rise to responses which are reinforced either by rewarding (positive) or punishment (negative). The association of outcome of a response in terms of reward or punishment increases or decreases respectively future responses. Operant conditioning therefore involves association of events with control.



Source: Blackshaw (1986)

Possibly the most famous set of experiments examining this sort of learning were done by followers of the school of B.F. Skinner. The classic tool is the Skinner box. Here, the animal is placed in the box, which has some sort of reward for conducting a behaviour. For example, if the animal presses a lever, it receives a food pellet. By trial and error, the animal learns that pressing the lever delivers the reward. In this way, the animal gains prediction and control over events in its environment. The animal learns to associate its own behaviour with a particular outcome. If the outcome is rewarding e.g. access to food, the animal learns to repeat the behaviour that resulted in food access previously. It therefore learns a conditioned response to obtain food (unconditioned response).

Table 2. Differences between classical and operant conditioning

Classical conditioning	*Operant conditioning*
1. Acquisition of a response to a new stimulus by association with an old stimulus.	It is a voluntary activity that brings about a reward.
2. Enables animal to associate events over which it has no control.	Enables animal to associate events over which is has control.
3. Animal gains prediction over events.	Increases animal's ability to control environment.
4. Rewards are associated with stimuli.	Rewards are associated with responses.

Applications of operant conditioning

i. *Reinforcement (positive/negative) and punishment (positive/negative)*

Operant conditioning allows one to use *reinforcers or punishers* that positively or negatively influence the likelihood of a behaviour being repeated. Reward strengthens the correct response. With selection of appropriate reward, animals could be trained to do remarkable things if reinforced at the right time. E.g. By waiting for accidental movement of eye lids, pigeons were taught to blink to receive food reward. Cats rub their owner's legs to receive food reward. The speed and strength of learning increases with size and attractiveness of the reinforcer.

Reinforcement can be positive or negative (Table 3). Both make response more likely in the future. Punishment, whether positive or negative make response less likely in the future.

Table 3. How reinforcement and punishment can positively or negatively affect a response

Response is more likely in future	*Response is less likely in future*
Positive reinforcement e.g. Tit bit reinforces begging at table by dogs.	Positive punishment e.g. Appling tension on the lead increases choking and neck pain in horses.
Negative reinforcement e.g. Easing tension on the lead reduces choking and neck pain in horses	Negative punishment e.g. Complete removal of food extinguishes begging at table by dogs.

Source: Blackshaw (1986)

Negative in the context of animal training refers to removal of something in the animal's world, while **positive** reinforcement refers to addition. When trainers reinforce a behaviour with the removal of something unpleasant, they make the behaviour more likely to occur in the future. That is, the response has been negatively reinforced. An animal must know that a stimulus is aversive for its removal to be reinforcing.

Animal training: *Refers to development of desirable responses and deletion of unwanted responses*. It reflects the principle of learning theory. Studying animal responses allows one to improve the timing of cues and rewards. Top trainers know when and how to reward their subjects. Frequent rewards prevent development of improved responses. Stinginess causes animals to loose interest and motivation. Removing reward brings about extinction of unwanted responses.

*Assignment/term paper: Write on “Reinforcement schedules in animal training”.

ii. *Shaping*

Shaping is a technique of reinforcing successive approximations to the final response. It allows a trainer to move from a situation where it is impossible to reinforce a desired response (which has never occurred) to one where the response is occurring and increasing in reliability following reinforcement. The concept is applicable in animal training in that if a trainer wishes to reinforce particular responses, they can either wait for the behaviour to occur spontaneously, which can then be readily reinforced or the behaviour pattern can be shaped. It requires a sense of patience to monopolize each tiny improvement as the only way to moving towards the final response. The behaviour should be rewarded as soon as it happens to avoid a phenomenon called ‘delay of reinforcement effect’ which is likely to lessen the effect of that reward. This may happen because it allows the animal to perform another response during the delay intervals which is reinforced. E.g. Send away exercise in dog training: Dogs have innate tendency to remain with the owner. The dog can be persuaded to leave the owner by rewarding it for small movements away.

iii. *Extinction*

It results when learnt response occurs but no longer followed by reinforcement. It is obvious that behaviours will drop out or become extinct when an animal no longer receives a reward for a correct response. E.g. Dogs that beg at dinner table stop begging if they are never rewarded. Extinction is usually accompanied by reversion to innate behaviours.

4. **Latent or exploratory learning**

Animals explore new surroundings and learn information which may be useful at a later stage (hence latent) and mean the difference between life and death. E.g. In mice, knowledge of the immediate environment of its burrow may help it escape from a predator. At the time of acquiring this knowledge, it had no apparent value, hence *not all behavioural activities are apparently directed to satisfying a need or obtaining a reward.*

5. **Insight learning**

This is the highest form of learning which does not result from immediate trial-and-error learning but may be based on information previously learned by other behavioural activities. Insight learning is based on advanced perceptual abilities such as thought and reasoning. Kohlar’s work on chimpanzees suggested insight learning: when presented with wooden boxes and bananas too high to reach, the chimps stacked up the boxes beneath the bananas and climbed up to get them. This response appeared to follow a period of ‘apparent thought’. Previous experience of playing with boxes (latent learning) may have increased the likelihood of the response.

3.2 Inherited or innate behaviours

Innate behaviours involves a collection of responses that are predetermined by the inheritance of specific nerve or cytoplasmic pathways in multi-cellular or single-celled

organisms. As a result of these 'built-in' pathways a given stimulus will produce invariably the same response. These behaviour patterns have developed and been refined over many generations (selected) and their primary adaptive significance lies in their survival value to the species. Innate behaviour patterns include orientations (taxes and kinesis), simple reflexes and instinct. Instincts are extremely complex and include biological rhythms, territorial behaviour, courtship, mating, aggression, altruism, social hierarchies and social organization.

Instincts are complex, inborn, stereotyped behaviour patterns of immediate adaptive survival value to the organism and are produced in response to sudden changes in the environment. It can be considered as 'unlearned species-specific motor patterns' or species-characteristic behaviour. These responses are handed down from generation to generation and, having successfully undergone the rigorous test of natural selection, clearly have important survival significance. However, instinctive behaviour patterns are not completely inflexible because all aspects of the development in an organism whether anatomical, biochemical, physiological, ecological or behavioural, are the result of the influence of constantly varying environmental factors acting on the genetic framework. In view if this, some behavioural patterns may not be purely instinctive (genetic) or purely learned (environmental), but influenced by a combination of the two.

1. **Agonistic behaviour**

Agonistic behaviour can be defined as a group of behavioural adjustments associated with fighting, which includes attack, escape, threat, defense and appeasement. The simplest explanation of the concept of agonistic behaviour is that it composed of a continuum of behaviours from threat to aggression to submission. Agonistic behaviour has the adaptive significance of reducing intra-specific conflict and avoiding obvious fighting which is not in the best interest of the species. Dangers from competition are avoided by agonistic behaviour.

Threat refers to those species-specific vocalizations, odours, postures, facial or body movements that signal the intent to display aggression. In stable social systems, threat causes immediate signs of avoidance or submission. In newly formed or unstable social groups, a threat may cause the recipient to threaten, or a threat may precede an outbreak of aggressive behaviour.

Submission includes species-specific behaviours, vocalizations, postures and odours that signal non-aggressiveness and reduce further attack by the aggressive individual. E.g In dogs and wolves, an appeasement posture may take the form of the animal lying down on its back or baring its throat to the victor. A submissive behaviour is usually exhibited following either a threat or an aggressive interaction. Therefore, while showing submission, the animal is stressed. Most submissive behaviours are learned behaviours associated with fight (from attack) or appeasement, and that an animal must have been attacked at some time in his life in order to show submissive behaviour. Submissive behaviour may be objectively measured because they always follow either an aggressive behaviour or a threat, and because each species has specific submissive postures.

Aggression is a segment of agonistic behaviour and can be regarded as those species-specific behaviours associated with attacks with the objective of causing physical injury. They are usually directed towards members of the same sex and species and have various functions, including the displacement of other animals from an area, usually a territory or source of food, the defense of a mate or offspring and the establishment of rank in a social hierarchy. Most species channel their 'aggression' into ritual contests of strength and threat postures which are universally recognized by the species. E.g. Horned animals such as beer and goats may resort to butting contests for which 'ground rules' exist. Only the horns are allowed to clash and they are not used on the exposed and vulnerable flank. Siamese fighting fish resort to threat postures involving increasing their apparent size.

Table 4. **Classification of aggressive behaviours common to food animals**

Behavioural category	*Definition/Example*
Inter-specific aggression:	
1. Maternal defense	Mother defends young against potential predators. E.g. Ewe with lamb attacks dog.
2. Defense of territory	Animal attacks intruder. E.g. grazing bull attacks man.
3. Predation	Animal attacks, kills and eats other animals. E.g. Lion catches and eats zebra.
Intra-specific aggression:	
4. Aggression after grouping	Previous unfamiliar animals are bought together, they fight and a social structure or hierarchy results. E.g. pigs.
5. Inter-male fighting	Adult males generally fight to win mates or territory. Eg. Rams or goats fight during breeding season.
6. Resource defense	Aggression increases with limited resources in cattle, etc.
7. Inter-gender fighting	Males attempt to mount non-oestrus females, aggressive behaviour results. E.g. Non oestrus sows attack boar who attempts to mount.
8. Aberrant aggression	Wool biting in sheep, ear and tail chewing in pigs, cannibalism or killing of young.

Maternal defense: Aggression towards humans from females is less common, but the lactating female may be a threat to workers due to maternal defense of young.

Territorial defense: Inter-specific agonistic behaviour is most often a management problem with large farm animals. Aggressive male animals, particularly bulls, boars and rams can be dangerous because they can injure or kill farm workers. Food animals may set up a territory which when violated by a human, provokes attack.

Predation: Some motor patterns used during predatory attack fit the definition of aggression. Pigs and poultry are considered omnivores and thus may occasionally attack and eat small animals.

Aggression after grouping: The most common management practice that induces aggression and submission is bringing together unfamiliar animals (especially in poultry, sheep, swine and cattle). This incites high and measurable levels of agonistic behaviour. The agonistic behaviour shown after grouping unfamiliar animals follows the continuum from threat to aggression and submission until a period of social stability is reached, during which only an occasional threat or attack is necessary for an animal to reinforce its dominance. If greater amount of agonistic behaviour is observed, the group may have an unstable dominance order. Inter-specific agonistic behaviour must therefore be managed to optimize productivity.

Inter-male fighting: Is observed during breeding season in normally un-aggressive flocks of food animals. It may be due to motivation to breed limited number of females or due to seasonal changes in physiology. E.g. high testosterone level.

Resource defense: When resources are limited in any season, aggression increases. E.g. limited feeder space.

Inter-gender fighting: Occurs during attempted sexual activity when (1) a male attempts to mount a female but receives aggression from an anoestrus female or (2) a male attacks a female in search for a receptive female.

Aberrant aggression: The intent seems to be to cause physical damage as in tail biting in pigs.

Ethogram of agonistic behaviours

An ethogram is a complete catalogue of all behaviour patterns and vocalization occurring in a species.

1. **Sheep**

They are often viewed as non-aggressive, gregarious animals but do show measurable levels of agonistic behaviour.'

Aggressive behaviour (fighting) include: shoving with shoulders, running together and butting. Play butting occurs in young lambs and more damaging aggression in ewes and rams. Most fighting is during breeding season.

Threat postures include: striking the ground, tooth grinding, lateral body presentation, sniffing, mounting and chasing.

Aberrant aggression: Some ewes show aberrant aggression towards their lambs or alien lambs. Wool picking with teeth is common in confined sheep.

2. **Goat**

Contact agonistic behaviour include: Pushing the forehead against another goat; Butting and rear clash.

Non-contact agonistic behaviour include: Staring; A horn threat with chin down and horns forward; Rush or rear as a challenge threat.

3. **Cattle**

Pre-fight behaviours: Active or passive avoidance lead to fight.

Threat: Close contact, head lowered, ready to fight and butting or active fighting. Butting could be regarded as a non-retaliated blow with the head, while fighting involves reciprocal butts, circling and pushing.
Submissive behaviour: The end of the fight begins with one animal showing submissive behaviour.
Aberrant agonistic behaviour: Include naval sucking, fence and pen chewing (aggression towards inanimate objects) and ear sucking. These behaviours may be a sign of nutrient deficiency. Other abnormal behaviours include: mis-mothering.

4. **Swine**
Threat: Head tilt and retreat or avoidance to chase and nose to nose contact.
Aggressive: Components of agonistic behaviour in the pig are composed of bites and pushes. Head-thrusts in combination with bites and shoulder pushes represent the phase of interaction that seems most intense.
Submissive behaviour: is shown by the subordinate pig turning its body and either running away or remaining stationary and presenting its rump. Submission may be signaled by lowering of the head.
Abnormal or aberrant agonistic behaviours: Tail/ear biting and cannibalism. Swine occasionally kill their piglets, and growing pigs bite tail and chew ears. *High concentration of atmospheric ammonia, dietary factors, floor type and lack of bedding may aggravate tail biting and ear chewing in pigs. Other abnormal behaviours in pigs include: abnormal mating behaviour, abnormal maternal behaviour, eating disorders, abnormal dunging etc.

5. **Chickens**
Threat: Chickens shown threats associated with fighting, leaping and wing-flapping. The major aggressive act is pecking.
Submissive behaviours are described as retreat.
Aberrant behaviour can be found among confined chickens. Cannibalism could be influenced by diet and management procedures.

Management of aggression
Besides farm machinery, animals are considered to be the 2nd leading cause of injury in some livestock farms. Injuries identified with animals include bites and kicks. There are situations in which the workers get pinned between the animal and farm building, implement or other fixed object.

One of the best ways to avoid livestock injuries is to understand animal behaviour. Only by knowing the animals and what to expect in certain situations can farm workers protect themselves and others from injuries.

Bearing in mind the behaviour patterns of cattle, sheep and pigs, a production programme to minimize aggression, livestock injury and maximize safety to stock men will include the following:

1. Animal should be raised in groups for better control. The three species in question prefer staying close to each other at grazing/feeding and other activities. Individuals become upset easily when left in isolation and can pose some danger to the stock man.

2. Provision of adequate housing/holding area as well as wallowing area for pigs: This is to provide shelter and minimize adverse environmental effects from high radiation or rainfall which may cause drastic changes in animal habits. Increase in space allowance and reduction in group size may reduce the level of aggression among livestock species.

3. Provision of adequate feed, water and pasture: The location of feed in the environment is very important. Several feeders should be placed at strategic locations to avoid one individual taking control over the available food. If resources are well distributed, there will be less competition and fighting.

4. The stockman should maintain a dominant role with farm animals because animals form social relationships with caretakers who provide shelter and care for animals.

5. Stock men should be alert when handling animals during the most active time at dawn or dusk.

6. Some short-term treatments sometimes used to minimize aggression between newly mixed pigs include the use of tranquillizer (azaperone). This reduces the immediate levels of aggression following mixing. However, once the tranquillizer has worn off, fighting would resume at levels that would have occurred; Presumably, the pigs still have to form their dominance hierarchies. Dosage may also be important, if it is too high, the pigs may be unable to familiarize themselves with new individuals during the period of the drug's effects.

Other methods such as mixing individuals during periods of low activity, or providing food to distract them from each other may have limited effectiveness, but likely postpone rather than prevent aggression.

2. Dominance status

One aspect of social behaviour arising from a group of individuals living together temporarily or permanently is the existence of social hierarchies or pecking orders. A pecking order is a dominance hierarchy in which animals within a group are arranged according to status. E.g. In a group of hens sharing a hen house, a linear order is found in which hen A will peck any other hen in the group, hen B will peck all hens other than A and so on. The position in the hierarchy is usually decided by some agonistic form of behaviour other than fighting. Pecking orders exist only where animals are able to recognize each other as individuals and possess some ability to learn.

Factors determining the position of individuals in the hierarchy include: size, strength, fitness and aggressiveness (See Table 5). Lower order male members may be raised up the hierarchy by injection of testosterone which increases their levels of aggressiveness.

Advantages of pecking order

1. It decreases the amount of individual aggression associated with feeding, mate selection and breeding site selection.
2. It avoids injury to the stronger animals which might occur if fighting was necessary to establish the hierarchy.
3. It ensures that resources are shared out so that the fittest survive. E.g. if a group of 100 hens is provided with sufficient food for only 50 hens, it is preferable, in terms of the species, for 50 hens to be adequately fed and the weaker 50 hens die than for them all to live and receive only half rations, as this might prevent successful breeding.
4. Social hierarchy increase genetic vigour of the group by ensuring that the strongest and genetically fittest animal s have an advantage when it comes to reproducing.

Table 5. Effects of breed ad horn size on social hierarchies in West African dwarf and Red Sokoto goats

Variable	Sub-class	No.	LSM (±SE)
Breed	West African Dwarf (1)	16	2.06±0.13
	Red Sokoto (2)	13	2.03±0.14
			(P>0.05)
Horn size	Small (1)	10	1.21±0.16
	Medium (2)	10	2.00±0.16
	Large (3)	9	2.93±0.17
			(P<0.001)
Breed*Horn Size	1,1	6	1.17±0.21
	1,2	5	2.40±0.23
	1,3	5	2.60±0.23
	2,1	4	1.25±0.25
	2,2	5	1.60±0.23
	2,3	4	3.25±0.25
			(P<0.05)

Source: Bemji *et al*. (2003)

3. Territorial behaviour

A territory is an area held and defended by an organism or group of organisms of the same or different species. Territorial behaviour is common to all vertebrates except amphibian but is rare in non-vertebrates.

The exact **function of territory formation** varies from species to species, but in all cases, it ensures that each mating pair of organisms and their offsprings are adequately spaced to receive a share of the available resources, such as food and breeding space. In this way, species achieve optimum utilization of the habitat.

The size of territories occupied by any` particular species varies from season to season according to the availability of environmental resources. Birds of prey and large

carnivores have territories several square miles in area in order to provide all their food requirements. Herring gulls and penguins have territories of only a few square metres, since they move out of their territories to feed and use them for breeding purposes only.

Territories are found prior to breeding, usually by males. Defense of the area is greatest at the time of breeding and fiercest between males of the same species. There are a variety of behavioural activities associated with territory formation and they involve threat displays between owners of adjacent territories. These threat displays involve certain stimuli which act as releasers. E.g. An adult male robin would attack another adult male displaying a red breast and a bunch of red feathers, but not a young male robin which did not have a red breast. The level of aggression shown by an organism increases towards the centre of the territory. The aggressiveness of males is determined partly by the level of **testosterone** in the body and this can affect territory size. E.g. the territory size of a red grouse can be increased by injecting the bird with testosterone. Territories are acquired through threats, gestures and postures in place of actual fighting. Having obtained a territory, many species especially carnivores proceed to mark out the boundary by leaving a scent trail. This may be done by urinating or rubbing parts of the body against objects called scent posts along the boundary of the territory.

4. Altruistic behaviour

Altruism is a form of social behaviour whereby one organism puts itself either at risk or personal disadvantage for the good of other members of the species. In the case of activities associated with parental care, altruism is not so difficult to comprehend since the action is clearly in the interest of the parents, offsprings and species. E,g, the female baboon protects and cares for its offspring for almost six years whilst most bird species feed and protect their demanding offprings until they are capable of fending for themselves. What is not so clear is the reason why some organisms give support to organisms which are not their offsprings. E.g. Birds and monkeys call out warnings to others in danger and female monkeys carry and care for the babies of other monkeys. In insects such as honey bees, wasps and ants, sterile female workers are prevented from producing offsprings, yet they spend their lives looking after their brothers and sisters. Hence, helping their sister (queen) to reproduce, they are effectively aiding in the production of queens, workers an drones with a genetic complement closer to their own than if they had offspring of their own. The conferring of a genetic advantage on closely related organisms forms the basis of altruistic behaviour.

Altruistic behaviour is very common amongst primates and varies from the extremes of social protection which exist between members of the same troop (monkeys), through acts of mutual grooming and food sharing (apes) to deliberate acts of self-sacrifice for family (God of humans). The extent of altruistic behaviour appears to be relatled to close relatives (kin) such as offspring and siblings (brothers, sisters cousins) with whom they share certain alleles.

Thus **adaptive significance of altruistic behaviour** is to increase the frequency of those alleles common both to the donor and recipient(s) of the altruistic behaviour.

4. Reproductive behaviour

Reproduction in many species consists of release of gametes into the environment. The only condition necessary for fertilization is the release of egg and sperm at approximately the same time. Reproductive behaviour may be summarized as:
1. *Synchronization*, whereby two animals come together and are physiologically ready to reproduce.
2. *Courtship*, whereby the two animals breakdown one another's tendency for physical avoidance and,
3. *Copulation*, whereby sex cells, usually sperms are transferred. Each step in the pattern of behaviour is essential for the succeeding step.

Why the need to study reproductive behaviour?
An understanding of the sexual behaviour of livestock is one of the keys to maintaining productive herds and flocks in tropical countries for the following reasons:
1. Since only a few males are needed to inseminate large numbers of females, the sexual behaviour and fertility of male animals are of crucial importance to building a herd or flock.
2. Behavioural observation is the main method used to ascertain whether a female is in oestrus and will become pregnant if inseminated, since artificial insemination is now the norm in intensive dairy cow production system.
3. Under tropical conditions where mixed herd are run and breeding often uncontrolled, knowledge of sexual behaviour is useful in that animals that are sick or unproductive can be identified by their lack of normal behaviour and culled.

Courtship and mating
There are many elaborate and ritualistic species-specific behaviour patterns associated with courtship and mating. In birds, mammals and some fish, these two processes often follow the establishment of a territory by the male. ***Courtship*** is a complex behaviour pattern designed to stimulate organisms to sexual activity, and is associated with pair formation in those species where both sexes are involved in the rearing of offsprings.

Courtship behaviour is controlled primarily by *motivational* and *releasing stimuli* and leads to mating. During mating, the behavioural activities are initiated by releasing stimuli and ended by *terminating stimuli* associated with the release of gametes by the male. The motivational stimuli for courtship in most species are external, such as *photoperiod*, and lead to rising levels of reproductive *hormones* and the maturation of gonads. In most species, this produces striking changes in secondary sexual characteristics and other behavioural activities including colouration changes, increase in size of parts of the body, as in the plumage of birds, mating calls as in nightingales, use of chemical sex attractants.

Of the variety of *signals* used in the *courtship* to attract members of the opposite sex, **sight**, **sound** and **smell** play important roles. Many insects (e.g. crickets), amphibian, birds and mammals use auditory signals in courtship. Substances called pheromones are secreted and released in small amounts by organisms, leading to specific physiological

responses in other members of the same species for the purpose of courtship and mating. E.g. Mares, cows and bitches secrete pheromones while in heat.

Mating systems

1. *Monogamous mating system*

- Involves one male and one female.
- Includes those species where both sexes are involved in rearing of offprings. E.g. about 90% of avian species.

2. *Polygamous mating system*

- Involves one male and many females.
- Only the female is involved in rearing offspring. E.g. Most domestic livestock (ruminants, pig etc.)
- It is in the reproductive interest of the male to seek out and mate with more females.

Courtship behaviour in domestic fowl

Male domestic fowl typically have fleshy head ornaments such as comb and wattle and perform elaborate courtship displays. It is shown that behaviour of males changed after females were introduced into experimental pens. The frequency of behavioural display known as wing-flapping increased. Wing-flapping is typically performed by males during aggressive interactions with other males and when courting females. Females show preferences for socially dominant males with large combs and highest wing-flapping rate. Females use morphological traits or characteristics that will enhance their fitness. Males may provide high quality resources and or parental care both of which directly increase female's reproductive success. Having acquired a female, the male dances in a circular manner round her (waltz dance) with one wing trailing before pursuing to mate her.

Nesting and laying behaviour

In the wild, a hen usually moves away from the rest of the flock to find a secluded nesting place. Domestic hens tend to lay close to their flock mate rather than in isolation. Within the flock hierarchical structure, sub-ordinate hens are often bullied, particularly when seeking nest boxes. To reduce the impact of excessive aggression within a flock and to reduce floor laying, it is important that sufficient nest boxes are available. All hens show elements of typical nesting and laying behaviour sequence as follows: Separating from the flock, examining potential nest sites, scratching and pecking at nest material, building a nest or choosing on already formed nest, entering the nest, forming a hollow, laying an egg, rolling the egg under the body, lying on the egg, getting up, standing, leaving the nest and crackling. If no adequate nest site is available, hens will develop abnormal nesting and laying behaviour and possibly stereotyped activity patterns. The following provision must be made to address the animal's basic need: social housing, laying nest, elevated perches, natural light, area for pecking, scratching and dust/sand bathing.

Brooding behaviour

Broodiness is an instinctive type of behavioural characteristic exhibited by avian species. In essentially all avian species, one or both parents must incubate eggs until hatching and then provide some form of post hatching care.

A hen lays only one egg every day or two. She does not start to incubate them until the whole clutch is laid so that all the chicks will hatch at the same time. The physiology of a hen changes after she's laid her clutch. She will remain on them, with her wings slightly spread to help keep them warm, for 21 days. The hen makes muttering, growling sounds if disturbed, and may even peck or otherwise try to defend her nest. She will only leave the nest once a day to eat, drink and defecate. The hen should be allowed to do this at least every other day in order not to starve or get the eggs dirty with her droppings. Once the chicks start to hatch she will remain on the nest with them for 24-48 hours. Any egg that is not hatched by then will be left behind when she takes the chicks for their first walk. At this time water and chick feed should be available for the chicks. It is best to move her to a protected nest once she has been sitting tightly for a few days. This protects her from being chased off the nest by more dominant hens, leaving the eggs to chill and die. Move her gently at night and keep the new nest dark for the next day.

A hen is also called *broody* when she is raising her chicks, protecting them, teaching them to find food, and hovering over them to keep them warm. The main *hormone* implicated in this type of behaviour is **prolactin**. Prolactin is highly correlated with display of incubation behaviour, brooding/feeding of young. A rise in prolactin may occur abruptly at the time of egg laying and incubation, or prolactin may rise more slowly and not peak until later in incubation. Prolactin levels often begin to decline only after the chicks achieve thermal independence and do not require constant brooding. Parental behaviour of galliform birds is atypical because the chicks are precocial (developed certain faculties earlier than normal), requiring relatively little parental attention and because the male provide little or no parental care.

Note that many breeds of chicken have had the instinct to go broody bred out of them so that they will produce more eggs. These include especially the Mediterranean breeds like the Leghorns which will never go broody. The Sex-linked hybrids and production strains of Rhode Island Red and Barred Rock also usually don't go broody.

Reproductive behaviour in other domestic livestock species

Following the attainment of sexual maturity in females, the sequence of reproductive events is cyclic in nature, mainly controlled by hormones. In the male, early secretion of foetal androgen regulates the hypothalamus, rendering the sex centre acyclic.

Oestrus behaviour

Oestrus is a behavioural strategy to ensure that the female is mated at the time of ovulation. Oestrus coincides with the greatest development of ovarian follicles brought about by follicle stimulating hormone. The psychological manifestation is brought about by oestrogen. The female in oestrus or heat becomes receptive to the advances of the male and may even actively seek out for him. Thus a tethered ewe in heat will be located and mated by a ram. Each mammalian species show oetrus behaviour at ovulation with one notable exception, the human.

Oestrous cycle

It is the period between one oestrus and the next. Oestrous cycle in females is nature's first priority in reproductive design. Cycles are only a consequence of infertility or failure to conceive. They are nature's way of making another bid for pregnancy. Oestrous cycle lasts for 16-25 days in domestic mammals (Table 1) and varies between species as well as within individuals.

Table 1. Oestrus cycle, oestrus duration and ovulation time in some mammals

Species	Length of oestrous cycle, days	Duration of oestrus	Time of ovulation
Ewe	16-17	24-36 hours	20-30 hrs from start of oestrus
Goat	21	32-40 hours	30-36 hrs from start of oestrus
Sow	19-20	48-72 hours	35-45 hrs from start of oestrus
Cow	21-22	18-19 hours	10-11 hrs after the end of oestrus
Mare	19-25	4-8 days	1-2 days before the end of oestrus
Rabbit	Reflex ovulator	-	10-11 hours after corpulation

Heat detection in farm animals

Heat detection is necessary for the following reasons:
- When animals are to be artificially inseminated,
- There is need to keep accurate breeding records, and
- There is need to check for absence of pregnancy after breeding.

There are behavioural signs of oestrus for each species:

1. **cow**
- Restless or nervous (hyperactive).
- Go off feed.
- Frequent bellowing (deep loud voice).
- Stands still to be mated by the male.
- Allows herself to be ridden by other cows in the presence of the male.
- Sometimes, vulva will be swollen and there will be mucus discharge (anatomical).

Bulls can detect a pro-oestrus cow two days before oestus and will remain close to her, trying to drive her from the herd. Alternatively, bulls can be attracted to an oestrus cow if she is being ridden by other cows. Periodically, the bull will smell and lick the cow's vulva and urine, often displaying the 'flehmen' or 'lip curling' response. i.e. curling of the upper lip combined with elevation of the head. This response helps the bull to evaluate chemosensory stimuli provided by the cow that will contribute to sexual arousal and will confirm her receptivity. As full oestrus approaches, tending becomes more marked and the bull will nudge the female's flank and rest his chin across the cow's back. The male will make several mounting attempts before the cow will stand for him. Once the female remain immobile, the bull mounts immediately. Ejaculation occurs within seconds of intromission and is accompanied by generalized muscular contractions. Most cows are mounted between 3 and 10 times by the bull during one oestrus period.

2. **Ewe**
- The most obvious sign is that they will stand to be mated by the male.
- Provocative urination in the presence of the male.

With sheep, **rams** will actively seek receptive ewes within the flock and will also spend a great deal of time sniffing the female's vulva and urine. 'Lip curling' is part of ram's sexual behaviour. Typically, the male will kick the female with its foreleg while flicking the tongue. The head is tilted and lowered while the shoulder is brought into contact with the flank of the ewe. The ram will simultaneously utter low-pitched calls. Several mounting attempts will take place until mounting with intromission and ejaculation occurs. This is often followed by a resting period before the ram will show interest in the same or another ewe. A ram will copulate with a ewe several times during the receptive period.

3. **Doe**
- The most obvious sign is that they will stand to be mated by the male.
- Wagging of tail (also when you place your hands on the loins of the goat).
- Bleating, restless behaviour and jumping on the backs of other goats.
- Provocative urination in the presence of the male.
- Slightly red and swollen labia (vulva); this is anatomical and may not be obvious in all cases.

In general, the behaviour of **bucks** is very similar to that of rams, but they exhibit a unique behavioural feature of urinating on their own forelegs and beards during courtship. The function of this behaviour is not known. When courting the female, the buck produces a moaning sound and thrust his tongue in and out.

4. **Sow**
- She becomes restless.
- Irritable (easily annoyed).
- Frequent urination.
- Vocal emissions.
- Stands to be mated in the presence of the male.
- Immobility response to man.
- Swollen vulva and mucus secretion (anatomical).

Boars appear to identify the sexual stage of the female by random searching and once in contact with an oestrus female, the male will pursue her, attempting to nose her sides, flanks and vulva. During this phase of courtship, the boar will produce a series of soft grunts called 'courting song', which may encourage the female to stand. The boar will also emit urine rhythmically and the odour of the urine may further increase the female's willingness to stand. Several mounting attempts will be made until the female becomes immobile, after which intromission follows rapidly. Ejaculation takes place within 3 to 20 minutes.

Factors affecting oestrus behaviour

1. *Genetic factors*: Different cattle breeds show considerable differences in the expression of oestrus behaviour in terms of duration and intensity. E.g. Zebu cows exhibit oestrus for a shorter period of time with less intensity than breeds of temperate origin.
2. *Nutritional factors*: Weight loss has an effect on cyclic ovarian activity, which ceases when cows lose 25-30% of their mature body weight. Cows fed on a supplement of groundnut meal are twice as fertile as those receiving no supplement.
3. *Social environment*: If ewes, does and sows are kept in a separate herd or flock from the males, their oestrus behaviour will be affected and it may be more difficult to detect oestrus. This is less of a problem with cattle. Overcrowding cows for an extended period can delay puberty and may also result in irregular oestrous cycles.
4. *Photoperiod and ambient temperature*: Climatic stress tends to reduce the rate of weight gain in all livestock species and this in turn will delay the onset of sexual maturity and therefore shorten the animal's breeding life. Hot ambient temperatures also adversely affect breeding sows, which are very prone to heat stress since they cannot pant or sweat. Hence an external source of cooling is essential in hot climates.
5. *Disease*: Female livestock suffering from raised body temperature resulting from an infection are unlikely to exhibit normal sexual behaviour. Several specific diseases associated with reproduction can also affect sexual behaviour. E.g. Cystic ovarian disease in cows, where raised levels of oestrogen affect the animal's behaviour patterns during the oestrous cycle. They may become restless and paw the ground and all signs of oestrus may be suppressed.

Factors affecting male libido and mating ability

1. *Genetic factors*: Different breeds show differences in their sexual behaviour. E.g. Low libido is sometimes seen more frequently in Landrace than Large White boars.
2. *Social behaviour*: Rank order or dominance hierarchy of males can have a marked effect on sexual behaviour, with dominant males achieving the most copulation. It is possible for the dominant male to be infertile, with drastic consequences on the herd fecundity. If large numbers of cows return to service within the herd, the dominant bull should be removed.
3. *Photoperiod and temperature*: Some domestic species such as sheep and goats show seasonal breeding in temperate and cold climates and seasonal fluctuations are widely observed in the libido of rams and bucks. These are caused by changes in day-length.
4. *Frequency of use*: E.g. it is recommended that young boars (less than 10 months of age) should copulate once a week whereas adult boars can mount twice every 5 days. Longer periods of sexual activity may decrease libido.
5. *Disease*: Infectious diseases that cause lameness and painful condition in the penis and prepuce such as balanoposthitis may reduce sexual performance. Hence, males must be properly examined on regular basis to ensure that only healthy males are allowed for breeding.

Maternal and neonatal behaviour

Maternal and neonatal behaviour greatly affect the growth and survival of the young. Human supervision of parturition can often improve the range of neonatal survival.

1. Pre-parturient behaviour

Cattle

Changes in behaviour can be observed as early as six weeks before parturition when the cow starts to avoid aggressive interactions with herd mates. Cows may be restless for up to 2 weeks before calving and this intensifies during the last 2 days. They will frequently and alternately lie and stand and eating patterns may be interrupted. Anorexia usually develops during the last day before parturition. The cow is likely to seek isolation from herd's mates and may stay apart from the herd for between three days and one week. A good management system will therefore provide individual pen for cows close to parturition. It is also advisable to steam up the pregnant cow before anorexia sets in. Maternal interest in the newborn of other females may occur in cows and one cow may 'adopt' the calf of another cow.

Sheep and goats

Pre-parturient behaviour includes restlessness, interest in the newborn lambs and amniotic fluids of other ewes and isolation from the flock. Restlessness indicates that parturition will take place in the next one or two hours. Restlessness refers to walking in circles, alternately standing and lying, and pawing the ground. Some ewes may also lick their lips or stick their tongues out. Pre-lambing maternal interest may include attempts to foster another ewe's lamb and sometimes, it may result in the death of the lamb since the ewe will lose interest in the alien lamb when her own lamb is born. Alternatively, she may neglect her own lambs. Stealing of alien lambs generally occurs where there is a high density of parturient ewes, either due to high stocking rates or to synchronized lambing. **Isolation of the ewe from the flock increases the chance of lamb survival because it promotes the establishment of a selective bond between the ewe and her lamb(s) shortly after birth and avoids interference from other parturient females.*

As parturition approaches, **goats** will leave the herd and seek a sheltered place to give birth, often near a vertical object. Shortly before parturition, the doe appears nervous, paws the ground, lies down and stands up repeatedly with signs of straining, and kicks and licks her back. Birth is usually completed within one hour of the first behavioural signs of impending parturition.

Pigs

The pre-parturient behaviour of the sow includes intermittent grunting and rapid breathing. When given the opportunity, domestic sows perform an elaborate nesting behaviour that is very similar to that of wild boar, the ancestor of the domestic pig. The sow seeks an appropriate site for building nest 15-24 hour before farrowing and then prepares the nest by rooting and pawing the ground. These actions are caused by hormonal changes mainly **prolactin.** The sows collects and moulds nesting material,

including grass, straw, branches or any other dry material that is available. Note that normal pre-farrowing behaviour cannot be performed when sows are confined and this may cause the sows to become stressed which could interfere with piglet survival. **Sows should be allowed to exercise as much as possible of their normal behavioural pattern by providing nesting material (straw or grass).*

2. Parturient and post parturient behaviour of domestic livestock

In all species, the process of giving birth is divided into 3 stages: dilation of the cervix, expulsion of the foetus and passage of the afterbirth. During the first stage of parturition, the dam shows restlessness and occasionally abdominal straining. Some may show signs of abdominal pain although these signs are often absent in older females. During the second stage, intense abdominal straining occurs. The amniotic sac breaks and a straw-coloured liquid is passed out. The *cow* may stand at first but during the passage of the calf's head, she usually lies down until the calf is born. The second stage ends with the expulsion of the foetus. Expulsion of the foetal membranes usually takes place about 4-6 hours later, but it may be delayed for up to 12 hours in cows. Both *sheep and goats* usually lie down during labour, although females of both species may stand during the final stages of expulsion. Most females stand and start licking their young within few minutes of birth. Licking is driven by an attraction to birth fluids and results in the young being licked dry; the sow rarely licks her young unlike the ruminants. Cattle, goats and sows usually eat the afterbirth but sheep rarely does so.

Some sows kept in commercial conditions (confined in crates or housed on bare concrete floors) remain restless throughout most of the farrowing period which is in contrast with the beheviour of sows kept under natural conditions. Restlessness of sows probably contributes to the crushing of piglets and reduces their intake of colostrums, leading to mortality. *Provision of bedding materials and avoidance of disturbance is desirable and will reduce piglet mortality and maximize productivity.*

3. Neonatal behaviour and nursing

The period of time following parturition is critical for maternal bonding. Therefore, *if contact between the newborn and its mother is prevented during the first few hours of post-partum, a rapid decline in maternal interest is likely to occur.*

Most *calves* are able to stand within 30-60 minutes of birth and up to 50% of calves may take more than 6 hours to find a teat. The time to first suckling depends on the vigour of the calf and maternal responsiveness. Suckling occurs at a frequency of 4 to 10 times a day, with each suckling lasting for about 8 to 10 minutes. Calves do not immediately follow their dams, but remain hidden while the cow grazes. After a few days, the calf will begin to follow the cow, but groups of calves of about the same age (nurseries) will be found lying together for much of the day during when cows need to travel several kilometers in search of food. One or two cows will stay with the calves probably to protect them from predators.

Lambs and kids are born in a relatively advanced state of development and most are able to stand and suckle within one hour of birth. Heavier ones tend to be more vigorous. They keep close to their mothers after birth and suckle with great frequency, sometimes more than once per hour. Sucking periods last for as long as three minutes during the first few days of lactation, but later the duration falls to 20-30 seconds. It is the **ewe** that keeps her lamb close to her side early in the lamb's life, whereas later, the lamb plays an increasing important role in maintaining the mother-lamb attachment. Later on, visual signals become more important and if the physical appearance of the lamb is changed particularly that of the head, the ewe may fail to identify it. *Auditory* signals are also important in ewe-lamb recognition.

After birth, the **doe** licks her kid for a period of 2-4 hours. There appears to be a critical period of about one hour that ensures the kid will be accepted. Thus if the kid is removed at birth and presented to the doe more than one hour later, it may be rejected. Recognition of the kid is based on *olfactory signals* and there is some evidence that if the odour of the kid changes, the doe may reject it. Kids stand shortly after birth, often within 20 minutes and suckle within the first hour. Towards the end of the first day of life, kids move away from their mothers to hide and remain concealed for several days. Females will either stay in the proximity of the kid or rejoin the herd, returning to the kid only to suckle it.

Piglets move around shortly after birth, usually taking 5-40 minutes to locate the udder and 20-60 minutes to suckle on a teat. Piglets failing to ingest colostrum within 20 hours post-partum will die. The sow lies on her side during nursing, although some may stand. Each suckling period is often preceded by a period of jostling between the piglets.

Management techniques to reduce neonatal mortality

1. *Nutrition*

The nutrition of dam particularly during the last trimester of pregnancy has a major effect on birth weight and survival of the young. Supplementary feeding should be provided during late pregnancy.

2. *Supervision of parturition*

Supervision during parturition should aim to detect animals with dystocia and to provide assistance. Close supervision immediately after birth should help to ensure proper mothering.

3. *Housing and provision of shelter*

When animals are given the opportunity to give birth in separate cubicles or pens, dams will stay closer to their young and experience less interference from others. Provide shelter from the sun as well as feed and water close to the area of parturition especially for sheep and goats.

One of the main requirements of farrowing accommodation is an optimal thermal environment for the piglets since newborn piglets need an ambient temperature of at least 35^{o}C. This is achieved by designing a creep area that can be heated and insulated. Farrowing crates can be used to reduce the risk of piglets being crushed.

4. *Fostering*

This is useful for orphans and when dams fail to show appropriate maternal behaviour, has too many young, or is unable to produce milk. Fostering is easy shortly after an animal delivers her young because she will readily accept any alien young that provide similar olfactory cues or signals. Breeds and individuals differ in their readiness to foster alien offspring. Several approaches to encourage the fostering process include:

- In sheep, provide a common odour to the foster lamb and the ewe's lamb. Wool wax and vegetable oil may be used.
- Confinement – placing a dam with alien off-spring in close confinement for some time may result in fostering.
- Skinning – If the dam's own offspring dies, the skin can be removed and tied onto an alien offspring to encourage fostering.

In *pigs*, fostering has two main purposes: 1.To move piglets in excess of the number of functional teats onto sows with spare rearing capacity. 2. To even out the size of litters by birth weight, thus avoiding smaller piglets suffering poor growth rates or high mortality due to competition with stronger litter mates. Fostering is useful when sow is ill or die at farrowing. Sows will readily accept alien piglets. It is desirable to mix the foster piglets with the sow's own litter for approximately 30 minutes in the creep area before introducing them to sow.

6. *Genetic selection*

- Individuals vary in their mothering ability and in the vigour of their young and these differences are partly genetic. For example, some strains of Merinos are notoriously poor mothers, particularly young dams giving birth to multiple young. Such differences allow for the possibility of genetic selection to reduce neonatal losses.
- Selection of breeding gilts according to teat conformation and number can be useful, since bad teat conformation is one of the main reasons why a sow will rear fewer piglets than desirable.

6. Maintenance behaviours

1. **Feeding behaviour**

Understanding feeding behaviour of livestock helps the stock owner maximize the productivity of his animals despite the limitations imposed by the available feed. Feeding behaviour of animals depends on the nature of their main feed source and it is therefore convenient to divide domestic livestock into ruminants (herbivores) and omnivores (pigs and poultry).

i. ***Feeding behaviour of ruminants***

Cattle, sheep and goats are ruminants and ruminating behaviour (repeated chewing of feed) takes a considerable proportion of their time, about 6-8 hours daily in cattle. The extent of rumination depends on the fibre content. Animals that are disturbed or stressed will temporarily cease rumination. Cattle, sheep and goats show different features of feeding behaviour, particularly in the degree of selectivity, preference for grazing or browsing and water consumption. Differences in feeding behaviour between species partly explain the benefits of mixed grazing. The combination of several grazing species usually results in a greater production per unit area than when only one species is grazed. This is because different species eat different forage. E.g. large unselective feeders

(cattle) graze coarse forage and render the range more acceptable to smaller more selective species (sheep and goats).
Grazing ruminants tend to show a diurnal rhythm, grazing mainly during daylight hours with two peaks of grazing activity – one close to dawn and the other in the late afternoon. When day length is short, the two periods merge. In the *tropics*, overnight grazing may be more important particularly if day time temperatures are high.

Cattle are relatively unselective when grazing and are among the most developed of all domestic herbivores. If cattle are given the choice, they will graze annual grasses rather than perennial ones as they find these more palatable. Cattle will browse (feed on twigs, leaves and crop residues) only when grass is in short supply or has low nutritive value. Browse (tree legumes) is an important source of feed in the tropics, especially when grass is in short supply. More commonly, cattle and sheep will graze on standing hay or crop residues during the dry season. They lose weight during this period and gain it during the rainy season when the grass grows again. Bush encroachment may occur if cattle are sole grazers.

Sheep and **goats** are more selective than cattle and both species will graze or browse depending on the availability of each type of forage. In general, sheep prefer to graze and goats prefer to browse. Goats also have the peculiarity of adopting the bipedal stance when feeding and they will even climb trees or onto cars parked under trees. They browse on species not eaten by other animals since they have a higher tolerance for tannins than other ruminants. Hence, goats do not lose body weight during the dry season. Sheep and goats are adapted to arid regions and need considerably less water than cattle.

ii. ***Feeding behaviour of pigs and poultry***
Pigs are omnivorous feeders and will consume a wide range of feeds of both animal and plant origin. Pigs are very opportunistic in their feeding habits. Free ranging pigs have a strong drive to forage over long periods of time. They spend over 50% of their day foraging, with rooting behaviour forming an essential part of this activity. Pigs cannot perform their natural behaviour when they are housed in intensive units, where they are often kept on solid floors with no beddings, and the full day's ration is provided in a trough and consumed in about 20 minutes. It often leads to behavioural problems such as tail biting. In the tropics, pigs tend to concentrate their feeding in the morning, when temperatures are lower.

Poultry in free range forage mainly by scratching at the ground to expose small feed items such as seeds, fruits, herbage and invertebrates. Young birds usually eat a higher proportion of invertebrates than adults, possibly because they require a higher protein diet. Geese may consume large quantities of grass. Under natural conditions, domestic poultry spend a large proportion of their time foraging, with peaks of activity in the morning and the evening. Intensive production systems that prevent the birds from performing such behaviour may result in behaviour problems such as feather pecking.

Imprinting behaviour in ducks is used by farmers in S.E. Asia who take their ducks to graze as a flock. The tendency of ducks to group together especially in S.E. Asia is used

to advantage. The ducks kept together scavenge on the fields from which rice has recently been harvested. They glean rice that has been shed in the harvesting process and consume insects and worms living in the rice paddies.

Water availability and feeding behaviour

Water is essential for life and can be supplied to livestock as drinking water, water in feed and as metabolic water produced by oxidation of organic nutrients. Cattle that are deprived of water rapidly lose their appetite, and if they are subjected to extended period of inadequate water supply, their growth rate will suffer.

Factors affecting water requirements and feeding behaviour of farm animals

Water requirements of livestock are affected by several factors which include: specie, physiological state of the animal, type of diet, dry matter intake, climatic conditions, water temperature and salinity. It is therefore difficult to list water requirements with any accuracy.

i. *Specie and physiological state*

Requirements for drinking water can be very high, and lactating dairy cows have the highest water needs of all domestic livestock. Most cattle need to be watered everyday. Water requirements of sheep and goats are less accurately known. They have more efficient system of water metabolism than cattle and produce much more concentrated urine. They can live in temperate climates without drinking at all if the pasture is not too dry, whereas cattle must have water to drink even under cool conditions. Water needs of pigs in the tropics range from 3.5-8 litres per day for pregnant sows and 20 to 35 litres per day for boars and lactating sows, the highest requirements being for lactating sows with large litters. Adult domestic chickens drink between 150 and 400 ml of water daily in temperate and tropical climates.

ii. *Climatic conditions*

In the temperate climates, dairy cows need to drink between two and three litres per litre of milk produced. In the tropics, they need at least twice as much water as dairy cows living in the temperate zone. Exposure to direct sunlight/lack of shade will further increase a cow's water requirements as well as other livestock species.

iii. *Water temperature and salinity*

Water temperature and salinity may affect water intake and therefore feed intake. Under hot conditions, water intake increases when water temperature is below ambient temperature. It is therefore advisable to place drinkers or water troughs in the shade. Water with high salt content is usually unpalatable to animals, but it is difficult to estimate the maximum acceptable salinity of drinking water because there is great variation between and within species in their salt tolerance. Sheep and goats have greater tolerance to salinity than cattle, and lactating animals require a lower salt content than non-lactating animals. It is suggested that maximum concentration of total salts in drinking water should not exceed 1.3% for sheep, 1% for beef cattle, 0.7% for dairy cattle and 0.5% for pigs.

iv. *Type of diet*
Composition of feed with high salt content increases the animal's intake of water, and when water is in limited supply, animals tend to reduce their intake of salty feed to a greater extent than their intake of low-salt feed. A constant water supply is therefore very important in saline areas, where plants tend to have a high salt content. Animal fed on high protein diet tends to require more water.

v. ***Homeostasis***
Homeostasis is the maintenance of equilibrium, or constant conditions, in a biological system by means of automatic mechanisms that counteract influences tending toward disequilibrium. The concentrations of oxygen, carbon dioxide, nutrients, hormones, organic and inorganic substances in body fluid remain unchanged, within limits, despite changes in the external environment. Homeostasis in organisms is exemplified by the operations of the endocrine system. The hormone-synthesizing activities of the endocrine glands are regulated by events occurring in the systems that the hormones regulate. For example, a rise of blood-glucose levels stimulates the pancreas to secrete insulin, which acts to accelerate the removal of glucose from the blood by conversion into glycogen and fat. *The sensations of **hunger** and **thirst** are also homeostatic mechanisms which help the organism maintain optimum levels of energy, nutrients, and water.*

Homeostasis alone does not control the drive to feed due to the following factors:
1. *Presence of other animals*. E.g. a pig will eat more in company of other pigs than when single. Motivation to feed therefore over-rides homeostatic principles.
2. *Palatability of the feed*: Feeding behaviour is strongly influenced by positive and negative reinforcement from the palatability of the feed.

2. **Eliminative behaviour**
Cattle, goat, sheep and poultry pass out feaces at random at any point whenever need arises while pigs tend to defecate on specific locations. Pigs tend to keep their bedding area clean and dry from excreta and urine when housed individually. Under crowded conditions, it is difficult for a group of pigs to maintain an organized eliminative behaviour. Horses, particularly stallion also show a careful and deliberate effort in selecting particular areas for defecation. The volume of feaces and number of times taken to defecate depends on the nature and quantity of feed ingested.

3. **Rest and sleep**
Clinically healthy animals are expected to lie down at least once in a day, either to rest or sleep, which are necessary for restoration, metabolic recoveries and conservation of energy. Horses spend approximately 2.5 hours a day resting, mainly in a standing position (fixed stance). They hardly spend more than 30 minutes sleeping. Cattle spend about 5 hours a day in a drowsy or sitting position while ruminating and about one hour sleeping. They may also stand or lie without ruminating. Rest and sleep are affected by diet. Time of sleeping decreases with increase in percentage of roughage in the diet.

Nutrient Intake and Utilization

Ruminants optimize forage consumption to meet their nutrient requirements if no physical or metabolic restrictions are imposed. *Voluntary intake* of forage is the amount consumed by the animal when its accessibility to forage is unrestricted. In such a case, regulation of intake is dependent only on endogenous mechanisms triggered either within the animal or by some characteristic(s) of the forage. **Forage (nutrient) intake** under grazing conditions is a modified expression of voluntary intake and is influenced by forage quality, forage availability, environmental stress and management. Environmental stress and nutrient intake are included because foraging for nutrients demands movement over long distances. Diurnal and seasonal thermal fluctuations and predator avoidance are more pronounced under free-grazing than controlled feeding conditions.

Forage intake of grazing ruminants is usually controlled by distension of the reticulum and cranial sac of the rumen. Distension of this sensory region is decreased by digesta passage to the lower tract and/or by reducing ingesta volume and mass through mastication and fermentation. Mastication, primary and secondary, is the major means of particle size reduction resulting in denser, less bulky digesta and more rapid fermentation and passage.

Animal Factors Affecting Nutrient Intake

Voluntary intake may decrease before, and increase after, parturition in both sheep and cattle. Decreased intake during late gestation is attributed to decreased reticulorumen capacity caused by a combination of rapid fetal growth and/or increased deposition of abdominal fat and hormonal mechanisms. The extent to which these mechanisms ultimately control voluntary intake is not known. Voluntary intake increases post partum, but lags behind increased energy requirements for lactation by 2-6 weeks, apparently because of the time required for the rumen to increase in size and re-establish maximum volume.

There is no clearly defined relationship between body condition (fatness) and nutrient intake in cattle and sheep. The general consensus is that abdominal fat restricts voluntary intake 3-30%, although various effects of fatness have been reported. Conversely animals in a depleted state, consume greater quantities of moderate to high quality forages (**compensatory intake**).

Beef cattle and sheep of different genetic backgrounds exhibit markedly different voluntary intakes and efficiencies of production. Maintenance requirements of beef cattle account for 70-75% of the ME requirements through a production cycle, under pen fed conditions. While limited quantitative data are available the maintenance energy costs of free-ranging cattle are estimated to be 20-50% greater than under pen fed conditions. Therefore, the mature size and milk production capability of cows could have a marked effect on their efficiency of production under grazing conditions. Metabolizable energy intake increases as mature size and milk production increases. Similarly, voluntary intake of 3/4 Simmental cows was greater than Hereford cattle under free ranging conditions. Under conditions of low forage quantity and/or quality the production potential of 3/4 Simmental cattle was not achieved.

Animal genotype and phenotype can have marked effects on voluntary intake and efficiency of production. Dairy cattle breeds have higher maintenance and lactation energy requirements and intake per unit weight than beef breeds. These are attributed to

differences in physiological prioritization of tissue growth and maintenance. Dairy breeds have a higher proportion soft tissue organ mass having high maintenance requirements. Additionally, dairy breeds store a larger proportion of fat internally than beef breeds, thereby decreasing insulatory capacity. *Bos indicus* cattle (Brahman type) have been found to exhibit lower maximum intakes of moderate quality diets, under minimal stress, than *Bos taurus*. Lower intake may be the result of *B. indicus* having a smaller digestive tract; however, on poor quality tropical grasses, *B. indicus* digests forages more completely and still exhibits greater voluntary intake than *B. taurus* (Hunter and Siebert 1985a, 1985b). Voluntary intake of moderate to high quality forages is greater for *B. taurus* than for *B. indicus*. When low quality tropical grass diets are supplemented with nitrogen, voluntary intake of *B. taurus* is greater than *B. indicus* indicating *B. indicus* may have a greater capacity to recycle nitrogen. Adaptability of these cattle species to the thermal environment also influences intake patterns. Based upon these findings for domestic ruminants, selecting genotypes suited to a particular range setting is an important management consideration.

Points on Animal welfare and rights

(An HSI Report: The Welfare of Animals in the Egg Industry)

Animal welfare is the physical and psychological well-being of animals. The term *animal welfare* can also mean human concern for animal welfare or a position in a debate on animal ethics and animal rights. Welfare is measured by indicators including behavior, physiology, longevity, reproduction, and attitudes towards different types of animal uses.
Systematic concern for animal welfare can be based on awareness that non-human animals are consciously aware and that consideration should be given to their well-being, especially when they are used by humans. These concerns can include how animals are killed for food, how they are used for scientific research, how they are kept as pets, and how human activities affect the survival of endangered species.
Animal welfare began to take a larger place in western public policy in 19th-century Britain. Today it is a significant focus of interest or activity in veterinary science, in ethics, and in animal welfare organizations.
There are two forms of criticism of the concept of animal welfare, coming from diametrically opposite positions. One view, dating back centuries, asserts that animals are not consciously aware and hence are unable to experience poor welfare. The other view is based on the animal rights position that animals should not be regarded as property and any use of animals by humans is unacceptable. Some authorities thus treat animal welfare and animal rights as two opposing positions. Accordingly, some animal right proponents argue that the perception of better animal welfare facilitates continued and increased exploitation of animals. Others see the increasing concern for animal welfare as incremental steps towards animal rights.

Battery caged chickens

Billions of chickens in the egg industry suffer from poor welfare throughout their lives. Male chicks, considered a byproduct of commercial hatcheries, are killed soon after they hatch. The females are typically beak-trimmed, usually with a hot blade, to prevent them from developing the abnormal pecking behaviors that manifest in substandard

environments. The overwhelming majority of hens are then confined in barren battery cages, enclosures so small that the birds are unable even to spread their wings without touching the cage sides or other hens. Battery cages prevent nearly all normal behavior, including nesting, perching, and dust-bathing, all of which are critically important to the hen, as well as deny the birds normal movement to such an extent that the hens may suffer from physical ailments, including osteoporosis and reproductive and liver problems. Once their productivity wanes, typically after 1-2 years, the hens are "depopulated," and many experience broken bones as they are removed from the cages. The birds are either killed by gassing on the farm or after long-distance transport to a slaughter plant, where they experience further stress and trauma associated with shackling, electrical water-bath stunning, and throat-cutting. Throughout the commercial egg industry, the welfare of birds is severely impaired.

Beak-Trimming

Many laying hens are beak-trimmed as young chicks18 in order to prevent potential outbreaks of injurious feather-pecking and cannibalistic behavior that can result from such intensive confinement in barren conditions, as well as to reduce feed wastage of adult birds. Beak-trimming generally involves removing of the beak tip, but in some cases, up to 2/3may be cut off. The most common commercial method uses a heated blade both to cut and cauterize the beak tissue, but newer technologies include infrared energy and laser procedures. Beak-trimming using a hot blade causes tissue damage and nerve injury, including open wounds and bleeding, which results in inflammation, and acute and possibly chronic pain. Beak amputation can also result in the formation of a painful neuroma, a tangled nerve mass, in the healed stump of the beak, particularly if the procedure is delayed until the birds are older than five weeks of age or if a large, critical amount (2/3) of the beak is removed. The beak is a highly innervated, complex organ containing free nerve endings that serve as nociceptors (receptors for painful or injurious stimuli) and sensory receptors that are concentrated in the area around the tip of the beak, innervated by branches from the trigeminal nerve. Hence, beak-trimming removes many of the receptors important for touch, taste, pain, and temperature perception. Chickens use their beaks to explore their surroundings. The beak is their primary means of touching and feeling, as well as picking up and manipulating objects, and chickens use their beaks in much the same way that we use our hands. Studies have shown that because birds need to adapt to a new beak form after this amputation procedure, their ability to consume feed is impaired following beak-trimming. Beak-trimmed chicks also exhibit difficulty in grasping and swallowing feed. Practices such as beak-trimming have been referred to as "stop-gap measures masking basic inadequacies in environment or management." Many factors present in today's commercial egg production industry heighten the risk of injurious pecking behavior, but important among these is the lack of environmental stimulation in monotonous, barren environments that restrict or severely limit important behavior, such as natural foraging (ground-pecking) activities. Beak-trimming has been banned or is being phased out in some European countries including England, Norway, Finland, and Sweden, due to the pain the mutilation causes and because adjustments to the environment and management practices can be used to mitigate the risks of injurious pecking and cannibalism outbreaks.

Behavioral Restriction

Hens in battery cages cannot perform many of their important, natural behavior, including nesting, dust-bathing, perching, and foraging. They are also so severely restricted in the movements they are unable to perform that they suffer from physical abnormalities due to lack of exercise.

Nesting behavior

Nesting behavior is so important to the laying hen that it is often used as a prime example of a behavioral need. Under natural conditions, approximately 90 minutes before oviposition (egg laying), a hen locates a remote, private place in which she carefully scrapes out a shallow hollow in the ground and builds a nest. Very similar behavior can be seen in non-cage husbandry systems for hens. Nesting behavior is triggered internally with a sudden rise in progesterone against a background of fairly high estrogen levels. This hormonal fluctuation, associated with ovulation, then results in nesting behavior approximately 24 hours later. The internal, biological signals to perform nest-site selection and nesting behavior occur no matter what the external environment. Studies have shown that hens are highly motivated to gain access to a nest site when they are about to lay an egg. Caged hens prior to oviposition are restless, show stereotypic pacing and escape behavior, or perform "vacuum" nesting activity, the expression of the motions of building a nest in the absence of appropriate nesting materials. Decades of scientific evidence suggest that hens are frustrated and distressed, and that they suffer in battery cages because there is no outlet for nesting behavior.

Dust-bathing

The absence of loose litter in a battery-cage environment is also behaviorally restrictive as hens are prevented from performing normal dust-bathing behavior. Dust-bathing keeps chickens' feathers and skin in healthy condition. Given access to dry, friable substrate, such as dirt, wood shavings, or peat, hens would normally dust-bathe approximately once every other day. During a dust-bath, the hen crouches, lies in, and rubs dust through her feathers before standing and shaking off the loose particles. The best experimental evidence suggests that the function of dust-bathing is to balance lipid levels in the feathers. However, dust-bathing is caused by a variety of factors, some of which are external and others internal. Light and heat trigger dust-bathing, as does the presence of a friable, dusty substrate, but even when deprived of these normal eliciting stimuli, hens in battery cages will still try to dust-bathe on the wire floor. Peripheral factors, emanating from the feathers (including ectoparasites), seem to be unimportant since even featherless chickens will dust-bathe. Although there has been a report of dust-bathing deprivation leading to stress, others have suggested that dust-bathing is not driven by a need, but is a pleasurable activity. This does not lessen its importance, since good welfare is dependent on both an absence of suffering and a presence of pleasure.

Perching and Roosting

Barren with wire mesh flooring, conventional battery cages also prevent hens from perching and roosting.

Perching is another natural behavior of the hen. When given the opportunity, hens will normally roost high in the trees at night. The scientific literature suggests that the foot of

a hen is “anatomically adapted to close around a perch” that is, their feet evolved to clutch onto branches. Perch use is important for maintaining bone volume and bone strength. Perches can also serve as refuges for hens to avoid injury from more aggressive hens and will reduce agonistic interactions.
In a naturalistic setting, roosting behavior is thought to function in protecting chickens from predation at night, but evolutionary history continues to drive the hen’s need to perform the behavior, even in the industrialized production environment. When perches are provided in cages, hens may spend 25-41% of day time on them, though this may be the birds’ method of utilizing the extra space. Hens immediately begin to use perches when the lights go off at night, and in one study, within 10 minutes, more than 90% of all hens were found on perches. When perch space is limited, hens will crowd together for roosting space at night. In motivational analysis experiments, hens show behavior indicative of frustration when thwarted from accessing a perch. They are also willing to push through an increasingly heavily weighted door for perch access. Thus, many studies conclude that hens are highly motivated to perch.

Scratching and Foraging
The wire floor of a battery cage also deprives hens of the opportunity to express normal foraging and scratching behavior. Hens are behaviorally adapted to engage in these activities, which would normally take place in loose, varied ground cover. The birds scratch the earth in search of food and as a means of exploring the environment. Studies have reported that domestic fowl spend more than 50% of their active time foraging. Battery-caged hens are fed a concentrated diet, yet, like other animals in captivity, their natural urge to forage remains strong despite the presence of a complete diet fed *ad libitum*. Studies have shown that hens will choose to forage for feed on the ground in loose substrate rather than eat identical food freely available in a feeder. The lack of appropriate foraging substrate may lead to redirected pecking and development of abnormal feather-pecking behavior.

Exercising
Hens in cages are so intensively confined that they have no opportunity to exercise and are not exposed to the normal range of physical forces that structure their bones. The scientific literature provides ample evidence that restriction of normal movement patterns to the extent found in cages causes physical harm in the form of bone weakness. Dynamic loading is a process that occurs during normal movements and causes stresses and strains to bone and muscle that keep the skeletal system healthy. The lack of exercise in cages leads to bone fragility and impaired bone strength. While all hens selectively bred for egg production are prone to skeletal weakness due to osteoporosis (see below), caged hens are more prone to the disease due to lack of exercise. Several studies have compared the bone strength of caged hens to those in perchery and deep-litter systems. Findings conclude a very significant reduction in bone strength in the birds in cages. This problem is so severe that in one study, 24% of birds removed from their cages at the end of the laying period suffered from broken bones. Preference testing has demonstrated that hens do prefer more space than is typically allotted to them in a conventional battery cage and that when given the opportunity to choose between enclosures that differ in size, they will generally choose the larger enclosure. Preference tests have also demonstrated that space *per se*

may not be as important as access to other resources, such as outdoor access or a littered or grass floor. Additionally, small spaces may temporarily be preferred for particular activities, such as nesting.

Engaging in Comfort Behavior

Many studies have shown that comfort behavior, such as stretching, wing-flapping, body-shaking, and preening, are reduced or adversely affected in some way by the battery-cage environment. These types of behavior are important for body maintenance and care of the feathers. The social spacing in a typical battery cage is restrictive to the point that hens may perceive their environment as being too small to engage in comfort behavior. Therefore, even if it is physically possible to perform these simple movements, they may not.

Exploring

Hens are naturally inquisitive, curious animals. Scientists have argued that exploratory behavior is important to animals on several grounds: Exploration satisfies the motivation to acquire information about the surrounding environment, creates agency and competency, and is also an end in itself. Some have further argued that situations that deny environmental challenge (because they are barren and devoid of natural stimuli) deprive animals of "the very core on which their physical existence is based, namely the ability to act." Exploratory behavior may be independent of goal-directed behavior (e.g., searching for a suitable nest site or foraging for food), as chickens continue to display exploratory behavior even when the functional consequences of these behaviors (e.g., nest sites and nutritious food) are present. Exploratory behavior is likely a behavioral need. The barren, restrictive environments of battery cages are detrimental to the psychological well-being of an animal. When environments are predictable, monotonous, and unchanging, they do not offer the degree of stimulation or opportunity for choice that would be found in natural environments. Scientists have suggested that environmental challenge is an integral part of animal well-being and that barren environments lacking challenge and stifling exploration engender apathy, frustration, and boredom.

Disease

Today's laying hen, selectively bred for high egg production,† produces more than 250 eggs annually, compared to 100 eggs per year a century ago.133 The red jungle fowl, the presumed wild ancestor of today's commercial breeds, lays only 10-15 eggs annually. The unnaturally high rate of lay of commercially raised egg-laying hens, sustained for a year or more, takes a toll on the health of the hen and can lead to abnormalities of the reproductive tract and metabolic disorders such as osteoporosis and accompanying bone weakness. As caged hens are unable to exercise, problems with skeletal fragility are exacerbated, and the birds may also suffer from cage layer fatigue and liver problems.

Conclusion

Indeed, restrictively confined in barren, crowded battery cages, laying hens suffer from behavioral deprivation, metabolic and reproductive disorders, and broken bones. They also experience painful beak trimming, careless handling, and inhumane slaughter. Innovative technology and systems for housing, transporting and slaughtering chickens

exists that could greatly improve the welfare of laying hens if more widely adopted within the industry. Further, selective breeding for skeletal strength and reduced propensity to feather peck would further improve the welfare of hens in commercial egg production. Scientific inquiry has clearly shown that battery cages are inappropriate environments for egg-laying hens and that additional improvements are needed to ensure the welfare of hens in the egg industry. On the other hand consideration needs to be for developing nations and teeming populace that lives far below United Nations requirement for a daily meal. Debate is staked to feeding the hungry or animal welfare, biotechnology or organic farming. Each nation needs to prioritize and determine what is most important.