# MAW - 001
# Animal Welfare
# Science and Ethics

Block

# 5

## IMPROVING ANIMAL WELFARE

# BLOCK 5 IMPROVING ANIMAL WELFARE

In the previous block we have discussed the application of animal welfare knowledge in the form of animal welfare assessment and audit schemes. Then the question is how to improve the welfare of animals based on the results of welfare assessment or audit? The purpose of this block is to answer this question with discussion on improving animal welfare through social conditions, human contact and genetic selection.

UNIT 16, **Improving Animal Welfare Through Social Conditions** delineates the complexity of social relationships, costs and benefits of social living, dominance relationships, social environment and its relation to welfare improvement and solving socially induced welfare problems.

UNIT 17, **Improving Animal Welfare Through Human Contact** focuses on influence of human contact on animal welfare, the effects of negative and positive contacts and neglect, opportunities and methods to improve human-animal relationships, animal signals and human-animal conflict.

UNIT 18, **Improving Animal Welfare Through Genetic Selection** describes the power of animal breeding, genetic vs. non-genetic determination, undesirable effects for welfare of past breeding strategies and using breeding to improve welfare.

# UNIT 16 IMPROVING ANIMAL WELFARE THROUGH SOCIAL CONDITIONS

**Structure**



## 16.1 LEARNING OUTCOMES

**a) Knowledge and Understanding:** After studying this Unit you will be able to:

- Explain the meaning and importance of social conditions in improving animal welfare.
- List ways in which the social environment provided in captivity differs from that in the wild.

**b) Practical and Professional Skills:** After studying this Unit you will be able to:

- Describe the complexity in social strategies found in captive animals.
- Illustrate why abnormal captive environments are used.
- Discuss how abnormal social environments affect welfare and ways in which negative effects on welfare can be minimised.

# 16.2 INTRODUCTION

## 16.2.1 Complexity of Social Relationships

The complexity of the social environment varies between:

- Species
- Size of the group, and
- Composition of the social group.

Social groups span a continuum of size and social complexity under wild conditions. The tendency to adopt similar social strategies persists under captive conditions. Social groups can be transient in nature and formed to achieve a specific purpose.

*Example:* Migratory herds or flocks, and schools of fish.

The membership of these groups may be very fluid and the identity of the individual members matters little to the others in the group. The effect of one animal on another may be limited to one animal copying the direction of movement of another, such as communal movement in a fish school in the presence of a predator. Communication may therefore be limited to changes in visual stimuli and the identity of the conspecifics is unknown and of little relevance. At the opposite end of the spectrum lie complex societies, which may persist indefinitely, whose membership is fairly stable over time and in which the identity of individual members is of great importance.

Members of social groups in many species compete for access to limited resources and adopt a system that assigns prioritisation of access to those resources in some way (discussed below). Complex societies formed of animals of different competitive abilities, dominance status or kin relationships require the capacity to establish relationships between individual pairs of animals in the group. By extension, this requires the ability to reliably differentiate between group members, recall the outcome of past interactions with specific individuals and to predict the likely consequences of future interactions. This places considerable demands on recognition and cognitive abilities and sets limits on the optimum size of groups in any given circumstance. Between the extremes of these two groups, lie all manner of different social grouping strategies. It is worth noting that more than one level of complexity may exist simultaneously where, for example, pre-existing individual relationships may persist when smaller groups coalesce into larger aggregations. Most captive species adopt a degree of social complexity that demands an ability to recognise individuals and remember the outcome of past interactions, at least for part of their life cycle. In the wild, clear differences can exist in gregariousness of males and females and at different ages or different times of the year. A particularly common pattern is for females to form social groups of often related members together with juveniles, whilst males disperse as they approach puberty and either form all-male groups with little genetic relatedness or live in isolation.

## 16.2.2 Costs and Benefits of Social Living

Gregariousness offers many advantages compared to living alone (Table 16.1). Although not the most obvious examples of these benefits, the potential for social

learning and social support remain relevant in captive environments. Practical examples exist of how these benefits persist even in environments highly modified from the wild. Social learning is of great benefit in the acquisition of new skills, such as when recently weaned animals need to learn how to use new artificial feeding and drinking systems. Here the opportunity to watch animals that have successfully learnt how to eat and drink can speed the adoption of new skills by the observers. Social support provided by the presence of other conspecifics can reduce anxiety associated with stressful or aversive events. For example separation anxiety in dogs is usually reduced when two rather than one dog is left alone without the owner.

**Table 16.1: Advantages of Living in a Social Group**

| Benefit | Explanation |
|---|---|
| Social learning | The acquisition of new skills is facilitated by copying experienced group members. |
| Social support | The physical or emotional support received due to the action of group members or simply the proximity of conspecifics. |
| Efficient predator detection | Surveillance for predators requires less individual effort and is more effective when in a group. |
| Mutual predator defence | Where an individual may fail to repel a predator, a group may succeed. |
| Prey saturation | This works in two ways. At its simplest, a single predator can only attack one animal and the likelihood of being the target is reduced when many other potential targets are present. Prey saturation also occurs when females synchronise oestrus and young are born during a short window of time and the local predator population is unable to attack all. |
| Efficient food acquisition | For predators, the capture of prey is easier with help. For all animals, locating a food resource is easier when animals search together. |
| Energy conservation | Body heat is preserved by the close proximity of conspecifics (as in huddling pigs and penguins). Energy use can be reduced during flight by flying in a group. |

Group living brings with it challenges that are not faced by an independent individual. Principal amongst these challenges is the need to divide limited resources between group members. Societal rules are adopted which minimise conflict as much as possible. These include the protection and respect of an individual's personal space (that space around it which cannot be entered without causing withdrawal or defence) and the formation and respect of dominance relationships.

### 16.2.3 Dominance Relationships

A dominance hierarchy can be defined as a social ranking system within a group of the same species in which certain forms of status and privilege are held by those ranking at the top, usually the stronger or more aggressive members. Dominance hierarchies are an emergent property of a group that results from the composition of pairwise dominance relationships between its group members. They differ in form between species and their form and rigour of enforcement is also dependent upon the scarcity of resources and therefore the benefits of gaining preferential access to them. A very large number of captive species adopt some form of dominance hierarchy structure within one or both sexes. Dominance is conferred by the ability to obtain and defend a resource, termed resource holding potential (RHP). The attributes that determine RHP are varied, but can be physical (e.g. body size and strength), determined by knowledge level (and therefore often related to age) or symbolic through the display of 'status symbols'. The latter are attributes which themselves do not confer a direct ability to overcome a competitor, but are only shown by animals in peak fitness and are an indirect show of healthiness and past ability to access resources.

*Example:* Size and colour of the comb on the head of chickens.

Experiments have shown that birds move up in a dominance hierarchy when their comb is artificially enlarged and reddened in colour. This is because the growth of such a comb can only be achieved by birds that have been successful in obtaining resources in the past. In this particular example, this status symbol shows that the bird has managed to survive despite the enlarged comb making the bird more obvious to predators. As we will discuss below, efficiently establishing and maintaining dominance relationships reduces conflict but is dependent upon animals having the ability to assess respective RHP easily. Captive conditions which make this more difficult are responsible for prolonged and excessive conflict in social groups.

**Check Your Progress 1**

**Note:** a) Use the spaces given below for your answers.

b) Check your answer with those given at the end of the unit.

1) What are the advantages of living in a social group?

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2) What is the principle challenge that group living brings that is not faced by an independent individual?

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3) Define dominance hierarchy

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4) Write the meaning of resource holding potential (RHP)

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5) Name the attributes that determine RHP

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## 16.3 THE SOCIAL ENVIRONMENT AND ITS RELATION TO WELFARE IMPROVEMENT

### 16.3.1 Captivity and Abnormal Social Environments

Captive social conditions rarely conform to those that occur in the wild and to which the species has evolved. Wild social groups most often contain individuals of different sex, size or age. The most common deviation from this is the grouping together of captive animals of similar RHP and the formation of groups with abnormal demographic structure (e.g. an unnatural proportion of males versus females and young versus old animals). Zoo exhibits for instance often contain groups where the composition of males and females has no resemblance to the wild and where dispersal of young sub-adults is prevented. In farm environments, animals of similar RHP are usually deliberately grouped together as this makes the feeding and marketing of animals easier. The integration of new group members is usually a gradual process in the wild but occurs suddenly in most captive groups. Group sizes frequently deviate from those adopted in the wild. The best example of this is the formation of flocks of many thousands of broiler (meat) chickens and turkeys (Figure 16.1) when the natural flock size is usually a dominant male, less than 10 adult hens and young birds that are yet to disperse.

**Fig. 16.1: Commercial flock of turkeys with several thousand group size**

### 16.3.2 Consequences of Abnormal Social Environments

Unnatural demographics, similarity in competitive ability, sudden forced introduction and inability to disperse result in the violation of societal rules. We can illustrate this by describing how pigs are routinely managed on commercial farms compared to their wild behavioural ecology. Free-living wild boar exists as solitary adult males and social groups of related females with their sub-adult offspring. The female groups occupy a territory but usually avoid confrontation with neighbouring groups. Integration of new animals into a group usually begins after the first week of life and occurs slowly. Aggression is rare except between adult males during the breeding season. Under commercial production, groups are formed by the immediate introduction of unfamiliar and frequently unrelated animals that are often of the same sex. These animals are grouped together due to their similarity in weight, which is the key determinant of RHP in pigs. Variation in RHP is therefore minimised. The grouping occurs in a confined pen where avoidance of conflict is difficult and signalling of defeat by dispersal is impossible. As a result, aggression when a group is first formed is intense as dominance relationships cannot easily be established without resort to the use of damaging aggression to determine relative RHP (Figure 16.2). Few captive species are stimulated to fight so readily and with such intensity as pigs and hence it is regarded as a significant welfare problem in this species. Aggressive encounters are also prolonged as the defeated animal remains in proximity to the winner, which may continue to attack in the absence of obvious retreat by the loser. After the establishment of dominance relationships between individuals and a dominance hierarchy within the pen, the maintenance of these relationships also involves more conflict than reported in the wild. This is probably due to the tendency of animals of only marginally lower RHP to challenge the status of those that are more dominant. It is noteworthy that creating a more diverse range of RHP within the group tends to reduce the occurrence of aggression in commercial pigs. It has also been shown that domestic pigs will immediately revert to the wild grouping strategy when released into the wild. This is evidence that several thousand years of domestication and recent intensive breeding has done nothing to eliminate the natural grouping strategy imparted by millennia of evolution.

**Fig. 16.2: Aggression between pigs of similar RHP (photo credit M. Farish, SRUC)**

### 16.3.3 Social Stress from Redirected Behaviour

In Block 1, Unit 3 we outlined how highly motivated behaviours may find an outlet in the redirection of the behaviour towards a group member when the usual target of the behaviour is missing. These behaviours included tail and ear biting in pigs, feather pecking and cannibalism in laying hens and fin chewing in farmed fish. These redirected behaviours or 'social vices' do not primarily result from housing animals in abnormal social environments but are usually a consequence of an unstimulating physical environment. They do however cause significant social stress in the recipients of the behaviour and can be worsened by social stress in the actors themselves. Social stress can be thought of as a secondary contributor to the occurrence of redirected behaviour and can compound the effects of an unstimulating physical environment (Figure 16.3).

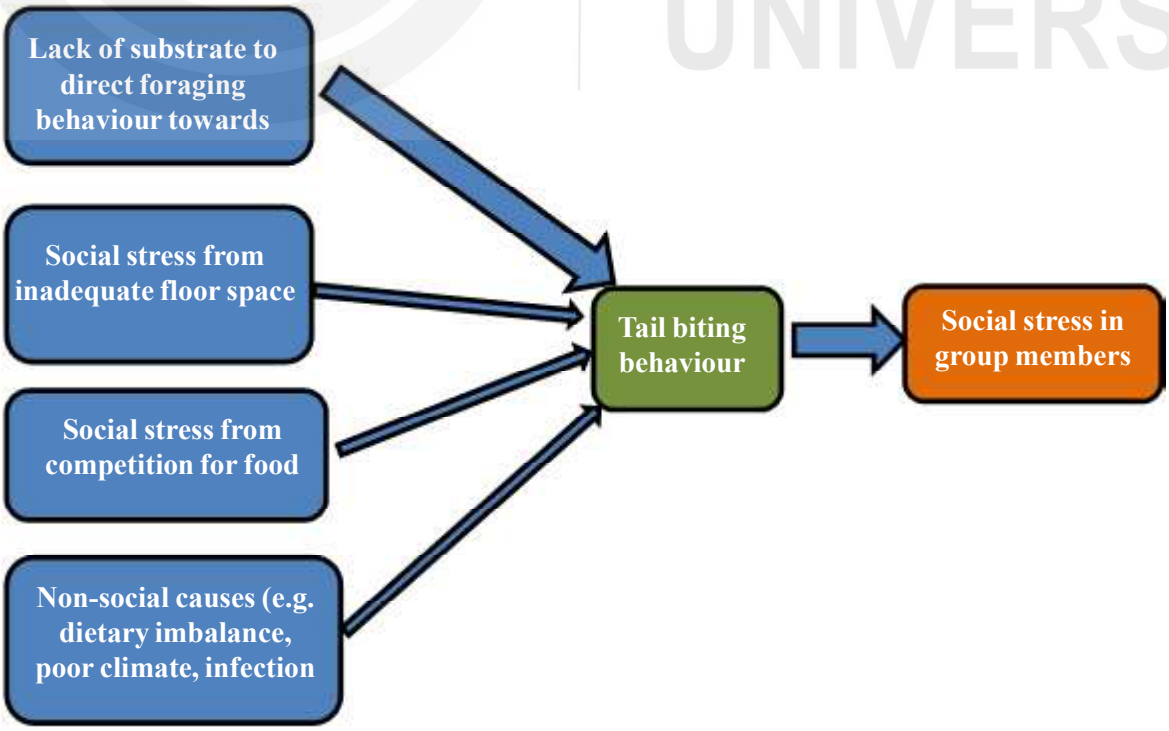


**Fig. 16.3: Diagram illustrating how chronic social stress from competition for limited resources can lead to abnormal behaviour (tail-biting) and social stress.**

Competition for food and space are known to increase the risk of these behaviours occurring. Furthermore, a disproportionate number of smaller, less competitive individuals tend to perform redirected behaviour since they are more likely to experience social stress and to be unable to cope with the combination of a challenging physical and social environment.

### 16.3.4 Why do We Manage Animals in Abnormal Social Environments?

Given the negative outcomes of an abnormal social environment, it is reasonable to question why we create zoo exhibits with an abnormal group structure, suddenly regroup pigs of similar RHP and house broiler chickens in flocks of many thousand birds. We may also ask why laboratory and companion animals are housed in isolation when most would naturally be gregarious.

In the case of laboratory animals, experimental replication may demand the use of isolated individuals and cultural norms (amongst other factors) play a role in determining that most people do not own large numbers of companion animals. In the case of zoo and farm animals, economic and management constraints have encouraged the use of group structures that are easiest to manage, practically and financially. This is most clearly seen on farms as illustrated in Table 16.2.

**Table 16.2: Constraints that prevent the use of naturalistic social group structures in commercial farming**

| Constraint | Outcome |
|---|---|
| Buildings are expensive | Building space must be used with maximum efficiency meaning that the best economic outcome is often achieved by maximising the number of animals housed even if each animal does not perform optimally due to social stress from inadequate space. |
| Labour is expensive | Management changes that require greater time input per animal will not be adopted, such as housing animals in many small social groups rather than a smaller number of larger groups. |
| Mechanical equipment is best suited to large groups | The use of machinery for feeding and cleaning is more compatible with unnaturally large groups. |
| Market demand for uniformity | Consumers and abattoirs determine product specification (e.g. the size of a joint of meat). Deviations from this specification (e.g. a joint from a larger or smaller animal) are penalised. This encourages farmers to create groups of animals of uniform size and weight during the production process, which are also similar in RHP. |

Before we proceed, please complete activity 1.

**Activity 1 (Visit):** Visit a nearby Zoo and choose an animal species with which you are quite familiar. Study the social environments (like composition of group, demographics, similarity in competitive ability, sudden forced introduction and inability to disperse etc). Write your observations on normal or abnormal social environments.

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**Check Your Progress 2**

**Note:** a) Use the spaces given below for your answers.

b) Check your answer with those given at the end of the unit.

1) Differentiate the characteristics of wild social groups and captive groups.

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2) What are abnormal social environments?

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3) Why do we manage animals in abnormal social environments?

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4) List the constraints that prevent the use of naturalistic social group structures in commercial farming.

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## 16.4 SOLVING SOCIALLY INDUCED WELFARE PROBLEMS

### 16.4.1 Preventing Social Stress: Designing Husbandry Systems by Reference to Wild Behaviour

The tendency of captive animals to revert to the social strategies of their wild counterparts is strong. Consequently, reference can be made to the wild behavioural ecology of a species to predict the conditions most likely to lead to social harmony. In progressive zoos, effort is made to create groups with an appropriate demographic mix of ages and sexes. On farms this is problematic as it counteracts the benefits of housing animals together of similar size and age. This has not stopped research that seeks to find a practical way to introduce wild grouping strategies onto commercial farms. In pigs, family pen systems that allow adult females and their litters to freely integrate shortly after birth mean that grouping litters together when older and when aggression is more damaging is no longer essential. This also mimics the wild strategy of integrating non-littermates at a very young age when aggression is less damaging. To date, this family pen system has not been widely adopted by commercial pig producers due to the increased space needed and more variable weaning weight. The evidence would indicate that social stress can be minimised on farms by housing livestock in groups that approximate those of their wild counterparts, but there is some way to go before practical and economic constraints that limit their uptake can be overcome.

Providing young animals with the opportunity to gain social skills early in life is worth exploring (Box 16.1).

**Box 16.1: Opportunity to Gain Social Skills Early in Life to Young Animals**

Appropriate and rich early life experiences are instrumental in many species achieving mature forms of adult behaviour. Establishment of social relationships is a cognitively demanding task and likely to benefit in many species from the opportunity to engage in social contact with new animals when young and practice social skills in a non-damaging context. This may be one of the key benefits of play fighting and why this behaviour is seen commonly in the young of some species. In pigs where damaging aggression in older animals is particularly routine, early life social contact may be particularly valuable as a way to minimise later aggression. Here the opportunity to freely meet unfamiliar piglets from an adjacent litter around

two weeks of age eases the establishment of dominance relationships when they are next grouped with unfamiliar pigs after weaning. It is likely that the opportunity to engage in play and especially play fighting may speed the acquisition of the skills needed to assess RHP.

Respecting dominance relationships requires that defeated subordinates are able to signal defeat by withdrawing from a contest and thereafter avoiding the dominant animal. This is greatly facilitated by the provision of adequate space. In particular, there appears to be a threshold effect whereby restrictions in space allowance below a certain level result in a major escalation in aggression. Environmental complexity is likely to be just as important as the amount of space. Visual barriers that allow separation of winner and loser will reduce aggression by two means:

- Firstly they provide the loser with the chance to avoid the winner, and
- Secondly they probably encourage the winner to believe that it has successfully evicted the loser from the group.

The establishment of dominance relationships occurs even if resources such as food and shelter are freely and abundantly available when the group is first formed. Supply of these resources therefore has little impact on the process of establishing dominance relationships. Thereafter, the vigour with which established dominance relationships are enforced depends greatly on the availability of resources. In situations where resources are limited, dominant animals are likely to enforce their preferential access over subordinates. Where resources are adequate, competition is reduced and dominance relationships may be very difficult for an observer to discern. Inadequate access to resources leading to social stress from aggression and the need to avoid dominant animals therefore result when resources are in short supply. This social stress is felt disproportionately by subordinate animals, but more dominant animals are not immune. When resource access reaches a critical level, the resources become so valuable that makes it worthwhile for subordinates to challenge more dominant animals for access. The stability of dominance hierarchies is reduced and dominance status fluctuates over time when competition is high. Understanding what resources a species needs and values and ensuring these are adequately provided greatly reduces social stress. This will also be facilitated by distributing resources around the environment such that a small number of dominant individuals find it impossible to defend all locations simultaneously.

*Example*: If food provision is restricted, competition can be reduced by providing the food in many locations rather than one.

### 16.4.2 Preventing Social Stress: Genetic Selection for More Positive Behaviour

Unit 18 in this Block considers the contribution of genetics to animal welfare in detail. So this subject will be dealt briefly here for your comprehension.

Behaviour is the manifestation of the animal's:

- Genotype, and
- Past and current environment.

The genotype can therefore affect the social behaviour shown by an individual, which has direct consequences for others in the group. Over past decades evidence has grown that many captive environments cause social stress but management change has not been adopted due to economic or practical constraints. Where progress is lacking, it ought to be technically feasible to reduce the expression of harmful social behavioural traits through selective breeding, as those traits examined to date are under some degree of genetic control. *(Unit 18 will discuss in more detail the evidence for this genetic determination, the likely consequences of breeding for behavioural change, the practical manner in which it could be applied and the ethical considerations of doing so).*

### 16.4.3 Treating Social Stress

Treating the outcome of social stress has proven difficult in practice and prevention of stress through the methods described above is more effective. Animals that need to form dominance relationships cannot be prevented from doing so, but they can be helped to achieve this at the least cost to their welfare through the provision of adequate space, places to hide and naturalistic group structures. Most strategies to control regrouping aggression that have a small economic cost are not effective and include making the animals smell the same, regrouping them in the dark and using tranquilisers. These methods aim to make unfamiliar animals appear to be familiar but in practice tend to simply delay the onset of aggression and the formation of dominance relationships. Similarly, stopping an outbreak of an abnormal social behaviour (such as tail biting or feather pecking) once it has begun is difficult as the behaviour itself becomes rewarding. Again, prevention is better than treatment. Foremost amongst the interventions must be the provision of a stimulating physical environment that allows an appropriate outlet for the foraging behaviour. This should be complemented by a social environment that reduces stress to all, including the weaker members of the group and should focus on adequate provision of space, a comfortably warm place to rest and easy access to food and water.

## 16.5 LET US SUM UP

- An understanding of social behaviour and social conditions is increasingly essential as more animals are housed in groups rather than in individual stalls or pens. There may be economic or welfare reasons for such housing.
- Keeping the above in view, we discussed how to improve animal welfare through social conditions. The focus of the discussion was on social environment and its relation to welfare improvement and designing husbandry systems as per social conditions / organization of species.
- Social groups vary in complexity from transient egalitarian aggregations to dynamic and highly complex societies. The latter rely upon individual recognition of group members and the ability to remember the outcome of past encounters.
- Captive animals retain the tendency to adopt the same grouping strategy as their wild counterparts. Reference to this behavioural ecology can help us to identify what group characteristics (composition of sexes, ages and competitive abilities) can help to minimise social stress. Captive social environments however usually deviate markedly from those in the wild.

- Dominance relationships allow prioritisation of access to limited resources by animals of highest resource holding potential.
- Housing animals together of similar RHP in environments that prevent the full display of submission compromises the ability to form and maintain stable dominance relationships.
- Avoiding social stress is easier than treating the symptoms of it. Avoidance can be achieved by ensuring valuable resources are adequately provided and that the captive social group composition matches that of the wild as much as possible.

## 16.6 KEYWORDS

**Dominance Hierarchy**: This is a social ranking system within a group of the same species in which certain forms of status and privilege are held by those ranking at the top, usually the stronger or more aggressive members.

**Dominant Animal**: A dominant animal is one whose sexual, feeding, aggressive and other behaviour patterns subsequently occur with relatively little influence of the other group members.

**Gregariousness**: is the degree to which individuals in an animal population tend to associate in social groups.

**Resource Holding Potential (RHP)**: Dominance is conferred by the ability to obtain and defend a resource, termed resource holding potential.

**Social Behaviour**: It can be defined as all behaviour that influences, or is influenced by, other members of the same species.

**Social Interactions**: Animal social behaviour, the suite of interactions that occur between two or more individual animals, usually of the same species, when they form simple aggregations, cooperate in sexual or parental behaviour, engage in disputes over territory and access to mates, or simply communicate across space.

**Social Stress**: Social stress in animals arise from drastic changes in social behaviour and population density, which will have a marked influence on growth, reproductive performance and many types of behaviour.

**Subordinate Animals**: Opposite of dominant animals, their behaviour can be relatively easily influenced or inhibited by other group members.

## 16.7 BIBLIOGRAPHY AND FURTHER READING

Broom, D.M. and Fraser, A.F. (2015). *Domestic Animal Behaviour and Welfare*. CABI International (This book gives some excellent examples of how captive environments lead to behavioural changes that can harm welfare. It also gives a good summary of many of the basic concepts in the field of social behaviour).

Keeling, J.L. *Social Behavior in Farm Animals* (2001). CAB International (This book summarises the costs and benefits of group living and how social behaviour has evolved and responded to domestication. It then gives a detailed description of the social behaviour of several of the major farm species including fish and horses).

## 16.8 SELF ASSESSMENT EXERCISES

1) Give examples of the variation in social grouping strategy observed in the wild.
2) Describe some of the ways in which social groups differ in form in captivity compared to the wild.
3) What is meant by the term 'resource holding potential' (RHP) and list some common attributes that affect RHP.
4) What is meant by the term 'dominance hierarchy' and how do captive social environments interfere with the formation and maintenance of dominance relationships?
5) Describe how social stress can contribute to the occurrence of redirected behaviour.

## 16.9 ANSWERS/HINTS TO CHECK YOUR PROGRESS

**Check Your Progress 1**

1) The advantages of living in a social group includes: social learning; social support; efficient predator detection; mutual predator defence; prey saturation; efficient food acquisition, and energy conservation.
2) Principal amongst these challenges is the need to divide limited resources between group members.
3) Dominance hierarchy can be defined as a social ranking system within a group of the same species in which certain forms of status and privilege are held by those ranking at the top, usually the stronger or more aggressive members.
4) Dominance is conferred by the ability to obtain and defend a resource, termed resource holding potential (RHP).
5) The attributes that determine RHP are varied, but can be physical (e.g. body size and strength), determined by knowledge level (and therefore often related to age) or symbolic through the display of 'status symbols'.

**Check Your Progress 2**

1) The wild social groups most often contain individuals of different sex, size or age. The most common deviation from this is the grouping together of captive animals of similar RHP and the formation of groups with abnormal demographic structure (e.g. an unnatural proportion of males versus females and young versus old animals).
2) Unnatural demographics, similarity in competitive ability, sudden forced introduction and inability to disperse result in the violation of societal rules, which are abnormal social environments.
3) In the case of laboratory animals experimental replication may demand the use of isolated individuals and cultural norms (amongst other factors) play a role in determining that most people do not own large numbers of companion

animals. In the case of zoo and farm animals, economic and management constraints have encouraged the use of group structures that are easiest to practically and financially manage.

4) The constraints includes: buildings are expensive; labour is expensive; mechanical equipment is best suited to large groups; and market demand for uniformity

**Check Your Progress 3**

1) The methods for prevention of social stress in captive animals includes: designing husbandry systems by reference to wild behaviour; providing opportunities to gain social skills early in life to young animals; genetic selection for more positive behaviour; treating social stress through the provision of adequate space, places to hide and naturalistic group structures.

2) The family pen system has not been widely adopted by commercial pig producers due to the increased space needed and more variable weaning weight, besides practical and economic constraints.

3) Establishment of social relationships is a cognitively demanding task and likely to benefit in many species from the opportunity to engage in social contact with new animals when young and practice social skills in a non-damaging context. This may be one of the key benefits of play fighting and why this behaviour is seen commonly in the young of some species. In pigs where damaging aggression in older animals is particularly routine, early life social contact may be particularly valuable as a way to minimise later aggression.

4) Respecting dominance relationships requires that defeated subordinates are able to signal defeat by withdrawing from a contest and thereafter avoiding the dominant animal. This is greatly facilitated by the provision of adequate space. In particular, there appears to be a threshold effect whereby restrictions in space allowance below a certain level result in a major escalation in aggression.

5) The vigour with which established dominance relationships are enforced depends greatly on the availability of resources. In situations where resources are limited, dominant animals are likely to enforce their preferential access over subordinates. Inadequate access to resources leading to social stress from aggression and the need to avoid dominant animals therefore result when resources are in short supply. This social stress is felt disproportionately by subordinate animals, but more dominant animals are not immune. When resource access reaches a critical level, the resources become so valuable that makes it worthwhile for subordinates to challenge more dominant animals for access. Therefore understanding what resources a species needs and ensuring these are adequately provided greatly reduces social stress.

6) Behaviour is the manifestation of the animal's genotype, and past and current environment. The genotype can therefore affect the social behaviour shown by an individual, which has direct consequences for others in the group.

# UNIT 17 IMPROVING ANIMAL WELFARE THROUGH HUMAN CONTACT

**Structure**

## 17.1 LEARNING OUTCOMES

**a) Knowledge and Understanding:** After studying this Unit you will be able to:

- Understand the meaning and importance of human contact in improving animal welfare.
- Take into account species specific animal signals in interactions with animals.
- Better explain the origin of human-animal conflict.

**b) Practical and Professional Skills:** After studying this Unit you will be able to:

- Evaluate the impact of human behaviour on animal health and welfare.
- Apply techniques to improve animal welfare through positive human contact.

## 17.2 INTRODUCTION

Any animal under human care depends for their survival, health and welfare on the quantity and quality of the care given by the owner or other involved persons. Feed, water, shelter and veterinary care are essential elements that should be provided by the owner for any animal in captivity. However, even if these needs are met, the quality of the interaction between the human and animal can hugely impact the welfare of the animal under care.

*Example:* Unpredictable negative handling by humans can result in fearfulness in the animal. This can be from physical contact, such as physical abuse, as well as from non-physical contact through negative verbal and body language or neglect. Note that the word 'animal' here refers to non-human animals (Box 17.1).

This unit is designed to provide insight into how human-animal relationships affect the health and welfare of the animal. We will not discuss how human-animal relationships can affect human well-being as this has been covered in Unit 3. This unit will cover the theoretical and practical aspects of human-animal interactions with a focus on practical solutions to improve these relationships. In this Unit, we also discuss how the quality of the human-animal interaction can impact on the welfare of animals, as well as productivity in the case of farm animals. We will look at practical solutions to reduce negative interactions and increase positive interactions, in particularly in veterinary clinics, farms and animal research facilities. We will also discuss the role of animal signals to better understand the way in which animals communicate, and human-animal conflict. Under each concept, lists an activity which you are encouraged to carry out in order to enhance your understanding of the theory.

**Box 17.1: Human vs. Animal**

Humans are part of the animal kingdom as much as other animals. However, note that the word 'animal' here refers to non-human animals.

Before we proceed, please complete activity 1.

**Activity 1 (Non Participant Observation):** Observe the interaction between a pet owner and his/her pet (e.g. dog, cat), either live or on video. What do you notice? Is the contact positive or negative? Write your observations with implications to welfare.

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## 17.3 INFLUENCE OF HUMAN CONTACT ON ANIMAL WELFARE

Captive animals are dependent on human care for their:

- Survival
- Health and
- Welfare.

For captive animals the owner or other involved persons (care takers) have the capacity to determine the animals' trust, including their day-to-day welfare. The animals' welfare will thus strongly depend on the actions of the involved persons, and the effect of their negative and positive actions is discussed in detail in the following sections. Here, we first discuss the basis of what makes an action positive or negative.

One reason for why humans may treat animals badly is because they do not perceive their actions as negative or harmful for the animal or they are unaware of what it is that causes a negative response in the animal. Animals' (including human) behavioural and physiological responses are strongly influenced by the extent to which they have predictability and controllability. A lack of predictability and controllability, even in positive situations, can increase behavioural and physiological stress up to a pathological state.

### 17.3.1 Predictability

Predictability, or 'the ability to predict' what is going to happen, allows the individual to prepare or anticipate on what is going to come.

*Example:* If the owner of a dog is always nice when he comes home and greets the dog, the animal will run towards the door and show a positive behavioural response to the human. If the owner is always angry when arriving home and he kicks the dog badly, then the animal will run away and hide as soon as he hears the owner. However, if the owner sometimes behaves nicely upon returning home but sometimes unexpectedly kicks the dog then the animal will not know when to approach or when to hide. As a consequence, the animal is likely to experience more stress than a dog which is always kicked.

Research experiments in rats showed that rats that are given electric shocks at irregular times developed severe gastric ulcers. However, when the rat could predict the occurrence of the electric shock, by seeing a light flashing up just before receiving the shock, they had fewer ulcers. When the action of the human is predictable, the receiver of the behaviour (the animal) can prepare in the best manner to sustain its health and welfare. This preparation may include safeguarding itself (e.g. hiding) from receiving harmful behaviour or relaxation when having the certainty of knowing that feed will be given every day. This preparation not only affects behaviour and welfare but also closely relates to physiology and thus health. If an individual knows when it will be able to eat and drink, the metabolism adjusts to these timings to optimize digestion, resulting in a better uptake of nutrients.

### 17.3.2 Controllability

In the above mentioned example of the rat the least amount of ulcers developed when the rats where given the opportunity to control the duration of the electric shocks. These rats would see, as in the above scenario, a light flashing up when an electrical shock was about to come but they could then stop the electric shock sooner by operating a lever. Rats that received the same amount and duration of electric shocks, but that could not control the shock themselves, showed severe gastric ulcers whereas the animals that could control the shock even outperformed the control animals that received no shocks at all. The receipt of electric shocks, as was done in this 1970s research experiment, is quite severe. Let's look at some relevant examples of a lack of controllability in which no direct physical harm is done to the animals. Caged pets and zoo animals have often no control over when humans, or other animals, will interact with them. They cannot physically escape the physical contact, gaze (eye contact) or presence of humans. This may result in profound stress even though the animal may be physically well cared for.

*Example:* A well-cared for rabbit that is kept in a cage that is located in a room with a cat right next to the cage may experience constant stress due to the constant exposure to a natural predator.

Zoo animals often cannot hide from the constant presence of humans. When given the opportunity to hide (through proper housing facilities), the animals often make frequent use of these hiding places, to the disadvantage of the zoo as visitors are unable to see the animal during parts or the majority of the day.

Before we proceed, please complete activity 2.

**Activity 2 (Visit):** If possible, visit a zoo and observe the animals' behaviour to the presence of humans. Do they have the possibility to hide from contact if they wanted to? Write your observations with implications to welfare.

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**Check Your Progress 1**

**Note:** a) Use the spaces given below for your answers.

b) Check your answer with those given at the end of the unit.

1) How can unpredictable negative handling by humans result in fearfulness in the animal?

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2) How do predictable human actions influence health and welfare of animals?

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## 17.4 THE EFFECT OF NEGATIVE CONTACT AND NEGLECT

In this section we discuss the different responses to negative contact and neglect as well as the negative effects that suboptimal human-animal interactions can have despite good intentions under the following headings:

a) Development of difficult behaviour

b) Development of fear

c) Development of agonistic behaviour

d) Reduced productivity in farm animals

It is important to realize that not all animals that are showing difficult behaviour, fear or aggression are being treated badly. Note that behaviours may also arise from other factors, such as genetics or previous experiences. Also, animals that are not showing any of these behaviours but that are treated badly are not necessarily treated that way on purpose. As discussed in Unit 4, humans may treat animals in a similar way as they have been treated, whereby they may perceive some actions (such as beating) as normal. Therefore do not make uninformed judgments based on human-animal interactions that you may see and be cautious if you want to address a situation in which you see an animal being maltreated.

### 17.4.1 Development of Difficult Behaviour

A first sign that the human-animal relationship is not functioning optimally is the development of difficult behaviour in the animal. Even when well cared for,

the owner may not understand the needs of the animal or is unable to read its signals (Animal signals are explained in more detail in section 17.8). Briefly, if the human does not understand the animal's signals, or is unaware of them being shown, or the human communicates in an unclear way to the animals, than the animal may gradually start to show stronger behavioural signals. This can lead to what is called 'difficult behaviour', resistance or disobedient behaviour. In reality, the animal may be confused by contradictory or unclear commands or may be unheard in its needs. Difficult behaviour can also arise from negative experiences, which may be unrelated to the human-animal relationship. A good human-animal relationship, with mutual understanding and trust, can reduce or eliminate such behaviour.

### 17.4.2 Development of Fear

Fearfulness in animals relates amongst others to the:

- Species
- Breed
- Genetics
- Personality type, and
- Life history.

There are three ways in which fear may develop as a consequence of the human-animal relationship (or the lack thereof):

a) Active negative handling (e.g. abuse)

b) Passive negative handling (lack of appropriate care)

c) Neglect (no care).

**a) Active Negative Handling:** The most apparent way in which fear can develop is through active negative handling.

*Example:* Physical abuse (e.g. beating, kicking).

As discussed earlier, negative behaviour may have a strong component of unpredictability and uncontrollability for the receiver. A high unpredictability and uncontrollability are likely to result in fear behaviour, even in the absence of direct negative behaviour from the human.

*Example:* Unpredictable food provision and having no control over when to eat may challenge the animal's stress physiology.

**b) Passive Negative Handling**: This often arises from situations in which the owner is:

- No longer able to care for the animal
- Is unaware of the species' needs for care
- Is unaware of the importance of the required care.

**c) Neglect:** Neglect, or 'the state of being uncared for', does not provide the animal with the opportunity to fight for better care. Instead, it can only wait for help or try to find alternative solutions to obtain food or attention.

### 17.4.3 Development of Agonistic Behaviour

If the animal has the possibility to respond to negative handling then it may start to show agonistic behaviour, depending on the species, genetics, personality and circumstances. Agonistic behaviours are all the behaviours related to aggression, ranging from threat display to the withdrawal after a conflict. Aggression relates only to the behaviour in which the animal shows damaging behaviour, such as biting, scratching or kicking. Most individuals will aim to avoid using aggression, either within their own species or with humans, as aggression is costly and can result in injury or even death. Therefore, animals have, throughout evolution, developed an extensive agonistic display to signal their intent.

*Examples:* Facial expressions that signal anger, such as raising the upper lip, showing teeth and tightening the eyes, and sound such as growling.

If such signals are being ignored, or are being responded to in an impropriate manner (e.g. approaching the animal), then the animal may become aggressive and attack. If threat signals are repeatedly and consistently ignored then the animal may become more direct in its aggression and may attack after showing minimal threat signals.

### 17.4.4 Reduced Productivity in Farm Animals

In farm animals, the effect of negative handling has been studied in relation to the productivity of the animals. In cattle and pigs it has been shown that negative handling can increase fear and reduce productivity. Fear and stress cost energy and will therefore lead to a less optimal feed conversion (more feed is consumed to obtain the same amount of growth). Fearful dairy cows may show a reduced milk production. In the case of chronic fear due to daily exposure to negative contact with humans, even if this is not physical contact, the effects on production can add up. Negative handling, such as rough handling, kicking, beating or using an electric pod to move animals can in addition impact carcass quality. For the farmer there are therefore financial reasons to take good care of the animals and to treat them in a way that does not cause fear.

Before we proceed, please complete activity 3.

**Activity 3 (Review):** List for yourself what you consider negative handling. Are there in the above examples situations that you would not consider as negative? Write your observations with implications to welfare.

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**Check Your Progress 2**

**Note:** a) Use the spaces given below for your answers.

b) Check your answer with those given at the end of the unit.

1) What are the negative effects that suboptimal human-animal interactions can have despite good intentions?

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2) What do you understand by the term 'difficult behaviour'?

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3) How to avoid / reduce 'difficult behaviour'?

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4) What are the factors influencing fearfulness in animals?

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5) Write the three ways in which fear may develop as a consequence of the human-animal relationship?

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6) What do you understand by active negative handling**?**

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7) Name the situations in which passive negative handling arise.

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8) What is Agonistic behaviour?

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## 17.5 THE EFFECT OF POSITIVE CONTACT

Most of the domesticated species are gregarious animals, which in nature would live in groups. Group living animals are sensitive to social cues and have a behavioural repertoire that support group living, such as affiliative behaviour.

*Example:* Mutual grooming in primates.

Whereas solitary species would move away from contact, group living species strongly respond to social interaction and have a need for social attention. Although positive contact is beneficial for any species, social species are more affected by it. As discussed previously about neglect, healthy animals may suffer mentally and physically if their social needs are neglected. Positive contact therefore directly contributes to the welfare of the majority of the domesticated social species through the following ways:

a) Play behaviour

b) Social support and bonding

c) Increased productivity in farm animals

### 17.5.1 Play Behaviour

Play behaviour is often regarded as a sign of good welfare. Humans can contribute to eliciting play and other positive behaviours in animals by providing them

with material or toys to play with, providing play partners or companions of the same species, or being themselves the play partner or companion for the animal. Play has a positive effect on the emotional state and through the release of hormones has a positive effect on immune function and growth. Play supports the social and motoric development of young and should therefore always be encouraged. Withholding play in young animals or not providing a suitable environment to play (as is the case for many farm animals in intensive husbandry systems) may affect the welfare but also the long-term development and social behaviour of the animal.

### 17.5.2 Social Support and Bonding

Some social species have a primary need to be kept together with other conspecifics or at least in company of another animal. This primary need arises from the fact that some species depend for their safety on the presence of a group or herd. Being without the presence of others (not being in a herd) means that they are vulnerable to predators. This innate sense of being unsafe outside the group means that they are more likely to survive in the wild, but also that they may become extremely stressed when kept in isolation. Sheep are an example of this, as they may refuse to eat, become withdrawn and even die when kept isolated from their herd (depending on their life history). Hand-reared animals (including sheep) or more domesticated species may regard companions of other species that they have been reared with, or humans, as their 'clan' or social group (as for example can be the case in dogs). Through good human-animal relationships these animals may receive social support from contact with humans and they may form an affectionate bond. Social bonds can reduce or eliminate the effects of negative experiences. For example, traumatized animals adopted from animal shelters may revert back to normal and positive behaviour when a trusting bond is established with the new owner.

### 17.5.3 Increased Productivity in Farm Animals

A positive human-animal relationship can increase productivity in farm animals. A positive relationship is not merely the absence of negative interactions but an active contribution to a positive relationship. In animal husbandry, this can be established through (individual) attention for the animals, calm and predictable behaviour, positive physical contact and a gentle and patient approach with handling the animals. Animal caretakers can also make use of positive sound cues or calm (classical) music to direct the animals or to calm them. Good handling and a positive contact can reduce stress, increase growth and increase milk production (See also the suggested further readings).

Before we proceed, please complete activity 4.

**Activity 4 (Practice):** Approach an animal (pet or livestock) in a positive way and watch the animal's response to your contact (If it is someone else's pet than always ask first if you may touch the animal and ensure that the animal is vaccinated). Write your observations.

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**Check Your Progress 3**

**Note:** a) Use the spaces given below for your answers.

b) Check your answer with those given at the end of the unit.

1) Positive contact contributes to the welfare of domesticated social species. Comment.

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2) How can social bonds reduce or eliminate the effects of negative experiences?

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3) What are the benefits of good handling of farm animals?

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## 17.6 OPPORTUNITIES TO IMPROVE HUMAN-ANIMAL RELATIONSHIPS

Human-animal relationships can be improved in every scenario, whether you are a pet owner or a veterinary practitioner. We here discuss some opportunities to improve the contact in situations where animals are frequently in contact with humans, often in an aversive situation under the following headings:

a) Veterinary practice

b) Farm management

c) Animal research

### 17.6.1 Veterinary Practice

Animals entering the veterinary practice are likely to be in pain or are ill, or will experience pain during, for example for vaccinations, and after the visit in case of a surgery. Most animals will therefore have a negative association with the veterinary clinic, even if this is not present on their first exposure to a clinic.

Animals have an excellent memory of places with negative associations and may respond with fear, disobedience or aggression when they realize where they are going to or where they are. This may extend to the vet who has treated them previously and afterwards people with similar clothes or smell as the vet may provoke a negative response. Vets and veterinary assistants should be aware of this and should be cautious but confident when handling the animal. Pairing treatments and visits with positive rewards (such as treats if appropriate) can help to reduce the negative associations animals can form with the veterinary clinic. Physical restraint or rough handling will increase the difficulty for future visits and should be avoided for the health and welfare of the animal as well as for the humans' safety. The relationship between the vet and the animal can be improved by making the intervention as fast and painless as possible and by comforting the animal with the species appropriate contact. Letting the owner stay with the animal may reduce the animal's fear in case of a good relationship.

### 17.6.2 Farm Management

Animal husbandry is often characterized by a large number of animals being kept by only a few people. This means that there is often little direct attention for the individual, as management occurs at the level of the group. Since the automation of farming systems the attention per animal has decreased even further. Animals are typically inspected briefly twice a day by visual inspection at the group level. Other moments of contact may occur when animals are handled for interventions, which are often painful for the animal (e.g. castration, injections), and moving them into different facilities or onto the truck.

Despite this limited contact, the few moments of contact can greatly impact on the behaviour of the animals. If the stock workers approach the animals unexpectedly, roughly and loudly, and if handling is rough and related to stress and pain, then the animals can become fearful of humans and more fearful in general. A 'Human-Approach Test' is a standardized test to scientifically assess the fearfulness of animals to human presence, and can be carried out in farm facilities. Fearful animals are more difficult to handle, which may lead to injuries or bruises for both handler and animal. Stockmanship can be improved by acting calmly and in line with the species perception of the environment.

### 17.6.3 Animal Research

In animal research, the animals are under close supervision, including that of veterinary inspectors. The animals' health and welfare must be monitored under any condition to ensure that welfare is in line with the ethical guidelines for the research on animals. Research animals are often exposed to frequent handling and novel situations in which the animal may have to actively participate. A good human-animal relationship will therefore make a substantial difference to the ease of handling and testing. As well as being better for the animals' welfare and the time management of the people involved, it will also contribute to better and more reliable test outcomes. Animals that are stressed, anxious or have been restrained may show different physiological parameters and behaviour. The human-animal interaction can be improved by, in addition to the earlier mentioned points, skillful handling and habituating the animal to test situations to reduce fear, and if the research allows petting the animal or regular positive physical contact. In animal research there are often multiple animal caretakers involved.

Having a main caretaker increases the opportunity for the animals to form a trusting bond with the caretaker.

Before we proceed, please complete activity 5.

**Activity 5 (Visit):** Visit an animal facility (veterinary clinic, zoo, farm, research facility) and, based on what you see, think of at least three methods to improve the human-animal interactions in that facility (Tip: think for example of staff attitude, expertise of animal care takers, equipment, individual attention for animal, etc.). Write your remarks.

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**Check Your Progress 4**

**Note:** a) Use the spaces given below for your answers.

b) Check your answer with those given at the end of the unit.

1) How can the relationship between the vet and the animal be improved?

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2) What is a Human-Approach Test?

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## 17.7 METHODS FOR IMPROVING HUMAN-ANIMAL RELATIONSHIPS

We here provide three practical science-based methods for improving human-animal relationship. Note that these are not exhaustive and you may think of other methods to improve the interaction.

a) Predictability and controllability

b) Physical and non-physical contact

c) Taking into account the sensory capacities of the species

### 17.7.1 Predictability and Controllability

As mentioned at the start of this Unit, predictability and controllability are key factors for good welfare and thus contribute to a good relationship. Predictability can be increased by giving structure to the day, with set meal times and care. Being predictable in your behaviour towards the animal can reduce stress and can increase the bond. Providing the animal with a certain degree of controllability can make it easier for the animal to fulfill its needs. Note that some animals should not be given full control as this may be harmful for the animal itself or for the surroundings. For example, when some pets are given the freedom to eat as much as they want, they consistently overeat and may suffer profound health issues. An example of controllability in farming systems is the use of electronic feeders that allow the animal to feed when it wants (but with a predetermined portion). This eliminates the anticipation for the feeding moment, which can be very stressful in feed restricted animals. When animals are calmer and more satisfied they can more easily form a good relationship with humans.

### 17.7.2 Physical and Non-physical Contact

**a)** ***Physical Contact:*** Gentle physical contact may result in the release of oxytocin, which is a neurotransmitter and hormone related with affection (but in some cases also with aggression). Oxytocin contributes to bonding and can give a positive feeling for both the receiver of touch and the one who touches. In addition, oxytocin also enhances immune function and growth and through this pathway may explain how a better productivity is realized in farm animals that are cared for in a positive way. Patting an animal in a gentle manner can therefore feel good to the human as well as the animal. However, take into account the species specific needs as signals. Not all species are keen on touch and some will avoid physical contact (for example reptiles). In species that do enjoy patting and scratching there may be areas on the body which are sensitive or that they instinctively protect. Prey animals, for example, are vulnerable in their flanks and this is where a predator would be likely to attack them. Naturally, their instinct is to protect this area and they may respond aversively when this area is suddenly approached.

**b)** ***Non-physical Contact:*** Non-physical contact may be even more important than physical contact, as it is a continuous signal. Animals are very capable of reading (human) body language, including facial expression, and recognizing voice as well as giving meaning to the emotion expressed by the tone of the voice. Having a positive attitude towards the animal will be recognized through your body language and tone of voice, whereas shouting and threat will be picked up as negative signal. Giving double signals, for example by shouting angrily while not truly being angry, may confuse the animal and challenge the communication.

### 17.7.3 Taking into Account the Sensory Capacities of the Species

Different species have different sensory modalities that they use for perceiving the world around them. Humans only use a limited part of the full spectrum of what can be perceived through vision, hearing, smell and taste. For example, dogs can hear sound frequencies that humans are unable to hear, many domestic species (dogs, pigs, rodents) can smell many times better than humans, and bats and whales use echolocation, a modality that humans do not possess. In contrast, humans perceive more colours than many animals do and our visual sight may be better than that of the animals that we interact with. However, some animals, such as many bird species, can see in visual spectra, such as ultraviolet, where we cannot and thus a plain white bird or wall to us, may look different to a bird seeing ultraviolet markings. Assuming that the animal perceives the world as humans do may limit the communication and our understanding of the animal's behaviour. The human-animal relationship can be improved by taking into account these species-specific sensory capacities in the interaction with the animal.

Before we proceed, please complete activity 6.

**Activity 6 (Observations):** Watch people interacting with animals (for example on the street, in a veterinary clinic, farm or in a horse riding school) and take the above tips for improving contact into account. Write down for each interaction what you think they can do to improve the contact or what you have learnt from watching the interaction.

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**Check Your Progress 5**

**Note:** a) Use the spaces given below for your answers.

b) Check your answer with those given at the end of the unit.

1) Write three practical science-based methods for improving human-animal relationship.

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2) How does predictability and controllability helps in improving human-animal relationships?

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3) How can gentle physical contacts improve human animal relationships?

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## 17.8 ANIMAL SIGNALS

Animals predominantly use body language, including facial expression, to communicate, but they can also use sound and scent cues. Reading and understanding animal signals is essential for good human-animal relationships. If natural signals are not recognized and consistently ignored than the animal may start to show increasingly stronger signals. In case of threat behaviour, which may start with a facial expression, this can continue into more direct agonistic behaviour or an attack. In most cases animals will show mild signals first before launching an attack. However, if threat signals are consistently ignored than the animal may develop a behavioural pattern of spontaneous aggression.

### 17.8.1 Prey vs Predator Species

Many of the domesticated animals are prey species (for example rabbits, cows, sheep). Their instinct is to run away, hide or protect themselves whenever they are approached by a natural predator. Predators (carnivores) typically have their eyes facing forward to focus on their prey during the hunt and they leave scent, which is different from omnivores. In contrast, prey animals have their eyes to the side of their head so that they have a wider view on the surrounding area and can better detect approaching predators. Prey species will recognize predators as such even if the species is not their natural predator. Note that humans are biologically predators as well, with both our eyes facing forward. Animals may thus perceive humans as predators and may respond accordingly if not accustomed to humans. There are various behavioural signals that can be perceived by prey animal as threat and should therefore be avoided:

a) Staring an animal straight in the eyes is perceived as threat or signal for attack

b) Suddenly approaching the animal at a vulnerable part where predators would commonly attack (such as the flank or neck)

c) Suddenly approaching the animal from the back, may scare the animal.

## 17.8.2 Predator Species

Predator species are not only the wild animals kept in zoos, like tigers and lions, but many of our domesticated species are in fact predators. For example dogs, cats, and mink. A predator's response to threat may be to fight rather than to flee. As above, staring a predator species straight in the eyes can be perceived as a threat but can also challenge the animal to attack. One of the agonistic signals in predators can be to show the teeth, either as threat or as mixed signal upon withdrawal. Showing your teeth, for example in a smile, may therefore have a different meaning for the animal you are interacting with. Animals use during their agonistic behaviour several cues which can signal dominance.

*Example:* Making yourself look larger is a cue for showing that you are stronger or dominant.

In contrast, making yourself small by crouching is a sign of submission. Such bodily signals can be used in the communication. Predators are more often solitary animals (not in the case of dogs for example), in contrast to prey species which group together to protected themselves against predators. The interaction with solitary predator species will therefore be different from interacting with a more social group living species.

Before we proceed, please complete activity 7.

**Activity 7 (Observation):** Watch people interacting with animals (for example on the street, in a veterinary clinic, farm or in a horse riding school) and take the above tips for improving contact into account. Write down for each interaction what you think they can do to improve the contact or what you have learnt from watching the interaction.

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**Check Your Progress 6**

**Note:** a) Use the spaces given below for your answers.

b) Check your answer with those given at the end of the unit.

1) Give examples for prey species.

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2) Write the behavioural signals that can be perceived by prey animal as threat and should therefore be avoided.

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3) Give examples for wild and domesticated predator species.

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## 17.9 HUMAN-ANIMAL CONFLICT

A negative human-animal relationship can result in human-animal conflict with either harmful consequence for the animal or for the human.

### 17.9.1 Attacks

Animals that feel threatened may defend themselves or their offspring by attacking. As discussed earlier, animals usually signal their intent in various ways such as facial expression, body posture and sound. If these signals are ignored then the animal may attack. Humans, including children, unaware of the threat signals of animals will have a greater chance of being involved in an attack. In particularly children, keen to approach and touch animals, may be vulnerable to being injured when the animal tries to defend itself. Teaching children about the signals that animals make is a more effective way of dealing with this than keeping them away from animals (e.g. see the ladder of aggression for dog behaviour). Attacks of wild or captive wild animals can happen for the same reason, when initial threat signals are ignored. However, wild animals may also attack humans if the human violates the animal's territory or forms a threat to the animal or its offspring. Wild animals usually try to avoid aggression towards humans, this is generally the last resort of animal that feels threatened or under attack. Trying to avoid surprising a wild animal (for example by making noises if walking in forests where wild animals live) and withdrawing or allowing the animal an escape route if unexpectedly encountering a wild animal can help to reduce human-wild animal conflicts. Another less frequent form of attack is seen where wild animals kill humans as prey, which might occur if the wild animal is injured and less able to hunt other prey species. Captive wild animals, and to some extend domestic animals, may also attack out of fear and panic when being handled.

### 17.9.2 Workers Safety

People working directly with animals on a daily basis often know the animals or at least species well. Still, injuries and death of stock workers due to handling animals occur frequently. Animals may attack for various reasons, as described above, but they can also injure or crush the person when moving. This can happen either unintentionally in narrow spaces or when the animal is in panic. The aim is to keep a calm and good relationship with the animal, with the human being aware of the common behaviour of the animal and the animal paying attention to the human. Extra caution should be taken when handling non-castrated male animals, mainly when kept for breeding purposes. Males have more testosterone, which makes them more likely to be aggressive, dominant and defensive of their territory or resources. Even male animals smaller in size than humans can kill when distressed.

### 17.9.3 Cultural Human-animal Conflict

There are worldwide various cultural and religious festivals, traditions and ceremonies in which animals are ritually scarified or injured.

*Examples:* Bull fights in Spain, Cock fights in South India, Taji dolphin drive hunt in Japan.

Before we proceed, please complete activity 8.

**Activity 8 (Identification):** Identify and list any cultural events in the region where you live (country or state) in which animals are being maltreated, injured or killed as a ritual or tradition. Write your opinion about such events.

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**Check Your Progress 7**

**Note:** a) Use the spaces given below for your answers.

b) Check your answer with those given at the end of the unit.

1) What are the usual signals given by animals before attacking?

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2) Why might wild / captive wild animals attack humans?

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3) Give examples for cultural human-animal conflict

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## 17.10 LET US SUM UP

- In this chapter we discussed how the human-animal relationship can affect the animal in a positive or negative manner.
- First, we discussed that predictability and controllability are important factors for reducing stress and increasing welfare.
- Negative contact and neglect can result in difficult behaviour, disobedience, fear or agonistic behaviour. Negative contact or neglect is not always intentional and it is important that people owning or working with animals have a proper understanding about what is harmful.
- In farm practices negative contact can reduce the productivity and product quality and farmers can therefore have financial benefit when taking good care of their animals.
- In turn, positive contact can increase productivity. Positive contact can stimulate play behaviour and affection and can contribute to a bond between animal and human in which they can mutually support each other through their behaviour.
- The human-animal relationship can in particular be improved in establishments where there are many animals and they are frequently handled, such as veterinary clinics, farms, and animal research facilities. Handling animals calmly and skillfully, while taking into account the species specific behaviour, can improve the human-animal relationship.
- Animals will show various signals through their body language, facial expression and sound. Paying attention to these signals will improve the mutual communication.
- Prey species will show different signals and give a different response to situations than predator species.
- Knowing the differences, and why animals respond the way they do, help us in understanding their behaviour and enables to handle them in a manner

then will increase trust. Human-animal conflicts may arise if animal signals are not understood or are ignored, in which case the animal may attack.

- Attacks can occur out of defense, panic or when being challenged to fight.
- Animals may also injure or kill humans unintentionally when they are in panic or when kept in a confined space.
- Human-animal conflict may also be injurious or fatal for the animal, for example in traditional cultural events.

In the next Unit, we will discuss how to improve animal welfare through genetic selection.

## 17.11 KEY WORDS

**Aggressive behaviour**: Damaging conflict behaviour, such as biting, pushing and fighting.

**Agonistic behaviour**: The full behavioural repertoire related to conflict, ranging from threat display to withdrawal after conflict; includes aggressive behaviour.

**Carnivore**: A carnivore, meaning "meat eater", is an organism that derives its energy and nutrient requirements from a diet consisting mainly or exclusively of animal tissue, whether through predation or scavenging.

**Controllability**: Being able to control or regulate events that are happening.

**Herbivore:** Herbivore is an animal anatomically and physiologically adapted to eating plant material, for example foliage or marine algae, for the main component of its diet.

**Human-animal Interaction**: The relationship and communication between humans and animals.

**Mutual**: A feeling or action experienced or done by both that are involved. For example: mutual trust, they both trust each other.

**Omnivore**: An omnivore is an animal that has the ability to eat and survive on both plant and animal matter.

**Predictability**: The ability to predict; having a valid expectation about what is going to happen under certain conditions.

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https://www.bsavalibrary.com/content/cil/canine-and-feline-behaviour/ladder_of_aggression

## 17.13 SELF ASSESSMENT EXERCISES

1) Give an example of how predictability and controllability can affect health.
2) Explain the basic physiological pathway of how gentle positive touch can result in better growth.
3) Give four ways in which human-animal interaction can be improved.
4) Write three important signals that dogs give as a threat before they attack.
5) Name three differences between prey and predator species.
6) Describe how you would approach a fearful (domesticated) prey animal.
7) Describe how you would approach a (domesticated) predator animal that shows threat signals.

## 17.14 ANSWERS / HINTS TO CHECK YOUR PROGRESS

**Check Your Progress 1**

1) Unpredictable negative handling by humans can result in fearfulness in the animal from physical contact, such as physical abuse, as well as from non-physical contact through negative verbal and body language or neglect.
2) When the action of the human is predictable, the receiver of the behaviour (the animal) can prepare in the best manner to sustain its health and welfare. This preparation may include safeguarding itself (e.g. hiding) from receiving harmful behaviour or relaxation when having the certainty of knowing that feed will be given every day. This preparation not only affects behaviour and welfare but also closely relates to physiology and thus health.

**Check Your Progress 2**

1) The negative effects of suboptimal human-animal interactions includes: development of difficult behaviour; development of fear; development of agonistic behaviour, and; reduced productivity in farm animals.
2) If the human does not understand the animal's signals, or is unaware of them being shown, or the human communicates in an unclear way to the animals, then the animal may gradually start to show stronger behavioural signals. This can lead to what is called 'difficult behaviour', resistance or disobedient behaviour.
3) A good human-animal relationship, with mutual understanding and trust, can reduce or eliminate 'difficult behaviour'.
4) The factors influencing fearfulness in animals includes: species, breed, genetics, personality type, and life history.
5) The three ways in which fear may develop as a consequence of the human-animal relationship are: active negative handling (e.g. abuse); passive negative handling (lack of appropriate care), and; neglect (no care).
6) The most apparent way in which fear can develop is through active negative handling (Physical abuse like beating, kicking). Negative behaviour may

have a strong component of unpredictability and uncontrollability for the receiver. A high unpredictability and uncontrollability are likely to result in fear behaviour, even in the absence of direct negative behaviour from the human.

7) Passive negative handling arises from situations in which the owner is: no longer able to care for the animal; is unaware of the species' needs for care, and; is unaware of the importance of the required care.

8) Agonistic behaviour is all behaviour related to aggression, ranging from threat display to the withdrawal after a conflict.

**Check Your Progress 3**

1) Group living animals are sensitive to social cues and have a behavioural repertoire that support group living, such as affiliative behaviour (For example, mutual grooming in primates). Whereas solitary species would move away from contact, group living species strongly respond to social interaction and have a need for social attention. Although positive contact is beneficial for any species, social species are more affected by it.

2) Social bonds can reduce or eliminate the effects of negative experiences. Through good human-animal relationships animals receive social support from contact with humans and they may form an affectionate bond. Social bonds can reduce or eliminate the effects of negative experiences. For example, traumatized animals adopted from animal shelters may revert back to normal and positive behaviour when a trusting bond is established with the new owner.

3) A positive human-animal relationship can increase productivity in farm animals. Good handling and a positive contact can reduce stress, increase growth and increase milk production.

**Check Your Progress 4**

1) The relationship between the vet and the animal can be improved by making the intervention as fast and painless as possible and by comforting the animal with – to the species appropriate – contact. Letting the owner stay with the animal may reduce the animal's fear in case of a good relationship.

2) Human-Approach Test is a standardized test to scientifically assess the fearfulness of animals to human presence, and can be carried out in farm facilities.

**Check Your Progress 5**

1) The three practical science-based methods for improving human-animal relationship are : Predictability and controllability; Physical and non-physical contact, and; Taking into account the sensory capacities of the species.

2) Predictability and controllability are key factors for good welfare and thus contribute to a good relationship. Predictability can be increased by giving structure to the day, with set meal times and care. Being predictable in your behaviour towards the animal can reduce stress and can increase the bond.

Providing the animal with a certain degree of controllability can make it easier for the animal to fulfill its needs.

3) Gentle physical contact may result in the release of oxytocin, which is a hormone related with affection. Oxytocin contributes to bonding and can give a positive feeling for both the receiver of touch and the one who touches. In addition, oxytocin also enhances immune function and growth and through this pathway may explain how a better productivity is realized in farm animals that are cared for in a positive way.

**Check Your Progress 6**

1) Many of the domesticated animals are prey species. Example: Rabbits, cows, sheep.

2) The behavioural signals that can be perceived by prey animal as threat includes: staring an animal straight in the eyes is perceived as threat or signal for attack; suddenly approaching the animal at a vulnerable part where predators would commonly attack (such as the flank or neck), and; suddenly approaching the animal from the back, may scare the animal.

3) Examples for wild predator species are tigers, lions and domesticated predator species dogs, cats, and mink.

**Check Your Progress 7**

1) Animals usually signal their intent in various ways such as facial expression, body posture and sound.

2) The reasons include: Children, keen to approach and touch animals, may be vulnerable to being injured when the animal tries to defend itself; Ignorance of initial threat signals; Violation of animal's territory or forms a threat to the animal or its offspring; Wild animals kill humans as prey, and; Captive wild animals, and to some extent domestic animals, may also attack out of panic when being handled.

3) There are worldwide various cultural and religious festivals, traditions and ceremonies in which animals are ritually scarified or injured resulting in conflict. Examples: Bull fights in Spain, *Jallikattu* (Bull fight) and Cock fights in India, Taji dolphin drive hunt in Japan etc.

# UNIT 18 IMPROVING ANIMAL WELFARE THROUGH GENETIC SELECTION

**Structure**



## 18.1 LEARNING OUTCOMES

**a) Knowledge and Understanding:** After studying this Unit you will be able to:

- Understand the concept of genetic selection in improving animal welfare.
- Appreciate how effective animal breeding can be.
- Have insight into how breeding techniques are applied.
- Be able to give examples of welfare problems that could be improved by breeding.

**b) Practical and Professional Skills:** After studying this Unit you will be able to:

- Discuss how past breeding strategies have affected welfare.
- Describe how breeding can have benefits for welfare but also the barriers that need to be overcome to achieve this.

## 18.2 INTRODUCTION

Domestication has shaped the characteristics of species for thousands of years and more recent selective breeding has dramatically increased the rate of change from the ancestral state. Those features which are the target of improvement

through genetic selection, such as growth rate, are referred to as 'traits'. Through the process of domestication, the focus of informal breeding was on reducing the fearfulness and aggressiveness of species towards humans. More recent structured breeding programmes focus on improving traits of economic importance (in livestock), convey an aesthetic quality (e.g. in dog breeding) or allow scientific discovery (e.g. in strains of mice developed as models of human disease).

In this Unit we discuss:

- How past breeding strategies have affected welfare, and
- How welfare can itself be improved through the use of breeding technology.

The discussion is relevant to all captive species where humans influence the transmission of genetic information but many of the examples will be from animal husbandry and agriculture due to the very large number of animals involved and the scale of the breeding industry that supports their genetic improvement.

## 18.3 THE POWER OF ANIMAL BREEDING

### 18.3.1 Selective Breeding

Selective breeding is unique in that it leads to permanent and cumulative change that builds from one generation to the next. This means that small improvements in a trait made in each generation can have very major implications when summed over many generations (Box 18.1).

**Box 18.1: Selective Breeding in Broiler Chicken and Pigs**

**Broiler Chicken:** One of the best examples of the power of selective breeding is the change in growth rate of broiler (i.e. meat) chickens. Selection over the past 50 years has been extremely successful, increasing growth rate from 25 to 100 g per day, meaning that birds currently reach slaughter weight in around 6 weeks.

**Pig Breeding:** The global pig breeding industry has also had major success in improving growth rate. Here, the annual improvement in growth rate is around 5 g/pig/day which may seem unimpressive given that a pig may grow in excess of 1kg per day. However, summed over many generations of selection, the change means that pigs now grow several times faster than they did a few decades ago. Even over shorter time spans, the improvement can be large. For example, the UK has seen a 21% improvement in the weight of meat produced from each sow per year over only a 5 year period.

**Dairy Cows:** Vast increases have also been achieved in milk production from dairy cows where the highest genetic merit cows now produce in excess of 12,000 litres of milk per year. Over longer time periods, changes can be truly profound and such changes need to be supported by improvements in nutrition and management (e.g. a high genetic merit cow can only achieve high yields of milk if fed appropriately).

### 18.3.2 The Structure of the Animal Breeding Industry

The conventional approach to quantitative breeding makes use of information about the relatedness of individuals and their respective performance in the traits

of interest. By this approach, it becomes apparent that certain fathers or mothers produce offspring that excel in certain traits (e.g. milk yield). This approach requires the testing of trait performance in the selection candidates themselves and/or their offspring, siblings, half-siblings and so on. More recently, selection decisions may also make use of molecular genetic information.

*Example:* Genomic selection makes use of knowledge of how each point in the genome affects the traits of interest.

It is then possible to screen animals for their genetic makeup (their 'genotype') at each of these points to find those whose genome most positively influences a trait. As costs fall of determining the base-pair sequence of DNA, animal breeding is also likely to make use of actual sequence data for particularly important genes.

The domestic species however differ substantially in which traits are selected upon, to what degree and the methods by which this is achieved. Consequently, the amount of genetic progress in 'improving' a species from its ancestral state is much greater in some species than in others. In the pig and poultry industries, large, multinational breeding organizations supply elite genetic material to farmers and the performance of their offspring in each trait of interest is measured and compared on dedicated 'nucleus' farms. These industries are also at the cutting

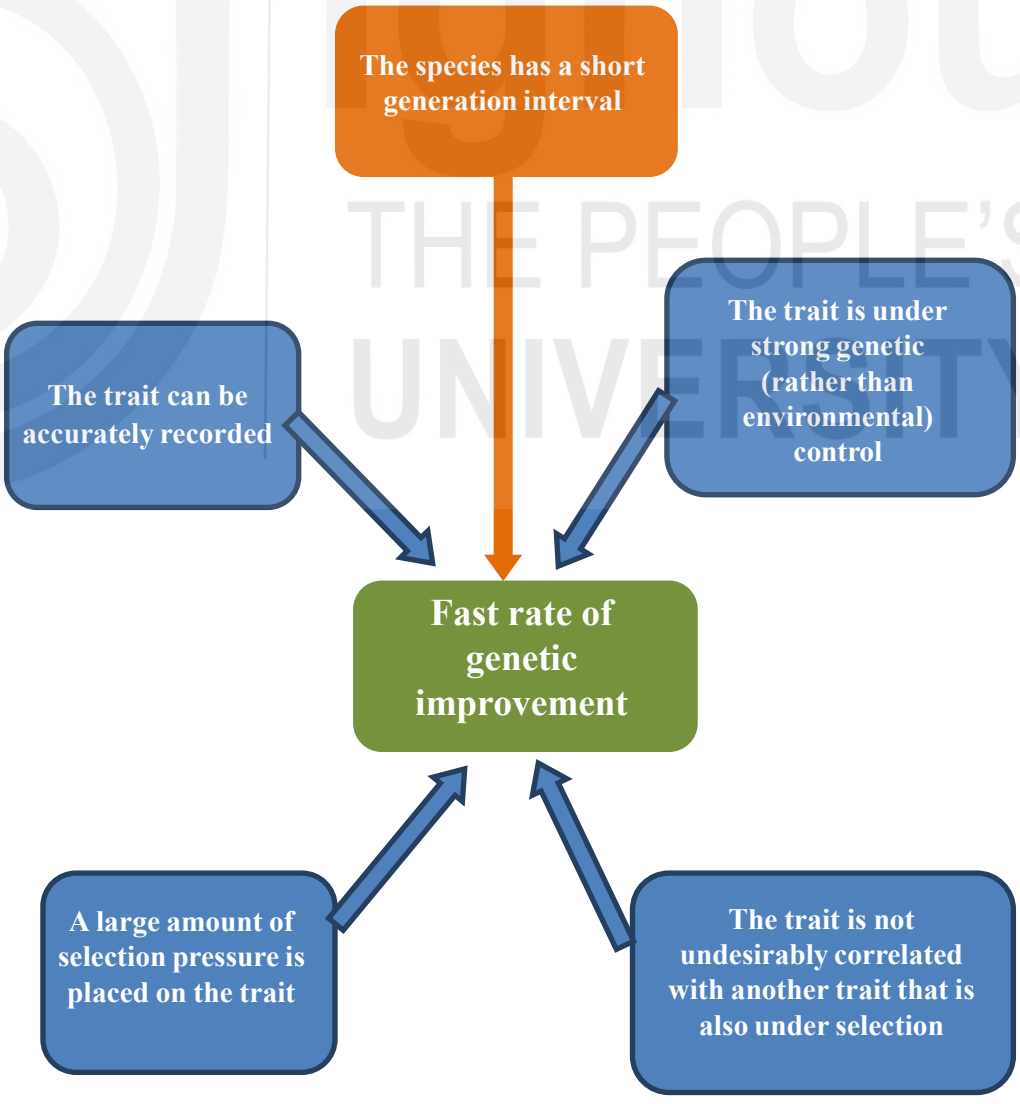


**Fig. 18.1**: **Factors determining how quickly a trait responds to selective breeding**

edge of developing and using new breeding technologies to increase the accuracy and speed of response to selection. The dairy industry is not far behind these others in embracing new technology. These industries contrast with the sheep sector where breed societies manage the registration of elite animals but the elite animals themselves and their offspring are managed on normal farms. To date, the use of molecular genetic information has been slow in this industry. Even here, however, the uptake of modern genetic selection methods such as genomic selection is increasing. Companion animal breeding shows most similarity with sheep breeding in that breeding occurs mostly at a local level but elite animals are registered by a breed society.

To achieve rapid change in one of these, it must not be adversely associated with any of the others (i.e. improving one trait must not lead to a correlated deterioration in another).

Some traits respond to breeding more rapidly than others. Within any species, this speed of progress is determined principally by four factors (Figure 18.1), plus the generation interval of the species (how quickly a new-born animal itself becomes a parent):

a. Firstly, to make rapid progress in a trait, it must be possible to record it accurately so that an accurate reflection can be given of how 'good' or 'bad' an individual is compared to its peers. This process of recording performance in a trait is called 'phenotyping'.

b. Secondly, the recorded trait must be under a large amount of genetic determination rather than simply affected by non-genetic environmental conditions.

c. Thirdly, rapid progress can be achieved when much selection pressure is placed on a trait. This means that the trait is a priority and the improvement of other traits is a secondary objective.

d. Lastly, several traits are usually simultaneously the target of selection.

Before we proceed, please complete activity 1.

**Activity 1 (Visit):** If possible, visit a nearby poultry / pig research facility and discuss with breeders on traits for which they are doing selective breeding. Write your observations.

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## Check Your Progress 1

**Note:** a) Use the spaces given below for your answers.

b) Check your answer with those given at the end of the unit.

1) What is meant by traits?

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2) What is the focus of recent structured breeding programmes?

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3) Why is selective breeding unique?

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4) How is sheep breeding different from pig / poultry breeding?

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5) What is Phenotyping?

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## 18.4 GENETIC VERSUS NON-GENETIC DETERMINATION

Most traits are influenced by a combination of the animal's underlying genotype (i.e. its specific and unique genetic makeup) and the past and current environment. Therefore, when a trait varies in its expression within a population, we can quantify how much of this variation is due to genetic and how much is due to non-genetic differences between animals. The strength of the genetic contribution is termed as the 'heritability' of the trait. Heritability is measured on a scale of 0 to 1 and expresses the proportion of the total variation seen in a trait that is due to additive genetic effects. In this definition 'additive' simply means genetic differences between animals that are passed on to the offspring to make it clear that epigenetic modifications (i.e. changes to the expression of genes that don`t influence the genetic code itself) do not count towards a heritability figure. A heritability of zero means that there is no visible genetic explanation for why a trait differs in expression between animals. A heritability of one means that all of the variation between animals can be explained by differences in their genotypes and that the environment does not alter expression (e.g. eye colour). The expression of most, if not all, traits of welfare significance vary between animals as a result of a complex mix of genetic and environmental causes. As such, welfare relevant traits have a significant heritability, although the genotype usually contributes less than the environment to variation in trait expression. Welfare traits are usually genetically complex and influenced by the small contribution of many, and often hundreds, of genes. The heritability of a number of health, neonatal survival and behavioural traits has been estimated in livestock, companion and laboratory species. In most cases, moderate heritabilities have been reported, usually in the range of 0.1 to 0.5. Based on this genetic variation, it has been possible to set up selection experiments where a population is made to diverge into two lines that contrast in their expression of a welfare trait. For example, populations exist that show a high or low genetic tendency to perform feather pecking (see Unit 16, section 16.3.3 for a description of this behaviour) as a result of mating high feather pecking birds together or low feather pecking birds together. Large differences in the expression of this behaviour are seen in these birds after only a few generations of selection.

**Check Your Progress 2**

**Note:** a) Use the spaces given below for your answers.

b) Check your answer with those given at the end of the unit.

1) What is meant by genotype?

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2) Write the meaning of the heritability of a trait

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## 18.5 UNDESIRABLE EFFECTS FOR WELFARE OF PAST BREEDING STRATEGIES

### 18.5.1 Causes of Undesirable Effects on Welfare

Genes often have pleiotropic effects, meaning that one gene can influence the expression of several traits at the same time even if the traits appear to be unrelated. Two genes with different effects (e.g. one affecting a production trait and one affecting a welfare trait) can also be inherited together if located in close proximity on the chromosome. This means that breeding for an economic or aesthetic trait has the potential to lead to desirable or undesirable genetic change in other traits of welfare significance.

### 18.5.2 Examples of Undesirable Effects of Breeding

Much evidence has now gathered of how targeting selection on production traits in livestock or conformational and aesthetic traits in companion animals has led to undesirable correlated changes in welfare traits. In the case of livestock, extensively managed breeds that have traditionally been under less intense selection pressure are not immune to undesirable effects. For example, increasing the number of lambs born by each female is likely to have contributed to a reduction in lamb survival and increasing the muscularity of beef calves has contributed to problems at parturition ('dystocia'). Nevertheless, breeding-related welfare challenges are most commonly associated with the highly selected poultry, dairy and pig sectors. Several examples exist in each species and include cardiovascular problems and lameness in fast growing broiler chickens, skeletal weakness in high egg producing hens, poor neonatal survival in large litters of pigs and increased lameness and mastitis in high milk yielding dairy cows.

Selection of dog breeds, and more recently cat breeds, for particular aesthetic characteristics, such as short noses relative to the skull length, small size, shorter limbs and long backs, have also resulted in undesirable welfare-related traits. For example short-nosed or 'flat-faced' breeds of dog are prone to respiratory and thermoregulatory distress, long backed dogs experience spinal weakness and paralysis and dogs bred for short limbs can experience arthritis and other joint problems.

Laboratory species are often deliberately bred to show genetic susceptibility to specific diseases such that these can be studied to aid understanding of human disease. Small populations also risk in-breeding where animals of close genetic relatedness are mated and the offspring suffer from health problems as a result of inheriting multiple copies of an allele that confers susceptibility to a disease. Such inbreeding can reduce health in zoos populations and rare breeds where members of the breed are mated together to maintain the breed's distinctive identity.

### 18.5.3 Reversing Undesirable Effects of Breeding

Since the early 1980s, awareness of these welfare issues and research to address them has grown. The increasing use made of molecular genetic information in breeding decisions, such as exploiting genomic selection, is expected to greatly increase the rate of genetic change achieved by breeding. This rate of change may in some cases double. Modern breeding technology therefore has the potential accelerate undesirable changes in traits of welfare significance and, conversely, may improve our ability to use breeding as a tool to directly improve welfare (the subject of section 18.6.).

Progress has been made in reversing or controlling undesirable welfare consequences whilst still allowing genetic improvement in economically important traits. In some cases addressing a problem has been simplified by the role of one or a small number of genes in the expression of the trait. The genetic cause of sudden death syndrome in pigs triggered by periods of stress was found and then controlled by careful breeding. Homozygosity (the expression of two copies of an allele at a specific point in the genome) was the cause of this syndrome but this homozygosity had been encouraged by breeding since it confers an advantage in growth rate. Most other traits are under the control of many genes, but progress in improving them can still be made. The dairy breeding industry can illustrate how breeding priorities have changed in recent years to tackle complex traits. Traditionally, dairy breeding targeted an improvement in milk yield and the proportion of protein and fat in the milk. This led to very large improvements in milk yield and quality but deteriorations in lameness and mastitis resistance and in fertility and lifespan. These deteriorations have become so significant in all countries that use high genetic merit dairy cattle that most national dairy breeding strategies now place at least some focus on welfare or functional traits in addition to production traits. In the UK, the Profitable Lifetime Index now places more pressure on these non-production traits (lameness and mastitis resistance, lifespan, calving ease and fertility) than conventional production traits (Figure 18.2). Whilst this broadening of the breeding strategy to include health traits has reduced the rate at which milk related traits can be improved, the overall profitability for the farmer has been increased. This is because veterinary costs have been reduced, periods of low milk yield or where milk must be discarded have been reduced and the cows have a longer lifespan.

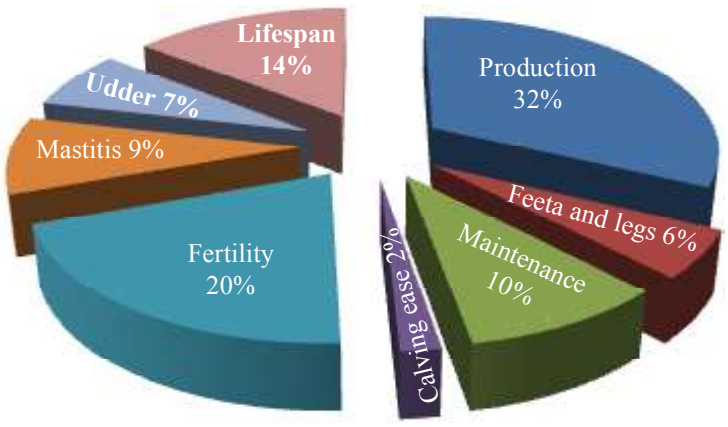


**Fig.18.2: Relative weight placed on traits within the Profitable Lifetime Index used to breed dairy cows. (Source of data: *AHDB Dairy;*https://dairy.ahdb.org.uk/technical-information/breeding-genetics/%C2%A3pli/).**

**Check Your Progress 3**

**Note:** a) Use the spaces given below for your answers.

b) Check your answer with those given at the end of the unit.

1) Write the causes of undesirable genetic effects on welfare.

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2) Give examples of undesirable effects of breeding.

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## 18.6 USING BREEDING TO IMPROVE WELFARE

Some complex welfare problems have proven remarkably resistant to improvement through management change alone. This is true of redirected social behaviour such as tail and ear biting in pigs and feather pecking and cannibalism in hens. The prevention of these behaviours can be achieved by the provision of resources that allow an appropriately targeted outlet for the foraging motivation. Providing these resources comes with a large economic cost, which is unsustainable for most intensive farmers. Extensive farming systems also have welfare problems that are difficult to improve through management change. Preventing neonatal mortality in sheep that give birth outdoors in unpredictable weather is challenging. Similarly, control of lameness in sheep and cattle that live in wet conditions on pasture contaminated by pathogens is difficult. For these reasons, some welfare problems have persisted for decades and are likely to remain a routine and tolerated aspect of modern production. Continued effort is required to find affordable management solutions to these problems, but research effort in recent years has also explored the genetic basis to these traits and the potential to improve them through selective breeding. Deliberate changes in breeding strategy have also been made in order to reverse the welfare consequences of previous selection focussed only on a narrow range of traits. This has been seen in dairy breeding (see above), but also to control tibial dyschondroplasia in broilers (inadequate development of the cartilage leading to pathologies in the growth plate), to prevent sudden death syndrome in pigs, to reduce health problems from in-breeding in a range of species and to some extent to control pathologies in dog breeds.

Breeding therefore has the potential to greatly improve welfare as well as to reduce it. From this, it should be clear that animal breeding is not in itself a

technique that inevitably reduces welfare. It is simply a tool but it is the manner in which it is used that determines the impact on welfare. The use of breeding to combat welfare problems has a very major advantage that traits can be improved without the requirement for expensive structural or management changes by the animal owner. Therefore, it offers a very efficient, permanent and inexpensive way to improve welfare problems. Since genetics usually contribute less than 50% to the variation in expression of a trait in a population, approaches where we adapt the animals by genetic selection should be complemented by continued efforts to optimize the environment for the animals. Two case study examples are given of how breeding may help to alleviate significant welfare problems that have existed for many decades (Boxes 18.2 and 18.3).

**Box 18.2: Case Study - Neonatal Survival in Piglets**

Piglet mortality is close to 20%, including still-births, and has remained at this high level without improvement for a long time. Past selection strategies have focussed on breeding sows to produce the maximum number of piglets born. Piglet birth weight fell as a consequence of this which increased the mortality rate of piglets during the first one or two days of life. Adjusting selection criteria to include neonatal survival, in addition to number born, is a more sustainable strategy and one that has allowed litter size to be increased without increasing the proportion of piglets that die.

The Danish pig industry has pioneered this approach and now has extremely large litters (Figure 18.3). It has achieved an increase of 2.3 pigs weaned/ litter in the last 10 years. To actually reduce the proportion of piglets that die would require greater selection pressure to be placed on survival (i.e. making it a higher priority relative to other traits under selection). Different strategies could also be taken, such as reducing the variation in birth weight within a litter. Currently large differences exist between the smallest and largest piglets within a litter and the smallest often die as they fail to compete for access to milk. Canalised selection programmes aim to reduce variation in a trait and could improve survival by removing from the population particularly small and large piglets. Selecting for improved placental efficiency might also improve birth weight and help to reduce the proportion of piglets that die. A major cause of piglet mortality is crushing by the mother as she lies down. A minority of mothers are responsible for the majority of crushing deaths with some killing 31% of their piglets. Breeding for improved maternal behaviour therefore could have a major role to play in improving piglet survival.

**Fig. 18.3: Selective breeding for large litter size in pigs has been highly successful but tends to create a large number of small and weak piglets.**

Breeding also has great potential to improve survival of neonatal lambs. Worldwide pre-weaning lamb mortality averages 15-20% and, like piglet mortality, has not improved in recent decades. Death is likely to be prolonged and

involve considerable suffering through starvation and hypothermia. Importantly, management options to protect or treat neonatal lambs are usually lacking in extensive outdoor production systems. Neonatal lamb vigour is a major determinant of survival. Lamb vigour is easy to record and has a moderately heritability. For example, a reduced ability to suck milk from the mother has a heritability of 0.32 which is higher than some other traits currently under selection (e.g. litter size only has a heritability of 0.16). Simple scores for lamb vigour and sucking ability have been developed and are starting to be adopted by the most progressive farmers.

Recent changes in breeding strategy have allowed litter size to be increased without increasing the proportion of piglets that die.

**Box 18.3 Case Study - Footrot**

Lameness of sheep and cattle caused by the virulent anaerobic bacterium *Dichelobacternodosus* is called 'footrot' and is a painful hoof infection. It is endemic in countries with wet climates where footrot hoof lesions have a prevalence of up to 23%. Infection can be prevented and controlled by careful hygiene but this is time consuming and requires continuous vigilance and action by the farmer (e.g. by use of foot-bathing with bactericidal chemicals and separation of infected from uninfected animals). Most farmers find it difficult to follow such strict hygiene and biosecurity precautions and efficient management can be problematic even on well-managed farms. Footrot resistance is heritable in sheep (heritability 0.15-0.25). Simple 5-point scoring methods exist for recording the severity of lesions and are being used in the breeding programmes of some countries to reduce footrot prevalence.

### 18.6.1 Barriers to Selection: Ethical Considerations

From a technical perspective, breeding has great potential to minimise the expression of welfare traits. However, deliberate selection to improve welfare, particularly where this involves modifying behaviour, may be unwelcome by some. There are various reasons for this:

a) Any change, especially a behavioural one, may be seen to reduce the 'naturalness' of the animal. A counter argument could be made that selection to improve welfare may actually reverse the effects of past selection and make the animals more representative of their ancestral or wild state.

   *Example:* Redirected behaviours that cause injury to group members have never been observed in the wild, so their reduction would make the behaviour of livestock more natural, not less.

b) Economic and practical barriers should not be allowed to prevent the adoption of interventions that are already well known to reduce a welfare problem and that breeding should not be relied upon as an alternative solution. An alternative view may be that consumer pressure and legislation has failed in the past to motivate the uptake of costly management interventions and is unlikely to do so in the near future. Therefore, an argument could be made that on-going and routine welfare problems should be addressed with every tool available, including breeding.

c) It could have unintended and undesirable impacts on other welfare relevant traits that we do not yet know about.

d) Selection against the expression of a trait does not necessarily mean that the experiences for the animal will improve. For example, it is unclear if a pig which does not tail bite is happier in a stimulus-poor, barren environment than one which does. Equally, if we were to select against the expression of lameness by measuring difficulty during walking, we may inadvertently select for animals that are simply good at hiding pain.

### 18.6.2 Barriers to Selection: Practical Considerations

For a simple trait like growth rate, few barriers exist to implementing selection. The trait is easy, accurate and inexpensive to record and the economic benefits of its improvement (its 'economic value') are easy to estimate and are large. For welfare relevant traits, more significant barriers need to be overcome before selection pressure can be placed on them (Figure 18.4):

- Welfare traits are often costly and difficult to measure (e.g. health traits and redirected behaviour where it is easier to identify the victims than the perpetrators).
- The inclusion of a new trait in the collection of traits already under selection (the 'selection index') inevitably reduces the amount of progress that can be made in the existing traits. This is problematic for welfare traits where the economic benefits (if any) and the societal or ethical benefits of improving a trait are hard to measure and may seem inadequate to justify reducing progress in traits that have a clear and large economic value.
- Selection to improve a welfare trait is even harder to justify if the trait is correlated in an undesirable way with an economic trait. For example,

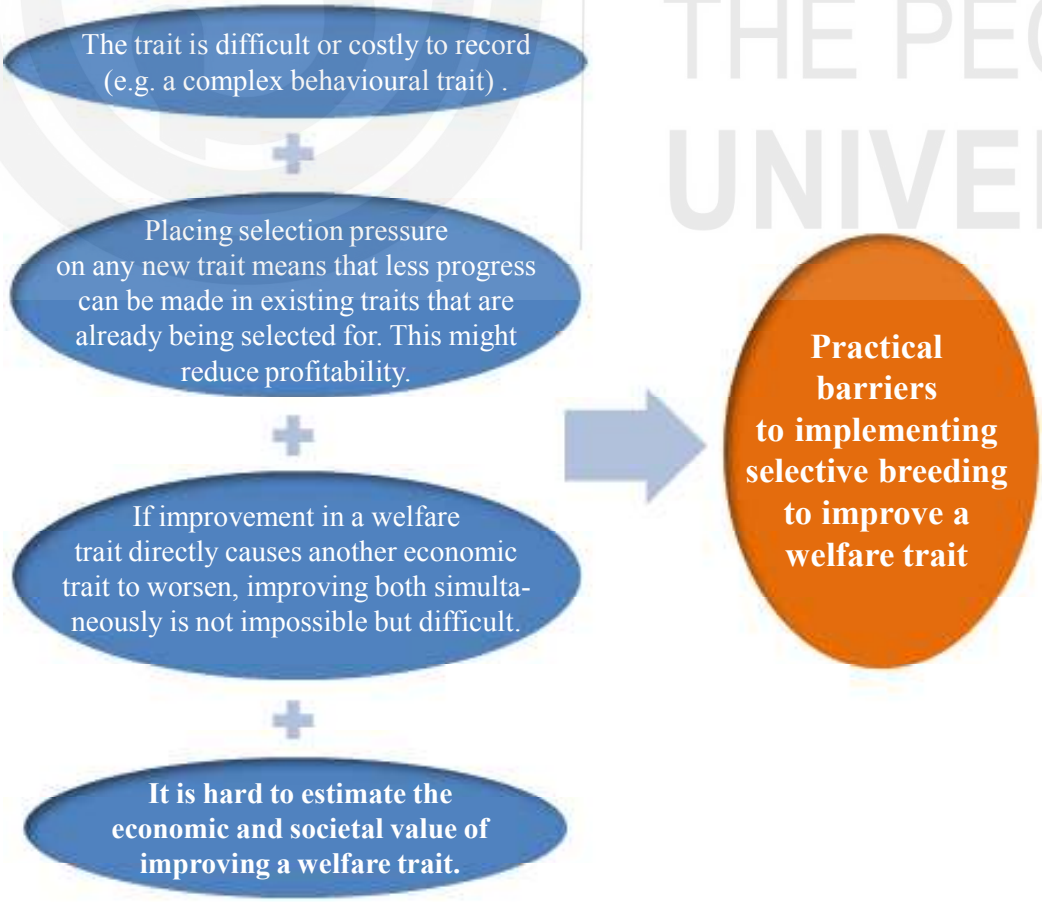


**Fig. 18.4: Practical barriers that make it difficult to improve a welfare trait through selective breeding.**

reducing a health problem that has resulted from selection for fast growth is likely to lead to a reduction in growth rate. In a situation like this, improving the health trait may be economically feasible if it improves survival, reduces veterinary costs and allows the animals to feed properly.

From the discussion above it should come as no surprise that few welfare traits are currently being improved by selective breeding even though many technically could be. It is also evident that those which are under selection have a clear welfare impact but also a clear economic impact. So far, this means that survival and health traits that majorly constrain productivity have been the focus of attention. It is likely that selection on other traits will become more feasible in the future as the automation of phenotyping becomes possible and the costs of technology for exploiting molecular genetic information fall (such as genomic selection which does not require routine phenotyping).

**Check Your Progress 4**

**Note:** a) Use the spaces given below for your answers.

b) Check your answer with those given at the end of the unit.

1) How may breeding help to alleviate significant welfare problems that have existed for many decades?

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2) Write any two ethical considerations in genetic selection

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## 18.7 LET US SUM UP

- Animal breeding has proven to be a highly effective way of maximising the benefits that humans derive from animals, whether these are economic, cultural or aesthetic.
- Genetic change has been achieved at different rates and by different means in different species. The application of modern breeding techniques is likely to accelerate the improvement of traits under selection.
- In most cases, traits that affect welfare are heritable and often to a higher degree than economically important traits that are currently the focus of selective breeding.

- We have seen many examples of how breeding can have negative effects on welfare in all forms of captive species. Inclusion of welfare traits in breeding strategies has in some cases reversed (at least in part) the negative effects of past selection.
- Many other traits cause serious welfare problems and have become a tolerated and routine aspect of the way that we manage animals. These traits could be improved substantially by placing selection pressure on them.
- There are significant ethical and economic barriers to directly selecting to improve welfare traits. Some of the economic barriers are likely to be overcome in the future by the greater uptake of modern breeding approaches that reduce the costs of recording complex traits.

## 18.8 KEYWORDS

**Animal Husbandry**: This is the branch of agriculture concerned with animals that are raised for meat, fibre, milk, eggs, or other products.

**Breeding:** Breeding is sexual reproduction that produces offspring by animals.

**Generation Interval**: It is the concept in animal breeding in which how quickly a new-born animal itself becomes a parent is recorded.

**Genetics**: Genetics is a branch of biology concerned with the study of genes, genetic variation, and heredity in organisms.

**Production**: The production of animal goods such as meat, dairy, wool, and leather.

**Tibial Dyschondroplasia**: In broilers, this is the inadequate development of the cartilage leading to pathologies in the growth plate.

**Trait**: The features that are the target of improvement through genetic selection, such as growth rate, are referred to as 'traits'.

**Genotype**: Genotype is the specific and unique genetic makeup of an animal.

**Heritability**: The strength of the genetic contribution to the variability of a trait is termed as the 'heritability' of the trait.

## 18.9 BIBLIOGRAPHY AND FURTHER READING

Rauw, W.M., Kanis, E., Noordhuizen-Stassen, E.N. and Grommers, F.J. (1998). Undesirable side effects of selection for high production efficiency in farm animals: a review. *Livestock Production Science,* 56: 15-33 (This paper published in a peer reviewed journal gives the most comprehensive description of the welfare traits that have been harmed by selective breeding for productivity).

Rodenburg, T.B. and Turner, S.P. (2012). The role of breeding and genetics in the welfare of farm animals. *Animal Frontiers*, 2: 16-21 (This paper is also published in a peer review journal and is open access. It describes how far we have come in improving welfare in the pig and poultry industries by using breeding).

Simm, G. (1998). *Genetic improvement of cattle and sheep*. Published by CAB International (This book gives an accessible overview of how breeding takes place in these species and will be useful as a more detailed guide to the mechanism, science and industry behind commercial breeding).

*https://dairy.ahdb.org.uk/technical-information/breeding-genetics/%C2%A3pli/*

The AHDB website above gives a little more information on the UK Profitable Lifetime Index for dairy cattle.

## 18.10 SELF ASSESSMENT EXERCISES

1) Explain why animal breeding is so effective in creating change in traits of use to humans.
2) Describe what is meant by the term 'heritability'.
3) Give examples of the way in which past selection strategies have had a negative effect on animal welfare.
4) Describe how some negative consequences of past selection strategies have been reversed by changing the breeding strategy itself.
5) Name some of the long-standing welfare problems that could be improved by future selective breeding.

## 18.11 ANSWERS/HINTS TO CHECK YOUR PROGRESS

**Check Your Progress 1**

1) The features which are the target of improvement through genetic selection, such as growth rate, are referred to as 'traits'.
2) More recent structured breeding programmes focus on improving traits of economic importance (in livestock), convey an aesthetic quality (e.g. in dog breeding) or allow scientific discovery (e.g. in strains of mice developed as models of human disease).
3) Selective breeding is unique in that it leads to permanent and cumulative change that builds from one generation to the next. Small improvements in a trait made in each generation can have very major implications when summed over many generations. Example: change in growth rate of broiler chickens.
4) In the pig and poultry industries, large, multinational breeding organizations supply elite genetic material to farmers and the performance of their offspring in each trait of interest is measured and compared on dedicated 'nucleus' farms. These industries contrast with the sheep sector where breed societies manage the registration of elite animals but the elite animals themselves and their offspring are managed on normal farms.
5) To make rapid progress in a trait, it must be possible to record it accurately so that an accurate reflection can be given of how well or bad an individual is compared to its peers. This process of recording performance in a trait is called 'phenotyping'.

**Check Your Progress 2**

1) Genotype is specific and unique genetic makeup of an animal.

2) The strength of the genetic contribution is termed as the 'heritability' of the trait. Heritability is measured on a scale of 0 to 1 and expresses the proportion of the total variation seen in a trait that is due to additive genetic effects.

**Check Your Progress 3**

1) Genes often have pleiotropic effects, meaning that one gene can influence the expression of several traits at the same time even if the traits appear to be unrelated. Two genes with different effects (e.g. one affecting a production trait and one affecting a welfare trait) can also be inherited together if located in close proximity on the chromosome. This means that breeding for an economic or aesthetic trait has the potential to lead to desirable or undesirable genetic change in other traits of welfare significance.

2) Example for undesirable effects of breeding include cardiovascular problems and lameness in fast growing broiler chickens, skeletal weakness in high egg producing hens, poor neonatal survival in large litters of pigs, increased lameness and mastitis in high milk yielding dairy cows, respiratory and thermoregulatory problems for short-nosed (brachycephalic) dog breeds.

**Check Your Progress 4**

1) The use of breeding to combat welfare problems has a very major advantage that traits can be improved without the requirement for expensive structural or management changes by the animal owner. It offers a very efficient, permanent and inexpensive way to improve welfare problems. Since genetics usually contribute less than 50% to the variation in expression of a trait in a population, approaches where we adapt the animals by genetic selection should be complemented by continued efforts to optimize the environment for the animals.

2) Any change, especially a behavioural one, may be seen to reduce the 'naturalness' of the animal. Economic and practical barriers should not be allowed to prevent the adoption of interventions that are already well known to reduce a welfare problem and that breeding should not be relied upon as an alternative solution. Selection against the expression of a trait does not necessarily mean that the experiences for the animal will improve.

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