

**WHAT IS ANIMAL WELFARE AND HOW CAN WE MEASURE IT?****JAAKKO MONONEN**

University of Eastern Finland  
Department of Biology  
P.O. Box 1627, 70211 Kuopio, Finland  
jaakko.mononen@uef.fi  
&  
MTT Agrifood Research Finland  
Animal Production Research  
Halolantie 31A, 71750 Maaninka, Finland  
jaakko.mononen@mtt.fi

**ABSTRACT**

Animal welfare can be defined as an individual animal's subjective experience of its mental and physical state as regards its attempt to cope with its environment. The mental state (feelings and emotions) of an animal cannot be measured directly, but has to be inferred from the behaviour, physiology, health and productivity of an animal. Various choice tests can be used to assess the behavioural priorities of animals. These tests provide insight into what animals regard as preferable or aversive. Unsuitable housing environments and management may lead to movement difficulties, abnormal responsiveness and abnormal behaviour. Also, a variety of responses of the neuroendocrine, autonomic nervous and immune systems can indicate coping difficulties and stress experienced by animals. Long-term stress may finally result in health problems and reduced productivity. Diseases and injuries themselves are naturally often coupled with suffering. Good productivity does not necessarily equal with good welfare while genetic selection for productivity, for example, may have negative welfare effects. Animal welfare is not only the absence of suffering, but also the animals' possibility to have positive mental states should be considered. Positive mental states can be interpreted from the behaviour and physiology of animals. Since the welfare state results from the complicated interaction of an animal with its environment, it is highly recommended that a diverse range of measures are used in animal welfare studies.

**Keywords:** animal welfare, behaviour, physiology, health, productivity

**DEFINING ANIMAL WELFARE**

Animal welfare is a multidimensional scientific and societal concept, and there is no single generally accepted scientific definition of animal welfare (FRASER, 2008: pp 72-78). Probably the most cited definition of animal welfare is: 'The welfare of an individual is its state as regards its attempts to cope with its environment' (e.g. BROOM & JOHNSON, 1993: p 74). This definition has later been modified, and for example NORGES FORSKNINGSRÅD (2005: pp. 30-31) emphasizes that 'state' refers to not only physical (or physiological) but also mental (or psychological) state. WEBSTER's (2005: p. 10) definition 'Fit and happy', expresses the same in the shortest possible way, with 'fit' referring to the physical welfare and 'happy' referring to the mental welfare.

Mental welfare does not refer only to states related to poor physical health (e.g. pain, disease or injury), but also includes more subtle negative feelings (e.g. boredom and frustration) as well as positive feelings (e.g. pleasure) (RUSHEN ET AL., 2008). It is worth noting that in the European Union's Treaty of Lisbon animals are recognised as sentient beings, and that this has to be accounted for during policy formulation, for example EU's Common Agricultural Policy (EC, 2012). 'A sentient animal is one for whom feelings



matter' (WEBSTER, 2005: p. 10-11), and our traditional mammalian and avian farm animals, for example, belong to this group of sentient animals.

The definitions of animal welfare based on physical and mental state still lack one important aspect of animal welfare. Natural living as a prerequisite for good welfare has been emphasised upon, particularly by social commentators and ethicists (FRASER, 2008: pp. 65-72.), and the consumers (MIELE & KJÆRNES, 2009). However, life in nature is full of suffering (DAWKINS, 1980: pp. 51-54), and the relationship between natural living and animal welfare is complicated (WEBSTER, 2008: pp. 188-190).

Accordingly, there are three approaches to animal welfare: feelings, biological functioning and naturalness (RUSHEN ET AL., 2008: pp. 6-9). The final conclusions of the animal welfare studies may depend on how these three are weighed (e.g. FRASER, 2008: pp. 242-247). This reflects the fact that the science of animal welfare is not free from value or ethical considerations.

## **EXPLAINING ANIMAL WELFARE**

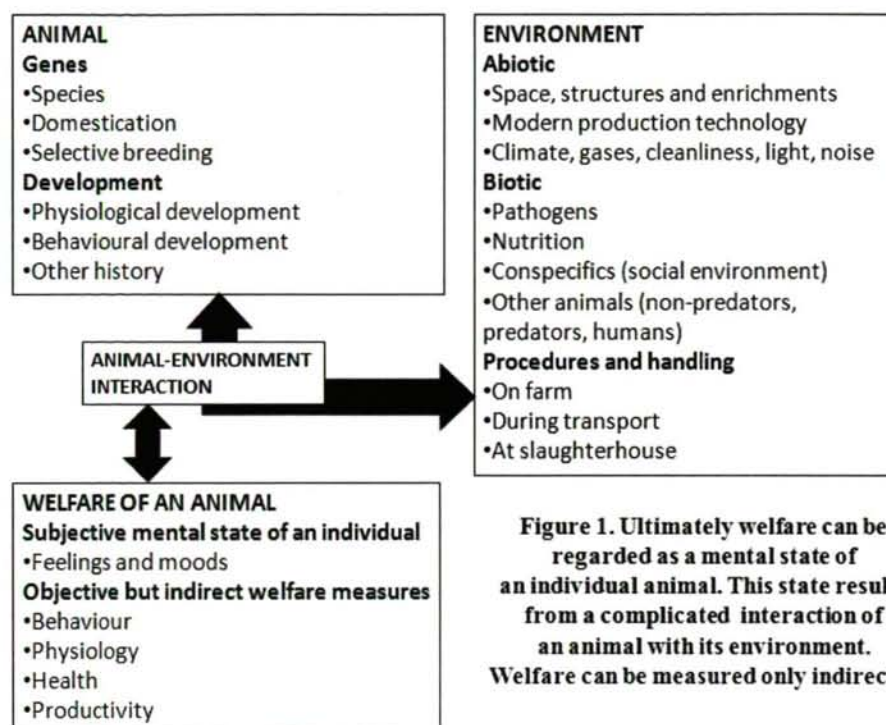
Despite the difficulties of defining animal welfare, basically the welfare of an animal depends on how well the adaptations possessed by the animal fit the challenges it encounters in its environment (FRASER, 2008: pp. 226-229). *Figure 1.* illustrates the interaction of an animal with its environment and the putative ways to measure animal welfare. *Figure 1.* is the framework for all discussions that follow, but to keep things brief, will be referred to only this once.

### **Animal**

Genes are the basis of the adaptations of an animal, but developmental factors also affect an individual's ability to adapt to its environment. In fact, domestication includes both genotypic and phenotypic adaptation (PRICE, 2003). Evolution has shaped the genes of animals in the course of millions of years during which animal species adapted to living in their natural environments. Domestication of most farm animal species began thousands of years ago, but living for thousands of generations in a close relationship with man has not had any dramatic effects on the behavioural repertoire or behavioural needs of farm animals (JENSEN, 2009). Rather, only the thresholds to manifest certain behaviour patterns has changed, most notably fear reactions towards man. On the other hand, the development of modern intensive farming started less than 100 hundred years ago, and therefore the massive welfare problems of farm animals in many of the current housing systems have not come as a great surprise.

During the last decades, selective breeding has been an essential tool to improve the productivity of farm animals (RAUW ET AL., 1998). Unfortunately, increasing productivity has also had some undesirable welfare-related side-effects that are reflected in animals behaviour (e.g. suppression of oestrus behaviour in dairy cows), physiology (e.g. immunosuppression in poultry) and health (e.g. leg problems in pigs and poultry). Selective breeding can be, however, used also to promote animal health and welfare (LAWRENCE ET AL., 2004; POTTINGER, 2008).





**Figure 1. Ultimately welfare can be regarded as a mental state of an individual animal. This state results from a complicated interaction of an animal with its environment. Welfare can be measured only indirectly.**

Developmental processes affect the phenotype of an animal all through its life. Stress hormones produced by a gestating female affect the development of the neuroendocrine system of its offspring ('prenatal stress'; LAY, 2000). Also, the experiences in the neonatal phase ('neonatal stress') possibly modify the neuroendocrine system and later reactivity of the animals. Learning, in particular, affects the behaviour of animals after these early phases of life, as they try to cope with their environment (EWING ET AL., 1999: pp 101-107). Successes and failures in these behavioural attempts to cope are crucial to the welfare of animals. Controllability and predictability of life promote coping and good welfare (KEELING & JENSEN, 2009). However, life is not affected only by physiology and behaviour. Injuries and mutilations, for example, may have long term effects on the welfare of animals (EFSA 2009).

## Environment

In modern intensive farming systems, the space provided for the animals is limited, which may prohibit even very basic movements (BROOM & JOHNSON, 1993: pp. 131-134). Although it is impossible to bring 'all of nature' into intensive housing systems, environmental enrichment may be used to fulfil species-specific behavioural needs of animals (BROOM & JOHNSON, 1993: pp 145-149): for example rooting material for pigs (ŠPINKA, 2009) or dust-bathing substrate for laying hens (MENCH, 2009). Methods for early detection of sickness illustrate the opportunities that modern technology can offer to enhance animal welfare (WATHES, 2008).

Climate (e.g. temperature and draught), gases (e.g. ammonia) and cleanliness are in concert with pathogens important factors that may affect the welfare of animals (e.g. EFSA, 2009). Low light intensities may, for example, reduce the motion confidence of dairy cows, and light regime probably affects their productivity. Noise, in turn, can induce fear reactions or disturb sleep.



The fulfilment of an animal's nutritional needs is crucial for its welfare (EWING ET AL., 1999), but feeding practices also affect welfare (EFSA, 2009). In cattle, the development of stereotypic tongue rolling may be enhanced by unfulfilled feeding motivation (although the animals' nutritional requirements are met), and rumen acidosis is more common, if concentrates and roughage are provided separately as compared to 'total mixed ration' feeding (RUSHEN ET AL., 2008: pp. 106-109).

Most farm animal species are gregarious and usually kept in groups (WEARY & FRASER 2009). Despite the evolutionary adaptations for living in groups, in many cases the combination of the physical and social environment that we provide, jeopardises the normal development and welfare of animals. Aggression in pigs, for example, is typically related to time limitations in food availability, limited space, and mixing of animals unfamiliar to each other (ŠPINKA, 2009). Other animal species can also pose a threat to animals farmed extensively, particularly predators (e.g. sheep and goats: DWYER, 2009). A good human-animal relationship is of paramount importance for animal welfare. Fear of stockpersons leads to long-term stress that is reflected in the behaviour, physiology and production of the animals (HEMSWORTH & BARNETT, 2000). Fear of humans is usually a learned response in farm animals, and can be counteracted by the manifestation of appropriate behaviour by the animal caretakers. Farm animals also encounter various procedures that may cause not only fear, but also pain, and in many cases both (e.g. disbudding and tail-docking in cattle: EFSA, 2009).

Animals may be transported several times during the course their lives and most animals are transported at least once, i.e. to the slaughterhouse. Although both transportation (including loading at both ends of the journey) and time at the slaughter house are a short part of the animals lives, in relation to their whole lifespan, these operations may be very stressful to animals (BROOM & JOHNSON, 1993: pp 87-88). Scientific research has, however, aided the development of more animal-friendly handling methods and vehicles, as well as stunning methods (WEBSTER, 2005: pp 169-176).

## **MEASURING ANIMAL WELFARE**

General approaches to, and more detailed descriptions of the methods for measuring animal welfare have been presented in several text books (e.g. BROOM & JOHNSON, 1993; FRASER, 2008). Animal behaviour, physiology, health and productivity can be used for measuring welfare. However, since welfare results from a multifaceted interaction of the animal and its environment, final conclusions of the effects of the housing environment or procedures, for example, on animal welfare should always be based on several studies with several welfare assessment methods.

The natural behaviour of an animal species is an important starting point for designing housing environment, but preference studies are needed to extract the key features of the environment that are most crucial for the welfare of each species (FRASER, 2009: pp. 190-216). Preferences of animals can be measured either in free choice situations or in situations where animals' have to work to gain for access to a resource. Choices made by animals can also be used also to assess the aversiveness of certain procedures to the animals.

Abnormal behaviour, such as stereotypic behaviour or self-mutilation, may stem from restrictive and stimulus-poor environment (FRASER, 2008: pp. 125-145; KEELING & JENSEN, 2009). The motivation to perform some behaviour patterns may be so strong that animals perform them without the normal key stimuli, for instance, dust bathing by laying hens (MENCH, 2009). The effects on welfare of this kind of 'sham' or 'vacuum'



behaviours are not very well understood. Also, poor structural design may hinder normal behaviour, for example lying and rising actions of dairy cows in cubicles (BROOM & JOHNSON, 1993: 131-133).

The signs of physiological attempts to cope can also be used to assess animal welfare. Activation of the autonomic nervous system and the hypothalamic-pituitary-adrenal axis indicate that an animal is perceiving stress (MOBERG, 2000). If stress is strong or prolonged, it affects the immune system, and consequently the health of the animals. Finally, stress may have effects on reproduction, longevity and productivity of animals (BROOM & JOHNSON, 1993: pp. 76-80).

## CONCLUSIONS

Ultimately welfare can be regarded as a mental state of an individual animal. This state results from a complicated interaction of an animal with its environment. Welfare can be measured only indirectly using behavioural, physiological, health and productivity measures. A diverse range of measures should be used in animal welfare studies.

This paper intentionally uses a limited number of references and focuses on text book references to facilitate an easy start for anyone who wishes to deepen his or her understanding of the science of animal welfare.

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## REFERENCES

- BROOM, D.M, JOHNSON, K.G. (1993): Stress and Animal Welfare. Chapman & Hall. 211 pp.
- DAWKINS, M.S. (1980): Animal Suffering. The Science of Animal Welfare. Chapman & Hall. 149 pp.
- DWYER, C. (2009): The behaviour of sheep and goats. In: P. Jensen (ed.), The Ethology of Domestic Animals, An Introductory Text. CAB International. pp. 161-176.
- EWING, S.A., LAY, D.C. JR., VON BORELL, E. (1999). Farm Animal Well-Being. Stress Physiology, and Environmental Design. Prentice Hall. 357 pp.
- EC (2012): European Commission. Communication from the Commission to the European Parliament, the Council and the European Economic and Social Committee on the European Union Strategy for the Protection and Welfare of Animals 2012-2015, Brussels, 15.2.2012. 12 pp.
- EFSA (2009): European Food Safety Authority. Effects of farming systems on dairy cow welfare and disease. Report of the Panel on Animal Health and Welfare. Annex to the EFSA Journal 1143. pp. 1-284.
- FRASER, D. (2008): Understanding Animal Welfare. The Science in its Cultural Context. Wiley-Blackwell. 324 pp.

- HEMSWORTH, P.H., BARNETT, J.L. (2000): Human-Animal interactions and animal stress. In: G.P. Moberg, J.A. Mench (eds.), *The Biology of Animal Stress, Basic Principles and Implications for Animal Welfare*. pp. 309-335.
- JENSEN, P. (2009): Behaviour Genetics, Evolution and Domestication. In: P. Jensen (ed.), *The Ethology of Domestic Animals, An Introductory Text*. CAB International. pp. 10-24.
- KEELING, L., JENSEN, P. (2009): Abnormal behaviour, stress and welfare. In: P. Jensen (ed.), *The Ethology of Domestic Animals, An Introductory Text*. CAB International. pp. 85-101.
- LAWRENCE, A.B., CONINGTON, J., SIMM, G. (2004). Breeding and animal welfare: practical and theoretical advantages of multi-trait selection. *Animal Welfare*, Volume 13. pp. S191-196.
- LAY, D.C. JR. (2000): Consequences of stress during development. In: G.P. Moberg, J.A. Mench (eds.), *The Biology of Animal Stress, Basic Principles and Implications for Animal Welfare*. pp. 249-267.
- MENCH, J.A. (2009): Behaviour of Fowl and Other Domesticated Birds. In: P. Jensen (ed.), *The Ethology of Domestic Animals, An Introductory Text*. CAB International. pp. 10-24.
- MIELE, M., KJÆRNES, U. (2009): Investigating societal values on farm animal welfare: The example of Welfare Quality®. In: L. KEELING (ed.), *An Overview of the Development of the Welfare Quality® Project Assessment System*. Welfare Quality Reports No. 12. pp. 43-55.
- MOBERG, G.P. (2000): Biological response to stress: implications for animal welfare. In: G.P. Moberg, J.A. Mench (eds.), *The Biology of Animal Stress, Basic Principles and Implications for Animal Welfare*. pp. 1-21.
- NORGES FORSKNINGSRÅD, 2005. Forskningsbehov innen dyrevelferd i Norge. Rapport fra styringsgruppen. 356 pp.
- POTTINGER, T.D. (2000): Genetic selection to reduce stress in animals. In: G.P. Moberg, J.A. Mench (eds.), *The Biology of Animal Stress, Basic Principles and Implications for Animal Welfare*. pp. 291-308.
- RAUWA, W.M., KANISB, E., NOORDHUIZEN-STASSEN, E.N., GROMMERS, F.J. (1998): Undesirable side effects of selection for high production efficiency in farm animals: a review. *Livestock Production Science*, Volume 56. pp. 15-33.
- RUSHEN, J., DE PASSILLÉ, A.M., VON KEYSERLINK, M.A.G., WEARY, D.M. (2008): *The Welfare of Cattle*. Springer. 310 pp.
- ŠPINKA, M. (2009): Behaviour of pigs. In: P. Jensen (ed.), *The Ethology of Domestic Animals, An Introductory Text*. CAB International. pp. 177-191.
- WATHES, C.M., KRISTENSEN, H.H., AERTS, J.-M., BERCKMANS D. (2008): Is precision livestock farming an engineer's daydream or nightmare, an animal's friend or foe, and a farmer's panacea or pitfall? *Computers and Electronics in Agriculture*, Volume 64. pp. 2-10.
- WEARY, D.M., FRASER, D. (2009): Social and reproductive behaviour. In: P. Jensen (ed.), *The Ethology of Domestic Animals, An Introductory Text*. CAB International. pp. 73-84.
- WEBSTER, J. (2005): *Animal Welfare. Limping Towards Eden*. Blackwell Publishing. 283 pp.