

## **Overall animal welfare assessment reviewed. Part 1: Is it possible?**

M.B.M. BRACKE<sup>1</sup>\*, B.M. SPRUIJT<sup>2</sup> AND J.H.M. METZ<sup>1</sup>

<sup>1</sup> DLO-Institute of Agricultural and Environmental Engineering (IMAG), Wageningen University and Research Centre, P.O. Box 43, NL-6700 AA Wageningen, The Netherlands

<sup>2</sup> Department of animal sciences, Ethology group, Wageningen University and Research Centre, P.O. Box 338, NL-6700 AH Wageningen, The Netherlands

\* Corresponding author (fax: +31-317-425670; e-mail: m.b.m.bracke@imag.wag-ur.nl)

Received 24 November 1999; accepted 31 December 1999

### **Abstract**

Several authors have concluded that scientists should not attempt to perform overall animal welfare assessment (OWA). They argue that scientists have continued to fail to make progress in this area and that value judgements are inherently involved in OWA for which science cannot provide answers. We take a more positive attitude toward OWA and argue that scientists should avoid creating a self-fulfilling prophecy. OWA is necessary for making actual moral and political decisions. Science has already accumulated much relevant information about welfare and this information should be applied in decision making.

The task of OWA is to assess welfare based on knowledge of the biological needs of animals. Weighting of welfare relevant factors constitutes a problem. However, when scientists cannot provide empirical data to solve weighting issues, this does not mean that rational answers cannot be found, e.g. in the form of procedural rules. OWA is conceived as a problem of multi-criteria decision making with fuzzy information. It focuses on the descriptive aspect of welfare, i.e. on what the welfare status of the animals really is without taking an ethical stance. The welfare status of animals depends on their biology and on the way animals assess their own welfare. It does not depend on how it happens to be perceived by us. Even though OWA necessarily remains a human activity, it is not arbitrary, nor does it allow of multiple 'correct' answers. OWA is a descriptive activity that can achieve more and more accuracy as science proceeds.

**Keywords:** welfare assessment, housing, decision support, weighting, ethics.

### **Introduction**

Concern for animal welfare is an issue for many people. Expressing concern about welfare often presupposes making an assessment of the overall welfare-status. Many

people are convinced about the validity of their personal assessment of the welfare status of animals. However, differences in opinion appear hard to resolve.

To help resolve these differences we are presently working on a model to assess the welfare status of farm animals on a scientific basis. Our goal is to develop a tool to perform overall welfare assessment (OWA), which can be used to support moral and political decision-making. For this purpose we are developing a kind of expert system, a decision support system (Bracke *et al.*, 1999). Such a system requires a method to assess welfare in an explicit way and on a scientific basis.

In this and the following part we will discuss various considerations for performing OWA. The second and third parts deal with available assessment tools and the biological basis for OWA respectively. In the present paper we will discuss the methodological question whether it is theoretically possible to perform OWA on a scientific basis. We are optimistic and believe OWA is possible.

However, scepticism about OWA is widespread, even among applied ethologists. Several prominent authors in the field of applied ethology have concluded that science is limited in its ability to determine 'overall' welfare or to compare welfare in disparate environments (Fraser, 1995; Rushen & de Passillé, 1992; Dawkins, 1998). Some authors (e.g. Fraser, 1995; Tannenbaum, 1991) have provided a forceful methodological argument that may be used to justify this scepticism about OWA. They argued that welfare cannot be defined and studied as a purely technical, scientific concept, because underlying value-related assumptions are inherently involved in OWA (Sandøe & Simonsen, 1992; Fraser, 1995; Fraser *et al.*, 1997). In this paper we will argue against a sceptical interpretation of this methodological argument and explain why we believe it is possible to perform OWA on a scientific basis.

## **Welfare definitions**

Welfare definitions have been reviewed by several authors (Rushen & de Passillé, 1992; Anon., 1992; Fraser *et al.*, 1997; Stafleu *et al.*, 1996), and were discussed in two relatively recent international conferences (see Journal of Agricultural and Environmental Ethics 6, Supplement 2: 1993; Acta Agriculturae Scandinavica Section A, Animal Science, Supplement 27: 1996). Below we will discuss points of disagreement and consensus to arrive at a subjective definition of welfare. Subjective definitions of welfare tend to strengthen the sceptic view that OWA is not possible, but the discussion of welfare definitions will also provide a clue to reject scepticism.

There appears to be general consensus regarding a number of properties relating to welfare (partly extracted from Broom & Johnson, 1993). (1) Welfare is a characteristic of animals, i.e. it is a descriptive property of animals; it is not a property of the environment. Since it is generally agreed that animals have a welfare status, we will not be dealing with the Cartesian argument that animals may be automata lacking consciousness (Bermond, 1997), nor with the application of Ockham's razor so as to deny radically that welfare states can be known (Kennedy, 1992). (2) Welfare can range on a continuum from very poor to very good. (3) The results of scientific measurements are relevant for welfare assessment. (4) The scientific assessment of

animal welfare requires that a variety of measures must be employed. There is, at present, no standard welfare 'thermometer'.

Welfare has been defined in various ways. Examples of much cited definitions of welfare are 'living in harmony with the environment and with itself, both physically and psychologically' (Lorz, 1973), and 'the welfare of an individual is its state as regards its attempt to cope with its environment' (Broom, 1986). Widely different concepts have been used to define welfare. They include (listed tentatively from the more objective to the more subjective): pre-pathological states (Moberg, 1985), stress, coping, fitness and adaptation (e.g. Broom, 1986), predictability and controllability (Wiepkema, 1982), harmony (e.g. Lorz, 1973; Hughes, 1976), emotional states, wants, subjective feelings, suffering (Dawkins, 1988; Duncan & Petherick, 1991; Sandøe, 1996).

A distinction has been made between subjective and objective definitions of welfare (Mendl, 1991; Rushen & de Passillé, 1992; Sandøe *et al.*, 1996; Barnard & Hurst, 1996; Sumner, 1996). Objective definitions relate welfare directly to measurable parameters (e.g. Broom, 1986). They tend to emphasise the importance of biological functioning and seem 'inspired' by the question how welfare can be measured in a scientific, objective way. By contrast, subjective definitions define welfare in terms of subjective emotional states of animals, i.e. as what matters to the animals from their point of view (e.g. Dawkins, 1988, 1990; Duncan, 1996). Subjective definitions are more prevalent in the philosophical literature (e.g. Singer, 1990; Regan, 1983) and seem 'inspired' by the question how animals ought to be treated ethically (Rushen & de Passillé, 1992).

Subjective definitions have the problem how emotional states can be studied scientifically (Mason & Mendl, 1993). On the other hand, objective definitions seem to have counterintuitive implications. Examples include cases of adaptive pain (Dawkins, 1980) and an unfelt tumour (example from Mason & Mendl, 1993). Objective definitions of welfare have these problems precisely because they are objective and accordingly fail to satisfactorily accommodate the perspectival (point of view) nature of welfare (Sumner, 1996).

Stafleu *et al.*, (1996) suggested an alternative classification that may help resolve these points of dispute. They distinguish three levels to define welfare: conceptual, explanatory and operational. Operational definitions concern the question how welfare can be assessed or measured in practice; explanatory definitions concern how welfare may be conceived within a scientific framework; conceptual definitions identify the meaning of the concept of welfare at a philosophical level. This classification made by Stafleu *et al.* may relate to the subjective-objective dichotomy in two ways. If subjective definitions apply at the conceptual level and objective definitions apply at the explanatory or operational level, then apparent disagreement would be resolved by pointing out the difference in abstraction levels. On the other hand, if the objective-subjective dichotomy applies within the conceptual level, then the dispute is more fundamental and important theoretically, but may have relatively little practical (operational) implications. Different approaches to welfare often lead to similar conclusions (Duncan & Fraser, 1997). The impact of cases like adaptive pain, unfelt tumours and injured unconscious animals are probably of little importance for actual OWA in relation to housing.

Furthermore, true proponents of an objective welfare definition are becoming

rare. Broom has generally been cited as a scientist defining welfare as an objective state. Recently, however, Broom (1998) re-emphasised the importance of feelings as part of his concept of welfare. Maybe there is more consensus on the issue whether subjective feelings of animals are a central part of the concept of welfare than would appear from the subjective-objective dichotomy. Sentience is generally accepted as a necessary condition for welfare. 'When people express concern about animal welfare, it is precisely the conscious experience of suffering that worries them most' (Dawkins, 1998, p. 306). Non-sentient objects like machines, computers or plants do not have a welfare status, at least not in a sense that is relevant in a socio-political context (Stafleu *et al.*, 1996).

Therefore, when all agree that emotional states are an important part of welfare and some believe emotional states are sufficient to define welfare, it seems rational to opt for a subjective definition of welfare as a starting point for OWA. In effect, we suggest to restrict the use of the term welfare to the representation of what matters to animals from their point of view. We use the term welfare to denote the animal's quality of life as it is experienced and valued by the animal itself, i.e. its prudential value (Sumner, 1996). A central role in welfare is taken by the emotional states that can be ascribed to animals. The welfare state of an animal is determined by all the emotional states and only the emotional states in so far as they are experienced subjectively by that animal.

Restricting the use of the term welfare to subjective states does not correspond with some intuitive notions which people may have about welfare. Per definition, a drugged animal that is kept in a permanently euphoric state has a high welfare status, even though it may be questioned whether this is morally acceptable. Alternatively, it would be a category mistake to believe that an unconscious animal that is injured has poor welfare (contra Broom, 1998). We would prefer to give such infringements another name, e.g. harm to integrity, but would not say that the animal's welfare was affected. We believe that to restrict the use of the term welfare to subjective emotional states will benefit discussions about welfare, because it can provide some conceptual clarity, which is much needed in this area. At the explanatory level, however, it is necessary to explain the relationship between subjective emotional states on the one hand and theoretical concepts that can be measured, at least in principle, on the other hand. At the operational level, finally, welfare assessment must necessarily depend fully on observable attributes, for, in the end, all information about animal subjectivity must necessarily be derived from what is or can be observed about the animals.

Because subjective definitions of welfare are the least 'measurable' of all definitions, they make OWA even more vulnerable to sceptical criticism than objective definitions do. Before we will discuss the main methodological argument we will briefly discuss a factual argument against OWA.

### **A factual argument against OWA**

Rushen & de Passillé (1992) stated that research has not been successful to perform OWA despite substantial political pressure. This observation may justify a recom-

mendation not to attempt OWA, but it fails to support the sceptic conclusion that scientists should not attempt OWA at all. Furthermore, even a well-intended recommendation comes with the risk of creating a self-fulfilling prophecy, warranting the question that scientists really tried hard enough to perform OWA.

The clause 'despite substantial political pressure' indicates that previous efforts should be taken seriously. However, to our knowledge a complete review of 'failed' attempts to perform OWA has never been published. This makes it difficult to evaluate whether previous attempts have been exhaustive.

Finally, even if this claim were true at present, the factual argument will lose force over time. Developments in other fields, such as neurobiology or information technology, may bring new perspectives and possibilities for performing OWA.

### **Some minor aspects of methodological scepticism**

Methodological scepticism about OWA concerns the limits of human cognition to know the welfare status of animals.

One argument is that there seems to be a general methodological problem with OWA because similar attempts in other fields have also failed. Well known are methodological problems with IQ tests and the apparent lack of human health and welfare indices. Opposing this criticism we recognise the development and use of index scores in several related fields. Examples include the field of medical technology assessment (e.g. McDowell & Newell, 1987; Streiner & Norman, 1995), psychiatric tests (the DSM IV, American Psychiatric Association, 1994) as well as tools to quantify environmental impacts (e.g. Lenthe *et al.*, 1996). Who hasn't been subjected to tests in school or to a psychological test for a job interview? Several of these indices have proven their use. When developed carefully and when used with care, indices may be extremely valuable for certain purposes. This also applies to an index for animal welfare.

A related argument is that welfare is not a constant feature. Welfare is a transient state which has multiple attributes and which is different under various circumstances (Dawkins, 1998). Similarly Fraser *et al.* (1975) argued that stress (read 'welfare'), like disease, cannot be put on a unidimensional scale. Welfare varies in nature; it varies over time; and it varies between individuals in a group. From this argument it follows that it is important to specify the exact circumstances. When this is done, we may, for example, state that the welfare status of a certain group of animals over a specified period of time is '7' on a scale from 0 to 10. This is a very short statement that conveys much information in a very efficient way. It specifies that welfare is reasonably good, but could still be better. Ideally, the scoring system should be transparent, in that a full explanation for this score can be given, including a specification of all underlying normative assumptions that were used to reach the welfare score (Sandøe & Simonsen, 1992; Fraser *et al.*, 1997). Such a methodology for OWA could be of substantial benefit for decision making concerning animal welfare.

## The argument that values are inherently involved

Fraser (1995) argues that science has a limited ability to compare welfare in systems that differ in a large number of features. Welfare is not a single attribute, like the height of a building, which can easily be measured in meters. On the contrary, welfare is a complex attribute, more like the safety of a building. The safety of a building will be different for different types of users of the building (p. 105). Similarly, different people will judge the welfare status of animals as very different, because they emphasise different attributes of housing systems as most important for welfare.

Since welfare is a complex attribute, a large number of variables (behaviour, physiology, productivity, health) must be taken into account. An overall welfare-judgement is possible when one system outperforms the other in every respect (cf. also Taylor *et al.*, 1995). However, a variety of measures are likely to yield a complex picture, with certain important advantages favouring each system. Fraser (1995) argues that science cannot provide the data that are necessary to decide which is the better system in such cases. In the absence of scientific facts value judgements are inherently involved in deciding which advantages of each system are most important.

This argument does not deny that animals have a welfare status about which science can provide much relevant information to help reducing value-based differences in people's ideas about animal welfare (e.g. Fraser, 1995, p. 106). Rather, the argument suggests that because science cannot solve value-based differences that are inherently involved in OWA, scientists should not attempt to perform OWA.

We have attempted to cast the reasoning steps of this sceptical argument into the syllogism below:

- a. OWA requires combining many different attributes of housing systems that point in different directions.
- b. Combining attributes that point in different directions requires weighting them against each other.  
If a and b then c.
- c. OWA requires weighting attributes.
- d. Weighting attributes inherently involves value judgements.  
If c and d then e.
- e. OWA involves inherent value judgements.
- f. Descriptive statements cannot logically refute or confirm value judgements.  
If e and f then g.
- g. Descriptive statements cannot logically refute or confirm OWA.
- h. Science only makes descriptive statements.  
If g and h then i.
- i. Science cannot logically refute or confirm OWA.
- j. What cannot be done, should not be attempted.  
If i and j then k.
- k. Science should not attempt OWA.

## Reply to the syllogism

The syllogism above contains 11 statements (a-k) involving five inference steps. The final conclusion (k), which is a value judgement (that scientists ought not to attempt OWA), is drawn from (i), which is a description (that science cannot prove OWA). This inference requires statement (j; that ought implies can, cf. Griffin, 1992) to avoid a naturalistic fallacy (statement (f) that descriptions cannot logically refute or confirm value judgements). This poses the question what science can and should do.

Bekoff *et al.* (1992) correctly pointed out that an assessment of animal welfare is always an assessment from a human's point of view. Scientists tend to be very careful when making statements about welfare, especially when it concerns the subjective states of animals, because as scientists they have a tradition of preferring parsimonious explanations that generally have been considered to exclude animal subjectivity. This sceptical attitude with respect to welfare stands in sharp contrast with the apparent ease with which 'ordinary' persons seem to be able to assess the welfare state of animals with which they have at least some familiarity. Often such private claims about welfare are made with a strong conviction that they are accurate and valid.

Recently, there has been a revival of putting the concept of welfare into an evolutionary perspective (e.g. Barnard & Hurst, 1996; Dawkins, 1998). For a moment we would like to put the human cognitive capacities regarding animal welfare in an evolutionary perspective. Humans have evolved as hunter-gatherers and farmers. Being able to recognise states of animal welfare, such as sick or aggressive animals, is likely to have increased fitness in humans. Wemelsfelder *et al.* (1998) found high inter- and intra-observer consistency of spontaneous subjective assessments of pig behaviour. This finding supports the suggestion that human cognitive abilities may be quite accurate in representing welfare. In line with this view the role of science could be to provide accurate factual data as well as to expose possible defects in our cognitive abilities to assess welfare.

The biological sciences that underlie welfare research seem to be unable to provide proof about animal consciousness. Opposing this demand, it has been argued that it may be unreasonable to demand proof in the case of welfare, because the underlying sciences themselves generally concern issues of statistical significance (the 5% probability level) rather than proof (Sambraus, 1981). Accordingly, instead of demanding proof, the task of OWA should be to provide the best possible solution or prediction of what the welfare status is, based on the scientific data that are available at the time the assessment is made. It follows that OWA is relative to the level of factual knowledge and this level may change over time depending on scientific progress.

Furthermore, the idea that science only makes descriptive statements (statement (h) in the syllogism above) may be questioned. Science is not value-free (cf. Rollin, 1990). Values are involved not only at the periphery of science, such as in deciding whether to allocate money to a project, but also more internal to science. Many descriptive activities require interpretations that involve value judgements. Since the quality of science, both internally and at its periphery, can be better or worse, *all* sci-

ences inherently involve values. In these senses, a scientific approach to OWA can be expected to be value laden as well. It follows that the (normative) claim that underlying value notions should be made explicit (e.g. Fraser, 1995; Fraser *et al.*, 1997) applies to all scientific activities and is not specific for OWA. Therefore, the inherent involvement of values in OWA cannot support a sceptical attitude unless values are involved in OWA in additional ways. We will discuss two such ways. One concerns the weighting problem and the other is about ethical concerns.

### The weighting problem

The weighting problem concerns the statements (a) to (e) in the syllogism. Although the statement (a) that many different attributes must be weighted, increases the complexity of welfare assessment, and therefore also the risk of making errors, the methodological issue concerns the unitary case of weighting two attributes against each other. An example, given by Fraser (1995, p. 106), is to weigh freedom from coccidiosis and freedom of movement. It would be impossible to weigh such attributes against each other, especially when people differ about what is more important and when scientific data cannot decide between them. Another example concerns tethered sows: "Observer A ... may conclude that the welfare of ... sows tethered in stalls is high because the animals are well fed, reproducing efficiently and free from disease and injury. Observer B ... concludes that the welfare of the same animals is poor because they give vocalisations that are thought to indicate frustration, and they escape from the stalls whenever the chance arises. Observer C ... agrees that the sows' welfare is poor because stalls are unnatural environments which prevent the animals' natural behaviour" (Fraser *et al.*, 1997, p. 202). The sceptic may be tempted to conclude from such examples that everybody can be right about welfare.

However, the way humans perceive welfare is not constitutive of the welfare status of animals. If observer A disagrees with observer B, then at least one of them must be mistaken. In the absence of proof, there is a second-best alternative, namely that procedure in which all available evidence has been taken into account in the most rational way. Rational OWA requires that reasons be provided for why certain aspects are believed to be more important than others. Rational OWA implies that the assessment is based on observable and measurable data and that the point of view of the animals is taken into account as much as possible.

Animals are able to compare widely different aspects of their environment (McFarland, 1989). Where animals can compare, they themselves are the norm because welfare was defined as what matters from their point of view. Where animals cannot compare, e.g. when assessments concern effects that apply over longer periods of time or between individuals in a group, a method for OWA must resort to other rational procedures (Sandøe *et al.*, 1996). The starting principle may be 'all to count for one, and nobody for more than one'. Adjustments to this principle are necessary, but must comply with the constraint of rationality, which includes, for example, the requirements of consistency and reflective equilibrium. The method of finding a reflective equilibrium uses our most basic intuitions to develop principles which, in

turn, are used to evaluate our more peripheral intuitions (e.g. DeGracia, 1996). In this respect OWA may be more akin to the social sciences and to philosophy than to the natural sciences.

In the end, animals must provide the norm of what is more important freedom from coccidiosis or freedom of movement. The extremes are easy to weigh. Undoubtedly, the mildest case of coccidiosis is better than the severest-possible restriction of space, while severe coccidiosis is undoubtedly worse than a mild restriction of space. Therefore, weighting of rather incompatible attributes, such as coccidiosis and space, is possible at least in extreme cases.

The relative self-evidence involved in extreme cases may have led several authors to argue that instead of trying to assess overall-welfare scientists should take a problem-oriented approach, which entails identifying, rectifying and preventing welfare problems (Fraser, 1995; Rushen & de Passillé, 1992). However, the problem-oriented approach fails to be a proper alternative for OWA. In order to establish that a problem really is a problem and to establish that it is important, one must have some grasp of the overall context. For example, severe lameness is obviously a real welfare problem. If this is a 'fact', then, by the same token, we have sufficient knowledge to use this kind of knowledge as a basis for OWA: the problem-oriented approach constitutes a way of doing OWA (cf. Taylor *et al.*, 1995). This would support our optimism about OWA. However, the problem-oriented approach is a rather narrow approach to OWA. It only concerns extreme cases and takes into account only the negative aspects of welfare. A more comprehensive view must also attempt to take into account less extreme cases as well as positive aspects of welfare.

When weighting involves less extreme cases, a standard is needed to verify whether the outcomes of OWA are valid. However, no golden standard is available, because the private minds of animals will probably never be directly assessable (Nagel, 1974; Dawkins, 1993; Mason & Mendl, 1993). This increases the uncertainty involved in OWA, but it may not be an insurmountable problem. OWA is not the only field lacking a golden standard. The same problem occurs in related fields, which we referred to above such as medical technology assessment and psychiatric tests. Validation of OWA may be performed in different ways. These may be based on a combination of optimism about our human cognitive ability to assess welfare and the ability of science to expose errors in this cognitive ability.

Further progress in OWA beyond simple cases of weighting attributes requires finding a rational way to perform OWA in a systematic and explicit way. It is not a simple task to take into account all available data (Rushen, 1991; Dawkins, 1997) and it is likely to require a multidisciplinary approach (Sandøe & Simonsen, 1992) involving multi-criteria decision making with fuzzy information. It would be naïve to believe that politicians can make decisions based on an accumulation of facts provided by scientists. The interpretation of facts involves weighting evidence, which is as much part of science as the gathering of data. In this respect OWA is itself part of the natural sciences.

Several authors have also shown to be optimistic about solving the weighting problem. For example, Morton & Griffiths (1985) propose that the various bodily and behavioural signs can usefully be given scores so that an accumulated score of

pain can be obtained. Taylor *et al.* (1995) and Appleby (1997) suggest that cost-benefit analysis may provide a solution to the weighting problem. Fraser (!, personal communication) is also optimistic that schemes for combining different measures into some kind of 'welfare score' can be developed if we really want to or need to, and that we could achieve some reasonable consensus among experts about which items are more or less important. This point illustrates that the authors we have quoted above may not be themselves as sceptical about OWA as would appear from the text. In our next paper we will review many other authors who have attempted OWA in a systematic and explicit way. This has made their work vulnerable for criticism, but, we will show, also open for further improvement.

### **Ethical concern**

A second candidate why values may be thought to be additionally involved in OWA constitutes ethical concern. Fraser *et al.* (1997) interpret the task of making values involved in OWA explicit as identifying values underlying ethical concern. Like Tannenbaum (1991) Fraser maintains that there is an 'inextricable connection' between animal welfare and ethical values. The term 'freedom' that was used to illustrate the weighting problem above, also has an ethical connotation (Fraser & Broom, 1990). However, welfare assessment per se is logically distinct from making an ethical assessment. Ethical statements are ought-statements, i.e. they are prescriptive. Welfare statements are is-statements, i.e. they are descriptive. It is a natural fallacy to derive an ought from an is (cf. statement (f) in the syllogism above). A situation with poor welfare for animals may very well be ethically acceptable, for example when the interests of the animals are outweighed by the interests of human beings, as may be the case in certain types of animal experimentation. Therefore, OWA and ethical assessment are logically distinct from one another (cf. Fraser & Broom, 1990, p. 256; Rushen & de Passillé, 1992; Broom, 1996; Barnard & Hurst, 1996; Dawkins, 1998).

OWA is not sufficient for ethical decision making. However, OWA is important and maybe even necessary for ethical decision making. There is widespread agreement that welfare is a morally relevant property of animals (e.g. Vorstenbosch, 1993). Because the relationships between humans and animals in all human societies are so intimate that many of our decisions affect their welfare, we cannot ignore our ethical responsibility. Because of this responsibility we cannot do without OWA. Making factual claims, either explicit or implicit, about the welfare status of animals is unavoidable in human society. Therefore, OWA is necessary for practical reasons. In addition, OWA may be performed for purely scientific reasons, namely when viewed as the attempt to find out what the welfare status of animals really is, as objectively as we possibly can and on the basis of the best available knowledge.

Because OWA is a descriptive activity, it must be possible to assess the welfare status of animals (provided they really have such a welfare status). However, welfare also has a prescriptive element in its meaning. Since welfare concerns what matters to animals from their point of view, it does inherently involve 'prescriptions' made by animals. By saying that welfare is poor, we identify, as it were, prescriptions is-

sued by animals, which are of the kind 'let this not happen to me'. However, all prescriptions also have a descriptive element in their meaning (Hare, 1981, p. 22). Even matters of taste, which are highly subjective, have a factual aspect that can be reported objectively. Mutatis mutandis, OWA involves the attempt to assess welfare descriptively, even though welfare is itself a prescriptive property of animals. Also OWA does not violate the principle of parsimony, because the goal is not to explain observable phenomena based on mental states, but to assess mental states and welfare based on observable phenomena.

## Conclusions

During the last few years we have been working on a project to find a method to assess welfare (OWA) on a scientific basis. This work has made us optimistic about its feasibility. However, we also perceive a sceptical attitude within the scientific community that may jeopardise progress in this field of research, because such scepticism may become a self-fulfilling prophecy. Our optimism has its origin in the belief, which is shared by many people, that OWA based on knowledge of the facts is possible. This is because OWA can be conceived as multi-criteria decision making with fuzzy information that concerns the descriptive activity to determine what matters to animals from their point of view. Values are inherent in OWA in the way values are inherent in all scientific activities (and especially in many fields of biology). However, as a descriptive activity OWA is logically distinct from making an ethical assessment. When performing OWA many uncertainties, especially concerning the weighting of attributes, must be dealt with. For this a multidisciplinary approach is needed. Knowledge about the animal's behaviour and physiology should be used in a systematic way to assess their welfare, because the animals themselves should provide the norm of what is important for their welfare. Where science fails to provide final answers, OWA may benefit from more fundamental research. However, we also stressed the importance of finding rational procedures to integrate the large amount of knowledge that is already available in a systematic and explicit way. We are optimistic that such a method for OWA can be developed.

## Acknowledgements

We wish to thank Dr. David Fraser for comments on an earlier version of this paper.

## References

- Anonymous, 1992. Report of the scientific veterinary committee (animal welfare section) on the welfare of laying hens kept in different production systems. Report: VI/5291/92-EN. CEC, Brussels, 147 pp.
- American Psychiatric Association, 1994. Diagnostic and Statistical Manual of Mental Disorders (DSM-IV), 4<sup>th</sup> Edition. American Psychiatric Press, Washington, USA.

- Appleby, M.C., 1997. Life in a variable world: Behaviour, welfare and environmental design. *Applied Animal Behaviour Science* 54: 1–9.
- Barnard, C.J. & J.L. Hurst, 1996. Welfare by design: the natural selection of welfare criteria. *Animal Welfare* 5: 405–433.
- Bekoff, M., L. Gruen, S.E. Townsend & B.E. Rollin, 1992. Animals in science: some areas revisited. *Animal Behaviour* 44: 473–484.
- Bermond, B., 1997. The myth of animal suffering. In: M. Dol, S. Kasanmoentalib, S. Lijmbach, E. Rivas & R. van den Bos (Eds), *Animal Consciousness and Animal Ethics: Perspectives from the Netherlands*. Van Gorcum, Assen, pp. 123–143.
- Bracke, M.B.M., J.H.M. Metz, A.A. Dijkhuizen & B.M. Spruijt, 1999. The development of a decision support system to assess the welfare status of pregnant sows. In: Th. Wensing (Ed), *Production Diseases in Farm Animals: 10th International Conference 1998*. Wageningen Pers, Wageningen, p. 235.
- Broom, D.M., 1986. Indicators of poor welfare. *British Veterinary Journal* 142: 524–526.
- Broom, D.M., 1996. Animal welfare defined in terms of attempts to cope with the environment. *Acta Agriculturae Scandinavica Section A, Animal Science, Supplement* 27: 22–28.
- Broom, D.M., 1998. Welfare, stress, and the evolution of feelings. *Advances in the Study of Behavior* 27: 371–403.
- Broom, D.M. & K.G. Johnson, 1993. *Stress and Animal Welfare*. Chapman & Hall, London, 211 pp.
- Dawkins, M.S., 1980. *Animal Suffering: The Science of Animal Welfare*. Chapman and Hall, London, 149 pp.
- Dawkins, M.S., 1988. Behavioural deprivation: a central problem in animal welfare. *Applied Animal Behaviour Science* 20: 209–225.
- Dawkins, M.S., 1990. From an animal's point of view: Motivation fitness and animal welfare. *Behavioral and Brain Sciences* 13: 1–61.
- Dawkins, M.S., 1993. *Through our Eyes only. The Search for Animal Consciousness*. W.H Freeman and Company, Oxford, 192 pp.
- Dawkins, M.S., 1997. D.M.G. Wood-Gush Memorial Lecture: Why has there not been more progress in animal welfare research? *Applied Animal Behaviour Science* 53: 59–73.
- Dawkins, M.S., 1998. Evolution and animal welfare. *The Quarterly Review of Biology* 73: 305–328.
- DeGrazia, D., 1996. *Taking Animals Seriously. Mental Life and Moral Status*. Cambridge University Press, New York, 302 pp.
- Duncan, I.J.H., 1996. Animal welfare defined in terms of feelings. *Acta Agricultura Scandinavica Section A, Animal Science, Supplement* 27: 29–35.
- Duncan, I.J.H. & D. Fraser, 1997. Understanding animal welfare. In: M.C. Appleby & B.O. Hughes (Eds), *Animal Welfare*. CAB International, Oxon, pp. 19–31.
- Duncan, I.J.H. & J.C. Petherick, 1991. The implications of cognitive processes for animal welfare. *Journal of Animal Science* 69: 5017–5022.
- Fraser, D., 1995. Science values and animal welfare: exploring the 'inextricable connection'. *Animal Welfare* 4: 103–117.
- Fraser, D., J.S.D. Ritchie & A.F. Fraser, 1975. The term 'stress' in a veterinary context. *British Veterinary Journal* 131: 653–662.
- Fraser, D., D.M. Weary, E.A. Pajor & B.N. Milligan, 1997. A scientific conception of animal welfare that reflects ethical concerns. *Animal Welfare* 6: 187–205.
- Griffin, J., 1992. The human good and the ambitions of consequentialism In: E.F. Paul & F.D. Miller Jr. (Eds), *The Good Life and the Human Good*. Cambridge University Press, Cambridge, pp. 118–132.
- Hare, R.M., 1981. *Moral Thinking. Its Levels, Method and Point*. Clarendon Press, Oxford, UK.
- Hughes, B.O., 1976. Behaviour as an index of welfare. In: *Proceedings of the Fifth European Poultry Conference*, Malta, pp. 1005–1081.
- Kennedy, J.S., 1992. *The New Anthropomorphism*. Cambridge University Press, Cambridge, 194 pp.
- Lenthe, J. van, L. Hendrickx, C.A.J. Vlek & W. Biesiot, 1996. Using Decision Analysis for the Integrated Assessment of the Climate Change Problem. IVEM, Groningen, 111 pp.
- Lorz, A., 1973. *Tierschutzgesetz*. C H Beck'sche Verlagsbuchhandlung, München, Germany.
- Mason, G. & M. Mendl, 1993. Why is there no simple way of measuring animal welfare? *Animal Welfare* 2: 301–319.
- McDowell I. & C. Newell, 1987. *Measuring Health: A Guide to Rating Scales and Questionnaires*. Ox-

- ford University Press, Oxford, 342 pp.
- McFarland, D., 1989. Problems in Animal Behaviour. Longman Scientific & Technical, Longman House, Burnt Mill, Harlow, Essex, 158 pp.
- Mendl, M., 1991. Some problems with the concept of a cut-off point for determining when an animal's welfare is at risk. *Applied Animal Behaviour Science* 31: 139–146.
- Moberg, G.P., 1985. Biological response to stress: Key to assessment of animal well-being? In: G.P. Moberg (Ed), Animal Stress. American Physiological Association, Bethesda, pp. 27–49.
- Morton, D.B. & P.H.M. Griffiths, 1985. Guidelines on the recognition of pain, distress and discomfort in experimental animals and an hypothesis for assessment. *Veterinary Record* 116: 431–436.
- Nagel, T., 1974. What is it like to be a bat? *Philosophical Review* 83: 435–450.
- Regan, T., 1983. The Case for Animal Rights. University of California Press, Berkeley, 425 pp.
- Rollin, B.E., 1990. The Unheeded Cry: Animal Consciousness, Animal Pain and Science. Oxford University Press, Oxford, 308 pp.
- Rushen, J., 1991. Problems associated with the interpretation of physiological data in the assessment of animal welfare. *Applied Animal Behaviour Science* 28: 381–386.
- Rushen, J. & A.M.B. de Passillé, 1992. The scientific assessment of the impact of housing on animal welfare: a critical review. *Canadian Journal of Animal Science* 72: 721–743.
- Sambraus, H.H., 1981. Der Nachweis von Leiden bei Tieren. EU MT, Zürich, Switzerland
- Sandøe, P., 1996. Animal and human welfare: Are they the same kind of thing? *Acta Agriculturae Scandinavica Section A, Animal Science, Supplement* 27: 11–15.
- Sandøe, P. & H.B. Simonsen, 1992. Assessing animal welfare. *Animal Welfare* 1: 257–267.
- Sandøe, P., M.H. Giersing & L.L. Jeppesen, 1996. Concluding remarks and perspectives. *Acta Agriculturae Scandinavica Section A, Animal Science, Supplement* 27: 109–115.
- Singer, P., 1990. Animal Liberation. 2<sup>nd</sup> edition. Avon Books, New York, 301 pp.
- Staffleu, F.R., F.J. Grommers & J. Vorstenbosch, 1996. Animal welfare: Evolution and erosion of a moral concept. *Animal Welfare* 5: 77–84.
- Streiner, D.L. & G.R. Norman, 1995. Health Measurement Scales: A Practical Guide to their Development and Use. Second Edition. Oxford University Press, Oxford, 231 pp.
- Sumner, L.W., 1996. Welfare, Happiness and Ethics. Clarendon Press, Oxford, 239 pp.
- Tannenbaum, J., 1991. Ethics and animal welfare: The inextricable connection. *Journal of the American Veterinary Medical Association* 198: 1360–1376.
- Taylor, A.A., J.F. Hurnik & H. Lehman, 1995. The application of Cost-Benefit Dominance analysis to the assessment of farm animal quality of life. *Social Indicators Research* 35: 313–329.
- Vorstenbosch, J., 1993. The concept of integrity. Its Significance for the ethical discussion on biotechnology and animals. *Livestock Production Science* 36: 109–112.
- Wemelsfelder, F., E.A. Hunter, A.B. Lawrence & T. Mendl, 1998. The inter- and intra-observer reliability of spontaneous qualitative assessment of pig behaviour. In: I. Veissier & A. Boissy (Eds), Proceedings of the 32<sup>nd</sup> Congress of the International Society for Applied Ethology. INRA, Clermont-Ferrant, p. 63.
- Wiepkema, P.R., 1982. On the identity and significance of disturbed behaviour in vertebrates. In: W. Bessei (Ed), Disturbed Behaviour in Farm Animals. Hohenheimer Arbeiten 121. Verlag Eugen Ulmer, Stuttgart, pp. 7–17.