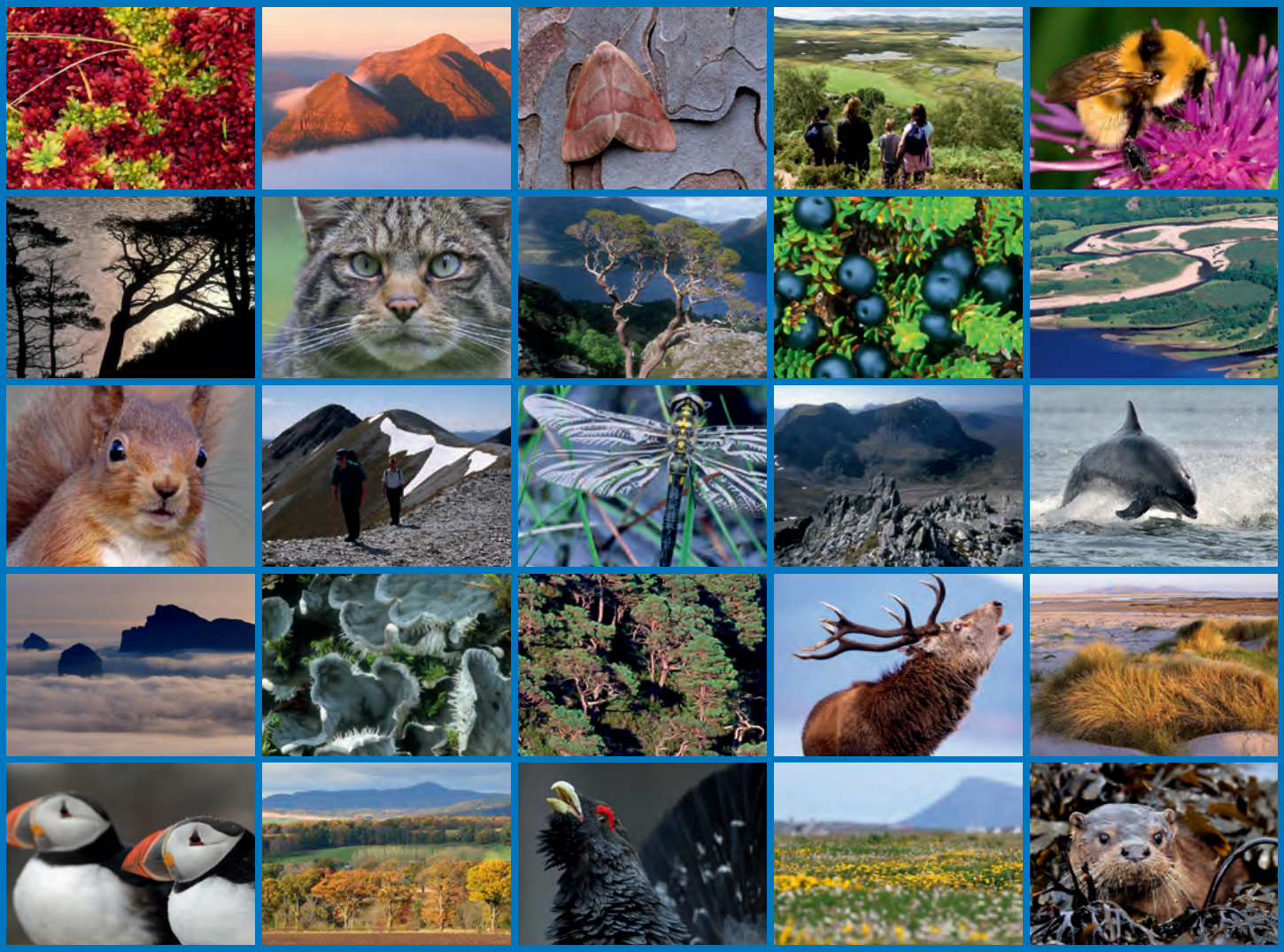
Scottish Natural Heritage
Commissioned Report No. 629

# Applying wildlife welfare principles at the population level



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# COMMISSIONED REPORT

**Commissioned Report No. 629**

# Applying wildlife welfare principles at the population level

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COMMISSIONED REPORT

# Summary

## Applying wildlife welfare principles at the population level

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### Background

Welfare of wildlife has increasingly become a focal point for SNH in recent years. SNH has developed a draft position statement on wildlife welfare which sets out essential principles on welfare which the organisation will adopt. This report is presented as part of an extension of such principles in seeking to establish how SNH's welfare principles should be applied at the level of groups or populations of animals.

### Main findings

- An animal's welfare lies on some continuum from poor to good.
- Welfare should not be considered a passive status but is primarily determined by an animal's own perception of its physical and emotional 'well-being' and its adaptive responses to environmental challenge.
- Welfare assessments should not simply consider the status of any individual at a given moment in time, but need to be integrated over time periods required to execute adaptive changes.
- A welfare problem arises only when an animal or a group of animals have insufficient opportunity (freedom) to respond appropriately to a potential welfare 'challenge' by adaptation and changes in its own behaviour.
- In assessing the welfare status of animals in groups or populations we must expect that even under identical environmental conditions, different individuals within that group or population may perceive their welfare status differently.
- Welfare of social groups cannot be adequately assessed by assuming that the impact on all individual group members will be identical.
- Welfare status at the level of a group of animals may be defined by the freedom adequately to adapt to prevailing environmental circumstance as a group.
- In seeking to ensure a positive welfare status at the level of a group we cannot expect to optimise welfare status of all individuals, but should ensure that the status of no individual falls below some critical minimum threshold.

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**Table of Contents** **Page**


**1. INTRODUCTION 1**

**2. A REVIEW OF THE GENERAL PRINCIPLES OF ANIMAL WELFARE 2**

**3. INDIVIDUAL VARIATION IN WELFARE STATUS AND COPING STRATEGY 4**

**4. WELFARE AT THE GROUP LEVEL 6**

**5. MANAGEMENT IMPLICATIONS 8**

**6. SOME DEFINITIONS 9**

**7. ASSESSMENT OF ADAPTIVE FUNCTIONING IN GROUPS 10**

**8. PRACTICAL APPLICATIONS 12**

**9. STRUCTURING THE ANALYSIS OF BIOLOGICAL AND ETHICAL ASPECTS OF WILDLIFE WELFARE 15**

**10. WORKED EXAMPLES 17**

10.1 Example 1: Supplementary feeding for wild deer overwinter? 17

10.2 Example 2: Eradication of hedgehogs from the Uists? 21

**11. REFERENCES 25**

**ANNEX 1: GLOSSARY OF TERMS 27**

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## 1. INTRODUCTION

Welfare of wildlife has increasingly become a focal point for SNH in recent years e.g. the inclusion of 'damage to welfare' in the Deer Scotland Act as a result of the WANE Act. SNH has developed a draft position statement on wildlife welfare. This sets out essential principles. This report is presented as part of an extension of such principles in seeking to establish how SNH's welfare principles should be applied at the population or group level. The current report is seen as a companion to a parallel report 'Applying Wildlife Welfare Principles to Individual Animals' (Ohl and Putman, 2013a).

It is recognised that, in many wildlife species, individual animals form part of a larger social group with which they have significant interaction; these interactions may themselves have significant impact on the welfare of each member individual. Further, in many cases management must take action at the level of the social group or population of which each individual is one part only and it may be impractical to consider the impacts on every individual within the group.

In this report therefore, we seek to extend principles established in relation to definition, and assessment, of welfare *status* of individual wildlife animals, as well as protocols developed for identification of actual welfare *issues*, to assessments at the group or population level. We also explore the extent to which the welfare of a group of animals may prove to be more than simply the sum of the welfare states of its individual members.

We would stress that comparatively little published literature addresses this idea of welfare at the group or population level. From a more conceptual standpoint the only formal consideration of what may be implied by consideration of welfare at the group level is that of Kirkwood *et al*. (1994). Most practical protocols which have been developed for safeguarding the welfare of (primarily) farm animals, maintained in groups, have concerned themselves with the physical provision of adequate resources (housing feed availability etc), in reflection of the principles established by the Brambell Committee in 1965, and do not directly assess the actual welfare status of individuals or groups as perceived by the animal(s) themselves.[1] Inevitably therefore, this current report is based on unpublished and original materials and is to that extent somewhat speculative.

By way of preamble, it is necessary to re-establish some of the principles explored in the companion report on welfare of individuals: particularly in establishing the biological framework for our considerations of welfare status. We would apologise in advance for any resultant repetition of materials. In such analysis it is also crucial to emphasise that our considerations throughout this paper relate only to responsibilities in relation to **animal welfare**; our considerations do not in any way address the rather separate issue of **animal rights** (e.g. Singer, 1989; Haynes, 2011 *inter alia*). Thus, quite explicitly and quite deliberately, we do not address here questions of whether or not humans have the right to exploit animals for food, to use them as laboratory models, to hunt, or to keep animals as pets. Simply we consider what may be the duty of care and requirements of action to ensure acceptable welfare of wild or more closely managed animals, whatever the (philosophical) debate about rights and wrongs of management in the first place.

[1] (although clearly individuals regarded as in poor condition would be identified within the overall treatment).

## 2. A REVIEW OF THE GENERAL PRINCIPLES OF ANIMAL WELFARE

In the first place we would note that much of the current welfare literature is heavily dominated by principles which, in effect, seek merely to avoid animal suffering. Thus the deliberations of the Brambell Committee in 1965 and their subsequent report have led to domination within the literature of approaches based on the so-called Five Freedoms with a presumption that animal welfare is preserved if the animals are kept free from:

- hunger, thirst or inadequate food,
- thermal and physical discomfort,
- injuries or diseases,
- fear and chronic stress,
- and were free to display normal, species-specific behavioural patterns.

As we have noted (Parallel report section 3) the Brambell Committee's report never set out to be a 'welfare concept', but was developed specifically to establish minimum requirements to ensure the absence of negative welfare. Despite this, over the years, many have taken them to define what is implied by welfare itself, and taken the provisions of the Five Freedoms to be necessary and sufficient to ensure positive welfare. This is clearly a misinterpretation of their intention.

More recent analyses of animal welfare acknowledge the fact that at any one point in time, an individual animal's welfare status lies on the continuum between negative/ bad welfare and positive/good welfare (e.g. Dawkins, 2008; Yeates & Main, 2008) and continued adherence to the Brambellian focus on the simple avoidance of negative states masks consideration of those factors which may help promote positive welfare as much as avoidance of negative welfare states. Accordingly, in this report we emphasise that welfare must be considered as more than simply the avoidance of negative states but any welfare concept should extend to embrace promotion of positive status (Fraser and Duncan, 1998; Boissy *et al*., 2007; Dawkins, 2008; Yeates and Main, 2008; Mellor, 2012; Ohl and van der Staay, 2012).

More fundamentally, a view of welfare which is dominated by an emphasis on the avoidance of negative states neglects the fact that, except in the specific instances where natural selection processes have been largely countermanded by deliberate selection by humans, animals have evolved, optimising the ability to interact with and adapt to (changing conditions within) their environment and thus exposure to environmental challenge and short periods of 'negative welfare' may be inevitable if these are understood as triggers to release from the animal's repertoire the appropriate behavioural or physiological response to adapt to those challenges (see for example Barnett and Hemsworth, 1990 among others).

Although it has taken some time for this idea to be more generally adopted,[2] and it is by no means universally reflected in the literature, many now do advocate this more dynamic view of welfare, such that a welfare issue arises only when an animal or a group of animals have insufficient opportunity (freedom) to respond appropriately to a potential welfare 'challenge' through adaptation by changes in its own behaviour (e.g. Broom, 2006; Duncan, 1993; Fraser and Duncan, 1998; Fraser *et al.,* 1997; Korte *et al*., 2007; Ohl and van der Staay, 2012).

On this basis we may then suggest that a positive (individual) welfare state would then be safeguarded when the animal has the freedom adequately to react to the demands of the prevailing environmental circumstances, resulting in a state that the animal itself perceives

[2] (this concept was in fact first suggested some 3 decades ago: see for example Dantzer and Mormede 1983; Broom 1988 amongst others)

as positive. Assessment of welfare should therefore focus not so much on the challenges which any animal may face at a given moment but on whether or not the animal has the freedom and capacity to react appropriately (i.e. adaptively) to both positive and potentially harmful (negative) stimuli.

By the same token, welfare should not be considered as an instantaneous construct to be assessed at some moment in time. An adaptive response may take some finite period of time; **crucially therefore our assessment of welfare not simply consider the status of any individual at a given moment in time, but needs to be integrated over the longer time periods required to execute such change.** We will return to this point later.

As noted, this view is NOT necessarily embraced by all commentators and, in the interests of balance within this review, it is important to emphasise that some authors still adhere to the more traditional views of welfare enshrined in various modifications of the Brambellian freedoms. However, these more adaptive approaches are gaining ground and in truth do represent a more biological basis for considerations of welfare status.

A further problem implicit in standard methods for objective assessment of welfare status is that such protocols inevitably reflect the observer's perspective and subjective judgement, whereas most modern commentators would now acknowledge that to some significant degree, any animal's status must be that perceived and judged by that animal itself (Duncan, 1993; Fraser and Duncan, 2008; Broom, 2006; Taylor and Mills, 2007; Nordenfelt, 2011; Webster, 2011; Ohl and van der Staay, 2012).

Such review suggests that instead of considering individual welfare in terms of some 'universal' or 'objective' state as might be assessed by some external observer, to the animal itself, its welfare status is a function of a subjective self-evaluation or self-perception, that, importantly, **may vary between individuals**. If we follow Broom (2006) in asserting that the welfare of each individual should be related to the adaptive capacity of that individual, such presumption makes it even more likely that distinct external conditions will affect the welfare of different individuals of any one group to a *different* extent. It seems probable, in addition, that in certain conditions, individuals may simply satisfice in relation to welfare (*sensu* Krippendorff, 1986) rather than seeking to optimise welfare status which may further contribute to variation in individual welfare 'state'.

The evidence for this clear variation in perception of its welfare status and in an animal's response to that perception is explored in considerable detail in our parallel report (Section 5), but is sufficiently crucial to our discussions in the present report that we summarise it here.

## 3. INDIVIDUAL VARIATION IN WELFARE STATUS AND COPING STRATEGY

What is significant in this context is that there is clear variation between individuals in sensitivity/responsivity of central nervous circuits processing emotions and internal perceptions and thus that different individuals may 'perceive' the consequences for themselves of one and the same environmental challenge in very different ways.

There may also be considerable variation between individuals in their actual behavioural or physiological abilities to respond adaptively, or in the actual coping strategy adopted. Thus there may be quite substantial variation in the way different individuals may respond to the same stressor and the strategies which they may use to cope with environmental or social challenge- not simply in relation to differences in the adaptive repertoire available to different individuals, but also in relation to coping strategy adopted.

Mendl and Deag (1995) offered a detailed exploration of this concept of alternative coping styles and present a range of examples (primarily in relation to the different way in which individuals may respond to a given status within social groups) and we offer examples in the companion report from later work by Korte *et al.* (2005), Koolhaas *et al* (2008, 2010) and others (Erhardt *et al.,* 2009; Henniger *et al.*, 2000). In effect these studies provide clear experimental evidence for significant individual variation in coping style which is closely related to predictable variation in behaviour and underlying physiology.

That variation in coping strategy must itself imply clear difference in the impact of one and the same stressor on the welfare of those different individuals. In addition, we should not necessarily presume that all individuals seek to maximise welfare status at any given instant of time.

At this point it is of relevance to consider the concept of 'satisficing' that has been developed by Simon (1955) as a psychological concept and that has subsequently been applied by ecologists to explain foraging behaviour in animals (Myers, 1983; Ward, 1992, 1993). Satisficing is an alternative to optimization for cases where there are potentially many possible alternative options which cannot effectively be fully-evaluated. A decision maker who gives up the idea of obtaining an optimal solution but obtains the optimum he can compute under given time or resource constraints is said to satisfice (Krippendorf, 1986).

The logical extension of such arguments is now clear: Given that there exists significant variability in how different individual animals may assess their own welfare status; if in addition a group of animals may consist of individuals some of whom seek to optimise welfare status while others (at that moment in time) are content to satisfice, then we, as external observers, may expect to observe within any group of animals a series of group members with different "absolute" welfare status (assessed by an external observer against some fixed set of criteria) yet which perceive their own welfare state as being optimal (or at least sufficient not to require action to alter that status).

**In such a case then - and crucial to our current considerations - the (objectively determined) welfare status of all members of that group may appear to vary over a considerable range, y*et al*l members perceive their own welfare state as optimal – or at least satisfactory**.

Such conclusion makes clear that purely objective functional scales for measuring the welfare status of individual animals, can have little validity in that, even under identical conditions, the actual welfare status of different individuals may very widely. Further it emphasises that in assessing the welfare status of animals in groups or populations we must expect high variation in apparent welfare and in attempting to safeguard satisfactory welfare

we must insert into protocols some minimum threshold value below which no individual should be allowed to fall, instead of (or in addition to) simply determining some average welfare status to be achieved.

## 4. WELFARE AT THE GROUP LEVEL

One of the first attempts to measure welfare at the group level was offered by Kirkwood *et al.* (1994) in again, one of the first attempts to extend welfare principles to free-ranging wildlife. These authors argued that an "Assessment of the scale and severity of harm to welfare requires consideration of several factors. We propose that at the simplest level these are: 1. The number of animals affected. 2. The cause and nature of the harm. 3. The duration of the harm. 4. The capacity of the animal to suffer."

This approach implicitly presupposed that a given cause and type of harm with a given duration will result in an identical effect on welfare in all individuals of one group as long as all individuals do have the same capacity to suffer (Kirkwood *et al*. (and later Mathews, 2010) presume that they do). Consequently, this scenario then suggests a linear correlation between group size/animal number and the scale of harm caused to (group) overall welfare. Put in another way, this implies that the welfare status of a group would be known as soon as we know about the welfare of any one of its members, since the welfare of a group is considered to be represented simply as the sum of the identical individual welfare of its members.

This calculation in practice assumes homogeneity of all members of a group in terms of state, sensitivity, and perception of welfare at any point in time – a 'universal' individual welfare. Yet, as we have argued above, there may be significant variation in what may be perceived as optimum or satisfactory welfare for different individual animals. In addition it is apparent that different individuals may have markedly different coping styles or strategies in how they may respond to environmental challenge (Mendl and Deag, 1995; Koolhaas *et al.,* 2010).[3]

If we thus follow Broom (2006) and later authors in asserting that the welfare of each individual should be related to the adaptive capacity of that individual, such recognition makes it even more likely that distinct external conditions will affect the welfare of the members of any one group to a *different* extent. This clearly has implications for efforts to assess the welfare status of individuals within a group or population – whether of domestic animals, farm livestock or free-ranging wildlife.

In effect it implies not only (as above) that the welfare status of all individuals in a given set of conditions may not all be equal in absolute terms but that, in addition, the actual effect (perception) of any compromise in welfare status may also not be the same for all individuals, since they may vary in the extent to which they respond to a given (positive or negative) influence (Koolhaas *et al.,* 2008).

By converse, in seeking to ensure positive welfare of such a group, we cannot expect to optimise welfare status of all individuals; however, in recognition of variability, we should at least add an additional constraint which ensures that the status of no individual falls below some critical minimum threshold.

If we now accept that the actual welfare status of each individual – and, more significantly, the welfare status it experiences - may show significant variation between individual members of any group when being exposed to identical environmental conditions, this then begs the question of whether or not optimising welfare at the level of the group as a whole demands (voluntary) compromise of the individual welfare of some of the group members (Ohl and Putman, 2013b).

[3] Indeed Mendl and Deag (1995) suggest the possibility that there may even exist, within groups of animals, some frequency-dependent stability of alternative coping strategies.

If we assume (with Kirkwood *et al.*, 2004) the existence of a 'universal' individual welfare that is true for all individuals, this would indeed have to be postulated. IF however, some degree of variation is accepted in the way in which individual group members may perceive and respond to a given environmental challenge, optimum welfare at the group level could be obtained by a combination of group members with different "absolute" welfare status (assessed by an external observer against some fixed set of criteria), yet each of which perceives their own welfare state as being optimal (or at least sufficient not to require action to alter that status – see below).

In such a case then, the welfare status of a group may be optimised while the (objectively determined) welfare states of its individual members may vary over a considerable range, but nonetheless all members perceive their own welfare state as optimal – or at least satisfactory.

## 5. MANAGEMENT IMPLICATIONS

In the parallel report on individual welfare[4] we have discussed at length (Section 8) what may be our moral and actual responsibilities to take action to address negative welfare or actively seek to enhance the positive welfare experience of all animals (including free-ranging wildlife).

Within the moral and legislative framework, how might we seek to extend our considerations about individual welfare to animals within the wider context of a social group or population? What are the implications of the discussions so far for assessment of welfare within groups of individuals, and attempts to mitigate any perceived compromise to welfare or in some way enhance positive welfare status?

At the individual level we assume that positive welfare is defined by the animals' freedom to adapt to environmental conditions up to a level that it perceives as positive. But we recognise that individuals may show significant variation in their perception of a given status and their 'decision' about how to respond to that perceived status. Thus we may expect that even under identical environmental conditions, different individuals within a group or population may perceive or experience their welfare status differently.

Given this, we would argue that welfare should thus not be understood as a 'universal' or 'objective' state, but rather as a subjective self-assessment, that varies between individuals. Different individuals within a group or population may thus be 'satisfied' with different levels of what an external observer would consider better or worse states. In assessing the welfare status of animals in groups or populations we must therefore expect high variation in apparent welfare.

In consequence, we conclude that welfare of social groups cannot adequately be assessed by assuming that the impact on all individual group members will be identical. Instead it is important to consider the welfare impact on members of a social group which are not seen as identical clones but may vary considerably in their 'welfare phenotype', and in addition the possible impact on the group as a whole in terms of its capacity to adapt to prevailing environmental conditions because of a given phenotypic distribution. Mendl and Deag (1995) further suggest the possibility that there may even exist, within groups of animals, some frequency-dependent stability of alternative coping strategies.

By converse, as above, in seeking to ensure positive welfare of such a group, we cannot expect to optimise welfare status of all individuals; however, in recognition of variability, we should at least add an additional constraint which ensures that the status of no individual falls below some critical minimum threshold.

[4] [Applying Wildlife Welfare Principles to Individual Animals]

## 6. SOME DEFINITIONS

In analysing the material presented above, we may review definitions relating to welfare summarised in Section 6 of the parallel report (Ohl and Putman, 2013a: Applying wildlife welfare principles to individual animals), now extending these towards application at the group level.

Adaptive Capacity: When exploring the potentially fitness-enhancing mechanisms of animal welfare, it is necessary, among more social species, to re-evaluate individual welfare as being related to the functioning of a social group.

We suggest that group welfare may be defined by the freedom adequately to adapt to prevailing environmental circumstance **as a group** and that group welfare may be optimised while the (objectively determined) welfare states of its individual members may vary over a considerable range, with nonetheless all members perceiving their own welfare state as being optimal or at least satisfactory. The adaptive capacity of a group describes the set of (physical and mental) abilities with which a group of animals is naturally endowed. The species-specific abilities of each group-member form a basis, which is refined and developed in each individual as a functional part of the whole. The adaptive capacity of a group is not static; it is dependent on the interactive functioning of each individual's internal state as well as on changing environmental conditions.

Welfare: Welfare describes an internal emotional state as perceived by an individual. As such, group-welfare or population-welfare does not exist except as an 'envelope' of the separate welfare states of its individual members. However, the welfare state of an individual represents a function of its adaptive functioning within prevailing environmental circumstances - an environment which also includes other members of its social group or population - and it is that functioning that can be assessed at the group level as well as at the level of each individual of that group. The adaptive functioning of a group then is the result of the characteristics of that group, as well as the environmental conditions to which the group is exposed.

Positive Welfare: Positive (or good) state of adaptive functioning describes the state in which a group has the freedom adequately to react to the demands of the prevailing environmental circumstances, resulting in a state that all individuals of that group perceive as optimum or at least satisficing. With a growing emphasis on the importance of positive experiences (Fraser, 1993; Fraser and Duncan, 1998; Duncan, 2005), good animal welfare is not ensured by the mere absence of negative states (Knierim *et al*., 2001; Duncan, 2005; Broom, 2010, see also Mellor, 2012) but requires the presence of positive affective states at the individual level.

Negative Welfare: The adaptive functioning of a group is compromised ('welfare status' is negative or bad) when a group of animals have insufficient opportunity (freedom) to respond appropriately to a potential 'challenge' through adaptation by changes in behaviour (where environmental challenges exceed the adaptive capacity of the group as a whole or the opportunities available are inadequate to permit the group effectively to express the appropriate adaptive responses). Negative 'welfare' at the group level, thus, describes a state in which distinct individuals still may perceive their own state as positive but that does not allow for adaptive functioning of the group as a whole. In such a situation, it can be expected that the number of group members experiencing 'negative welfare' or 'suffering' will progressively increase over time.

## 7. ASSESSMENT OF ADAPTIVE FUNCTIONING IN GROUPS

At the individual level we assume that positive welfare is defined by the animals' freedom to adapt to environmental conditions up to a level that it perceives as positive. We have argued that for example some individuals within social groups are not exploiting opportunities for adaptive responses which might help improve apparent welfare status, resulting in the consideration that these animals do not see any need to be doing so because they perceive their status as positive (or at least satisfactory).

Welfare thus should not be understood as a 'universal' or 'objective' state, but rather as a subjective self-assessment, that varies between individual phenotypes. As a consequence, different individuals may be 'satisfied' with different levels of what an external observer would consider better or worse states.

Such observation leads to two significant conclusions:
i) Such conclusion makes clear that purely objective functional scales for measuring the welfare status of individual animals, can have little validity in that, even under identical conditions, the actual welfare status of different individuals may vary widely.We conclude that welfare issues can be assessed by an outside observer only in terms of study of the behaviour of the animals concerned and whether or not they may display appropriate adaptive response to any given environmental challenge. Human determination of a group's adaptive functioning is only as good as the observer's perception of the signals that the group emits. A negative state of 'group-welfare' then is perceptible via reactions that are aimed at changing the existing situation. A positive state of 'group-welfare' is perceptible via reactions aimed at keeping the existing situation as it is.

ii) Within a social group or population of animals, welfare status cannot adequately be assessed by assuming that the impact of environmental challenges on all individuals will be identical. The welfare status of a group may be optimised while the (objectively determined) welfare states of its individual members may vary over a considerable range, but nonetheless all members perceive their own welfare state as optimal – or at least satisfactory.

Given all the above, how may we set about actually assessing the status of adaptive functioning in groups or populations of wildlife animals? In as far as any protocols are currently available, they have been based on the assumption that 'welfare' of groups of animals is represented by the sum of the 'universal' welfare status of all group members, an assumption we challenge in this paper. Further, as we have noted, many protocols for the assessment of individual welfare have been based on the avoidance of negative states ("avoidance of suffering"): with approaches to the assessment of welfare status based on the supposition that this positive welfare merely implies freedom from:
• hunger, thirst or inadequate food,
• thermal and physical discomfort,
• injuries or diseases,
• fear and chronic stress,
• and are free to display normal, species-specific behavioural patterns.
[see again, in Section 3 and
http://ec.europa.eu/food/animal/welfare/sum_proceed_wq_conf_en.pdf ]

But as we have reviewed in a companion report (Ohl and Putman, 2013a), there may also be an implicit responsibility for active facilitation of positive welfare-states (see for example Dawkins, 2008; Yeates and Main, 2008; Ohl and van der Staay, 2012) and further, welfare should not simply be assessed as a single static measure at one given instant of time, but as a more dynamic, interactive state reflecting an animal's capacity to adapt to environmental challenge by changes in its own physiology or behaviour.

Considerations above challenge the more functional protocols developed for assessing individual welfare status, even for more closely-managed animals - and especially in terms of any attempt to apply such protocols to free-ranging groups of animal.

It becomes clear that if we accept that welfare is defined by an *ability to adapt and respond to environmental challenge in an appropriate way* - (and that thus both positive and negative welfare states are a function of the actual adaptive capacities of the individual animal and the opportunity it has to express those responses) - then our assessment must be primarily based on detailed observation of the physiological condition and behavioural responses shown by each of the individual members as one functional part of a group of animals over time.

In free-ranging animals however, environmental conditions that exceed the adaptive capacities of an individual are likely to translate into a lack of expression of positive emotional states (such as comfort-behaviour) as well as a lack of behaviour necessary to fulfil actual demands (such as foraging) (Fraser *et al.,* 1997, Watson *et al.*, 1999, Mellor, 2012). Further, behavioural extremes may be observed, such as high levels of intra-group aggression (Koolhaas *et al.,* 2010) or changes in group structures. All such changes not only indicate that prevailing environmental condition are exceeding the animals' adaptive capacities, but are exerting chronic stress themselves and will therefore facilitate a further decrease in physiological condition as well.

Positive affects or emotional states may include pleasure, comfort, contentment, curiosity and playfulness (Mellor, 2012) which suggests that regular observation of such 'positive' behaviour-types might argue for the individual(s) concerned being in a status that it perceives as positive itself indeed. We should note though, that the absence of positive indicators is not sufficient to prove a negative welfare state.

However, routine protocols of behavioural observations should include positive indicators such as play behaviour and notice that the regular absence of play behaviour in young/adolescent individuals is likely to indicate high environmental pressure (Held and Spinka, 2011). In adult animals, play behaviour may be observed less regularly, while e.g. active exploration, social- and self-grooming behaviour can be expected to be present at a regular basis (Crofoot *et al.,* 2011, Kikusi *et al.,* 2006).

While such observations may be practicable for individuals or groups which we may study over prolonged periods of time (and may well be applicable to closely-managed animals including closely-managed wildlife), such an approach is clearly not likely to be feasible in application where encounters with individuals or groups are typically occasional, fleeting and at a considerable distance.

Here, inevitably, we must base assessments primarily at the group level and these will be biased in favour of physical condition scores or rather coarse behavioural indicators. Further such measures will largely be applied at group rather than individual level. This may well be appropriate, given that effective management measures (mostly 'non-specific measures' *sensu* Swart, 2005) can only be targeted at the group or population level. But where decisions are made which aim to optimise the welfare of the group as a whole, we should acknowledge that the welfare status of the **group** may be optimised while the (apparent) welfare states of its individual members may vary over a considerable range.

## 8. PRACTICAL APPLICATIONS

How may we try to translate such theoretical constructs into what measures might be practically available for field use to determine the condition of a population of wild animals? Here once more we explore what measures might be available by considering how we might try to assess the condition of a population of wild red deer.

Clearly if we truly believe that an individual animal's welfare status is defined in terms of its own self-perception of its well-being, then we must rely in major part on behavioural cues to advise us of whether or not that individual (or others in its group) are showing behaviours which are directed towards altering/improving their current status - and whether or not those behavioural responses are likely to be successful (i.e. whether amelioration of welfare status is within the animal's own adaptive capacity).

In practice, most of these assessments provide an index of population condition through a cumulative assessment based on survey of individuals within the group. In general, in interpretation and analysis of such data however, we should recognise that the adaptive capacity of a group or population is unlikely to be well represented simply by the mean welfare status of its individuals, since it is to be expected that they will show considerable variation in apparent and actual welfare status. In consequence - and in deference also to our recommendation (section 4, paragraph 6) that in evaluating the welfare status of a wider group or population of animals we must add a critical minimum threshold below which no individuals might be expected to fall - we suggest that it is extremes in (the distribution of) individual welfare status that might be more significant for the assessing the status of a group rather than the mean status of its members.

In effect the 'mean' value of a given parameter will not necessarily differ between two sets of data that consist of either relatively similar measurements or of measurements which may be distributed over quite a wide range. What *will* differ, however, is the variation of such a set of data and it is that variance which may well be more significant in assessing welfare at the group or population level. That is not to say we should ignore the mean value totally, since it is clear that a shift of the mean value towards a negative welfare status (of *all* group members that is) will indicate a potential welfare problem, too. Thus we advocate consideration of both mean and variance of whatever parameters might be employed to assess welfare status

With such proviso, we may then extend behavioural measures suggested in the companion report on individual welfare (Ohl and Putman, 2013a, after Putman, 2005)[5] as observation of an individual separated from the rest of the group or actively being bullied; signs of lethargy; assessment of feeding behaviour (Ohl and Putman, 2013a). In application to assessment of the welfare of a group or wider population, however, these same indicators now need to be qualified since, within the group, negative welfare of some individuals will most likely be opposed by positive welfare of other individuals. The adaptive capacity of the group as a whole is likely to become compromised only if the distribution of the group members shifts towards both extremes (indicating persistent social instability within the group), or to the negative extreme only.

Environmental conditions that exceed the adaptive capacities are also likely to translate into a lack of expression of positive emotional states (such as socio-positive, affiliative behaviour, e.g. social grooming Crofoot *et al.,* 2011, Kikusi *et al.,* 2006) as well as a lack of behaviour necessary to fulfil actual physiological or social requirements (such as social stability, adaptive herd behaviour etc.) even when opportunity to express that behaviour may be present. Instead, behavioural extremes may be observed, such as high levels of intra-group

[5] and note as also highlighted in Best Practice Guide Deer Health: Changes to Normal Behaviour

aggression (Koolhaas *et al.,* 2010) or changes in group structures. All such changes indicate that prevailing environmental condition are exceeding the groups' adaptive capacities.

While such observations may be practicable for groups which we may study over prolonged periods of time (and may well be applicable to closely-managed animals including closely-managed wildlife), such an approach is clearly not likely to be feasible in application where encounters with groups are typically occasional, fleeting and at a considerable distance. While accepting that opportunities for prolonged observation of wild species are less likely we would still advocate the use of behavioural cues where possible, including the identification of clearly appropriate and adaptive behaviour (or lack of appropriate response in given circumstances).

However, in addition to such behavioural cues assessments of physical condition may offer valuable additional information; and where observations genuinely are fleeting at best and cannot be maintained over a more protracted period, inevitably assessment must be focused more on such estimates of physical condition score within the local population.

Data on physical condition in the field may be derived by use of physical condition scores (such as that of Riney, 1955, 1980, for red deer) as well as other indicators such as evidence of injury, disease, scouring or poor coat condition. Once again however, we emphasise that assessments at the group level should consider not only average condition but the variance or range of condition estimates.

Where there is less concern about the condition of specific individuals and information is rather sought about the welfare status of the population as a whole (on the average) some assessment of condition may also be derived by examination of (age-related) weight and condition (kidney fat or other physical index) of animals culled from the population. Experienced assessors may also make some estimate of the level of both external and internal parasitic load. While such assessment is inevitably restricted to assessment of physical condition (which is of course only one element contributing to overall welfare status) and cannot be directly related to any individual still alive within that population, it does at least offer managers some practical way of assessing average condition within the (remainder of) the population as whole and - as above - through assessment of the variance and range of condition apparent within sampled individuals, may help identify the population minimum against some pre-determined acceptable minimum threshold (section 4, paragraph 6).

*Table 1: Indicators of welfare. Assessment should integrate information from as many of these indicators as possible.*

| **Assessment of Animal Welfare** | | | | |
|---|---|---|---|---|
| **Based on adaptive capacities** | **Individual level** | | **Group level** | |
| | **Positive indicators** | **Negative indicators** | **Positive indicators** | **Negative indicators** |
| The animal(s) should be free adequately to react to hunger/thirst. | Appetitive and successful foraging behaviour<br>Normal activity pattern<br>Appropriate body condition | Unsuccessful foraging behaviour<br>Lethargy<br>Inappropriate body condition | Appetitive and successful foraging behaviour and activity pattern as a group<br>Normal variation of body condition | Unsuccessful foraging as a group; successful foraging only in minority of group members [extreme variation within group) |
| The animal(s) should be free adequately to react to climate conditions. | Seeking and finding shelter<br>Appropriate fur condition<br>Appropriate modulation of body condition during seasons | Not finding shelter<br>Bad fur condition<br>Body condition worse than can be expected in relation to season | Seeking and finding shelter for all group members<br>Appropriate modulation of variation in fur and body condition during seasons | Not finding shelter or finding insufficient shelter for the group<br>Fur and body condition bad throughout the group or in extreme variation |
| The animal(s) should be free adequately to react to physical injury or disease. | Seeking and finding rest and shelter<br>Functional immune system [e.g. appropriate wound healing/lack of scouring] | Inability to seek and find shelter<br>Infection/inappropriate wound healing; persistent scoring | Functional immune system [e.g. appropriate wound healing; lack of scouring] | Signs of infection across [parts of] the group; e.g. persistent scouring |
| The animal(s) should be free to express its full non-social behavioural repertoire. | Adequate behavioural responses to non-social circumstances/challenges [covering both avoidance and approach behaviours] | Persistent behavioural inhibition, lethargy, context-inadequate behaviour | Adequate behavioural responses to non-social circumstances/ challenges that involve the group as a whole [covering both avoidance and approach behaviours] | Behavioural responses that do not involve the whole group |
| The animal(s) should be free adequately to respond to social interactions. | Adequate behavioural responses to social interactions [covering both socio-positive and socio-negative behaviours] | Persistently being bullied (in social species); social isolation | Social stability within the group [as displayed by adequate socio-positive and socio-negative behaviours] | Social instability; splitting up in sub-groups |
| The animal(s) should be free to experience the full spectrum of emotional states and respond to those states adequately. | Executing anxiety-related behaviour and stress-responses as well as play-or other pleasure-related behaviour in appropriate context | Inadequate emotional responses [lethargy, hyperreactivity]; absence of adequate emotional responses; e.g. lack of anxiety | Displaying anxiety-related behaviour and stress-responses as well as play-or other pleasure-related behaviour at the group-level and in appropriate context | Absence of pleasure-related behaviour; inadequate emotional responses [lethargy, hyperreactivity] at the level of the group |

## 9. STRUCTURING THE ANALYSIS OF BIOLOGICAL AND ETHICAL ASPECTS OF WILDLIFE WELFARE

The considerations presented in this report are not only of relevance once a perceived welfare *issue* occurs. On the contrary, much of our discussion is directed towards how we may assess the welfare status of animals in their own right. This welfare status is, *per se*, neither morally to be judged good or bad; it simply reports a factual condition.

Subsequent subjective analysis may decide that that determined status does constitute a *welfare issue* (that is: a welfare status which is perceived as a moral problem by an outside observer) which needs to be addressed. In which case we must explore what are the welfare advantages or disadvantages of different alternative possible interventions.

A different line of argument notes that changes to existing management practice towards some unrelated objective (completely unrelated to addressing any welfare concerns), or indeed the adoption of some new management objective (and associated measures required to deliver that new objective) may in itself as a side-effect have a potential impact on animal welfare. In such a case we may wish to assess the relative welfare implications of a proposed change in management or of the alternative management measures available to deliver the new objective.

Formal examination of the various factors which may influence decisions in any given situation, and the advantages and disadvantages of the various interventions which may be possible, can be facilitated by use of formalised and structured approaches (see section 7.5 and 8.3 of Ohl and Putman, 2013a).

In an attempt to illustrate this, we have selected a number of case studies which we will work through step by step to try and show how we may translate assessment of welfare status into appropriate action. We deliberately select examples which start at different levels: the examination of the implications of some proposed change in management strategy towards some unrelated objective; action which might be taken after recognising an actual welfare problem; examination of the consequences of some existing intervention practice, to demonstrate how each may be followed through the decision-making frameworks. Note however that the examples are illustrative only and show how to focus discussion; we make no attempt to provide solutions to the examples chosen.

Throughout this exercise we presume that:

- the moral duty of care for animals is absolute and context-independent
- unacceptable animal suffering is to be avoided
- welfare status of an animal is related to its adaptive capacity and the perception of the individual itself.

A full assessment of wildlife welfare should comprise both a biological and an ethical assessment in order to result in sustainable wildlife welfare management. Each analysis will ideally start with an ethical reflection (on the question that is to be answered and one's own starting point) and will finally cover all necessary analytical steps and will be based on the same general presuppositions.

The primary aim of the whole exercise is to disentangle the biological and moral aspects of a 'case' and resolve clearly what may be 'hidden' or implicit issues:

- what is the *biological welfare status* of the animal/group of animals in question and what are the biological implications of any intervention proposed to alter the welfare status?
- what animal welfare status is deemed *morally* acceptable and what are the ethical implications of any intervention proposed?

Any situation where the welfare status of any animal is assessed as biologically beyond its adaptive capacities and/or is considered by wider society as ethically unacceptable[6] may result in a potential *welfare issue*. While it may not always be possible to resolve a welfare issue, management decisions should be based on consistent evaluation of both biological assessments and moral presuppositions, and considerations should be made transparent in order to avoid polarisation of welfare debates. In the case studies presented below we show how a structured approach helps ensure all relevant factors are taken into consideration when examining a given 'case'

This approach requires the following steps:

i) brief description of the case (what constitutes the 'welfare issue' or the 'objective' which needs to be considered? What are the management measures or interventions under discussion and what are they aiming at?)
ii) resolving the case into specific questions (does xxx constitute a moral dilemma and if so, what IS the potential moral dilemma? does xxx result in animal suffering and, thus, does xxx constitute a (biological) welfare problem?)
iii) analysis of the biological welfare status of animal(s) is demanded in any case. In practice, we thus need to assess whether adaptive capacity of the individual or group is or is likely to be exceeded)
iv) analysis of moral aspects that affect the case and identification of potential ethical dilemmas (supported by the Ethical Framework (see Figure 1 and 3) and aiming at differentiating between cases that constitute an actual welfare *problem*, a welfare *issue*, or a different moral issue related to wildlife management)
v) analysing whether potential animal suffering is morally acceptable (supported by the Intervention Scheme) and aiming at analysing whether actual animal suffering does demand intervention (see Figure 2), or whether animal suffering potentially caused by any intervention may be ethically acceptable (see Figure 4)]

We will in this concluding section explore the initial steps (resolving the issues and identifying the underlying biological and ethical questions) for two examples by way of illustration of the need to clarify exactly what may be the deeper underlying questions in each case. The intention is not to resolve any of these 'cases' or reach clear 'decisions' about what should be done in any of the examples chosen; rather our purpose is to illustrate how such 'issues' might best be addressed in a more formal analytical manner.

[6] We may note that in this latter case a welfare issue may be perceived by society even in a situation where *biologically* we might suggest that welfare status is not actually compromised.

## 10. WORKED EXAMPLES

### 10.1 Example 1: Supplementary feeding for wild deer overwinter?

The practice of providing **supplementary feeding for wild deer overwinter** is a controversial one and provides a good illustration of the need to resolve exactly both objectives and welfare implications of such supplementation, because assessment of the 'acceptability' of such intervention may depend very much on objectives (see Figure 1). Briefly, such food supplementation overwinter may be provided in an attempt to offset a perceived shortage of natural food overwinter, thus assisting animals to maintain body condition and/or to reduce overwinter mortality.

Alternatively however food may be provided for completely unrelated objectives: in a belief that it will improve antler mass and trophy quality of mature stags, as a device to try and heft stags more closely to a given property (and stop them wandering further afield) or as a diversionary tactic to draw wintering animals away from areas which might be sensitive to sustained heavy impacts (unfenced forestry or vegetation of high conservation value, where excessive impacts might be damaging).

Since the primary objective has significant implication for the aspects we need to evaluate in our considerations, as well as the route of exploration, it is essential clearly to define that objective:

If winter feeding is being considered, or is actually being undertaken to ameliorate a perceived welfare problem/welfare issue, we first have to ask whether there IS a welfare issue in the first place (see Figure 2).

Here, this resolves back to:

- Is there a shortage of winter food or is the seasonal decrease in food availability within the animals' adaptive capacity (i.e. within limits for which it/they possess appropriate physiological or behavioural adaptation)?
- Does seasonal decrease in food availability exceed the adaptive capacity of some individuals or that of the group?

Related biological questions, if a welfare issue is perceived, might also be:

- Is it food that is limited at all (or shelter)?
- If the answers to both of these suggest that supplementary feeding may be appropriate and an effective way of addressing a real welfare problem (that the welfare of the deer genuinely IS compromised by lack of natural food over winter and provision of appropriate supplementation might improve welfare overall), then we should also consider the questions:
- Is supplementary feeding ethically acceptable?[7]
- Does it actually achieve what it is supposed to achieve in terms of maintaining welfare or reducing overwinter mortality?
- Does winter feeding affect animal welfare at the individual level or at the level of the group?

While many managers provide some supplementation on a regular basis (every winter and throughout the winter period) other provide additional feed only in some years or in the worst of weather in direct response to severe conditions. In this latter case we should also ask

[7] in some countries such as Austria and Germany it is actually compulsory, but to many people it is not ethically acceptable because it is felt that it is in some way 'interfering with nature'- and in the Netherlands for example, as well as in many parts of the United States, it is expressly forbidden?

what is the (separate) effectiveness of regular feeding, or this latter ‘crisis feeding’. Thus in effect the preceding questions resolve to:

- What are the welfare advantages and disadvantages of offering supplementary feeding (on a regular basis or as 'crisis' management (both at the individual level and at the level of the population)?

If the proposed intervention turns out to be feasible and if the disadvantages of that intervention do not outweigh the advantages, supplementary winter feeding could be considered ethically justifiable.

In an alternative scenario, however: supplementary feeding may be provided towards a non-welfare-related objective such as diversionary feeding to draw animals away from areas of sensitive vegetation, or to try to heft animals to a particular land-ownership etc. Even though not explicitly directed towards altering welfare status, such intervention may nonetheless have direct implications on the welfare of individuals and the population as a whole. Thus the same process should be followed.

To analyse whether the consequences of the intervention may be ethically justifiable, that is, whether the advantages of realising the objective outweigh the potential disadvantages, we again have to identify the underlying biological/factual and ethical questions that will provide us with those advantages and disadvantages.

Here, this resolves back to the questions:

- Is supplementary feeding as a management measure *per se* ethically acceptable to society and is this acceptance based on sufficient information?
- Are there economic or other values that support the objective?
- Does provision of supplementary feed actually achieve what it is supposed to achieve in terms of redirecting the animals’ movement patterns?
- What are the advantages and disadvantages of offering supplementary feeding (including welfare effects, but not restricted to it)?
- Is protection of sensitive vegetation (or other objective) acceptable to society?
- Is supplementary feeding in this particular instance thus ethically acceptable to society, even if it may have some negative impact on welfare of individuals or populations, and is this acceptance based on sufficient information?

In both scenarios: a concluding statement should make the following aspects explicit:

- what are the presuppositions
- what is the primary objective
- how are relevant facts/values weighed and why.

## Figure 1: Winter feeding of deer - objectives and ethical dilemmas

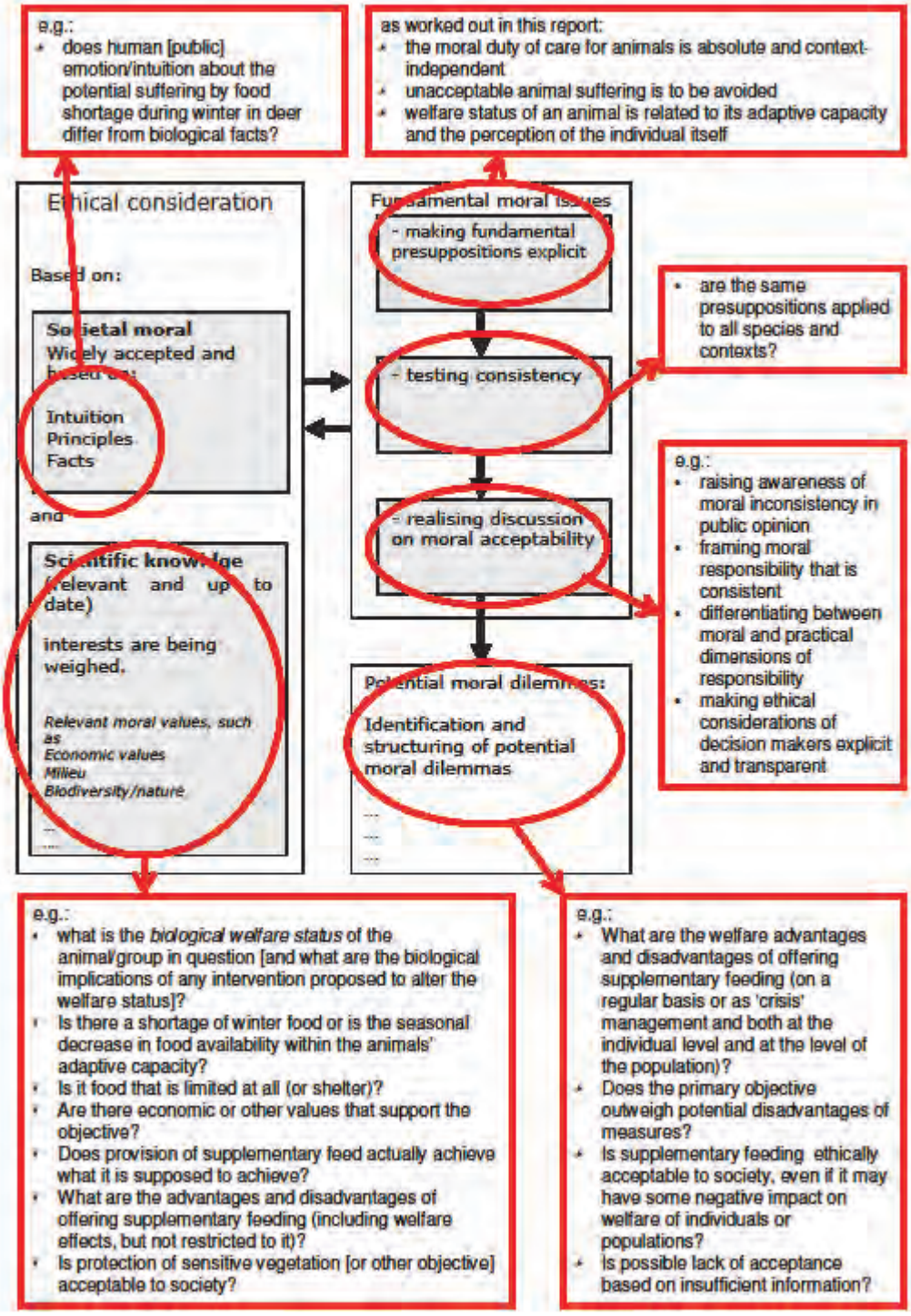
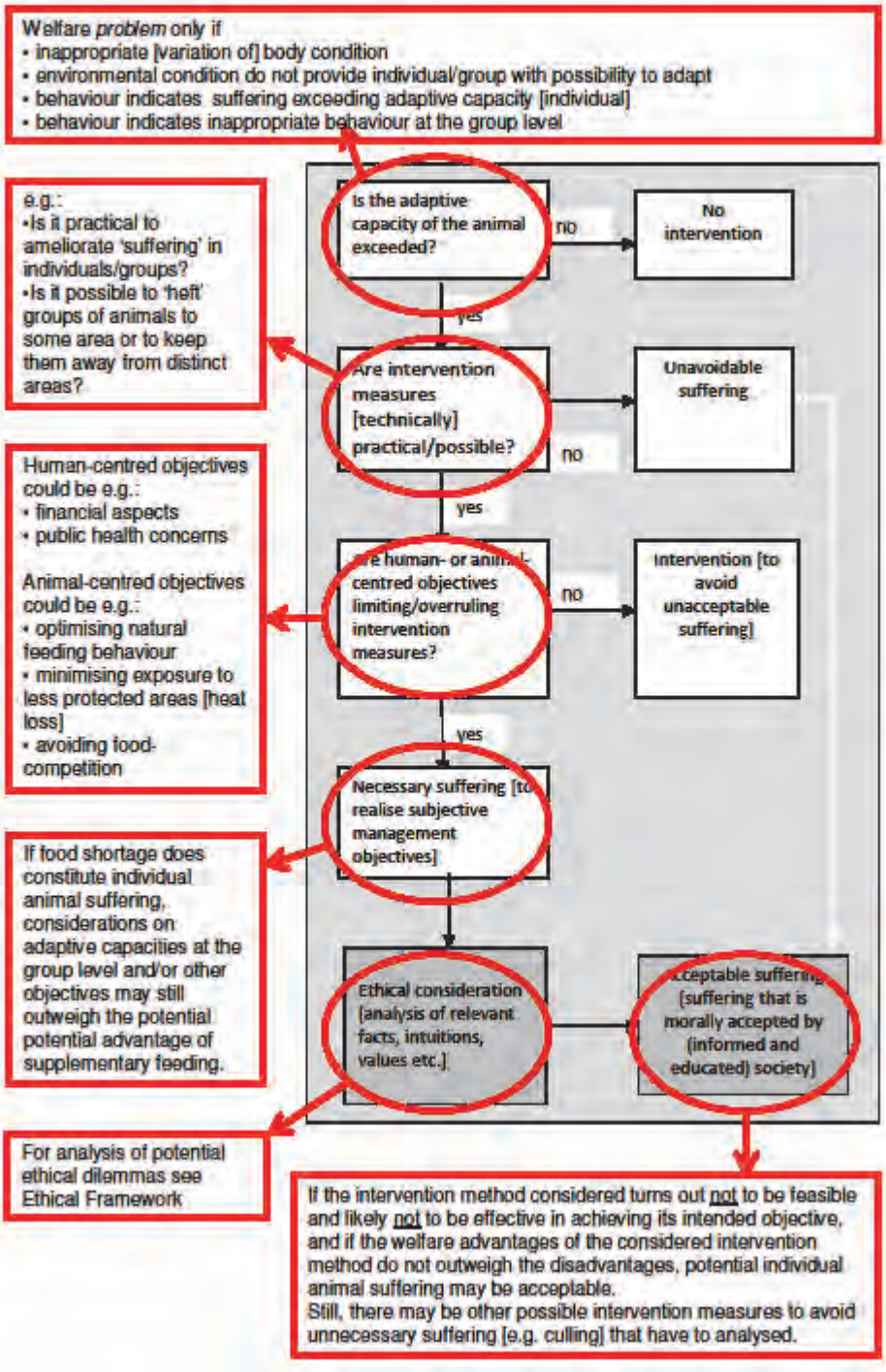


**Figure 2: Winter feeding of deer as intervention to ameliorate 'suffering'**



### 10.2 Example 2: Eradication of hedgehogs from the Uists?

The eradication of any introduced predator from islands, where they may be causing an impact on eggs and chicks of ground-nesting birds is fraught with controversy. Here is an instance where the management intervention is clearly directed at some objective unrelated to the welfare of the target species (unlike the situation in our previous two examples, where in some cases interventions were directed towards addressing a perceived welfare issue in the same species).

While the objective might be for conservation ends, or to safeguard/promote the welfare of some other species, this then begs the question of whether or not one is ever morally entitled to promote the interests of one species above another? This case thus constitutes a *duty-of-care* case rather than a wildlife *welfare* case (see Figure 3). And clearly, the answer to that is not absolute - and public opinion might differ considerably when the eradication is proposed of an introduced species for the protection of a native, indigenous species than when both species are native to the UK. Similarly public opinion may well offer a different view when eradication is proposed of for example, a population of brown rats, as opposed to when eradication efforts may be targeted on a more favoured species such as hedgehog: while the general public may have relatively few concerns even about the deployment of anticoagulant poisons in control of populations of rats, it may at the opposite extreme have strong ethical reservations about any form of lethal control for hedgehogs.

In this case thus public intuition and emotion may oppose biological/ecological facts that are identical: on islands both rats and hedgehogs tend to have been introduced rather than native; both can have severe impacts on breeding success of ground-nesting birds. Instead of excluding such intuition/emotion from the professional decision processes, a full ethical consideration embraces such 'subjective factors' next to more factual ones and aims at finding a balance that accounts for moral and all other relevant factors (as outlined in section 9).

The explicit objective of the proposed management intervention in removal of hedgehogs from the Uists was for conservation: to protect the eggs and chicks of threatened ground-nesting bird species from predation by animals known to have been introduced to the system by human agency. Given such objective, perhaps the first questions are

- Is it ethically justifiable to favour (and biologically enhance the population status) of one species over another species?
- Is it ethically acceptable to eradicate *introduced* species to protect populations of threatened native species?
- Does our duty of care towards native species differ from our duty of care towards other species?
- Is there a difference in what may be ethically acceptable in relation to for example rats, rather than hedgehogs?
- What is the value of native wilderness?
- Are there other values that affect considerations?
- What alternatives are available?

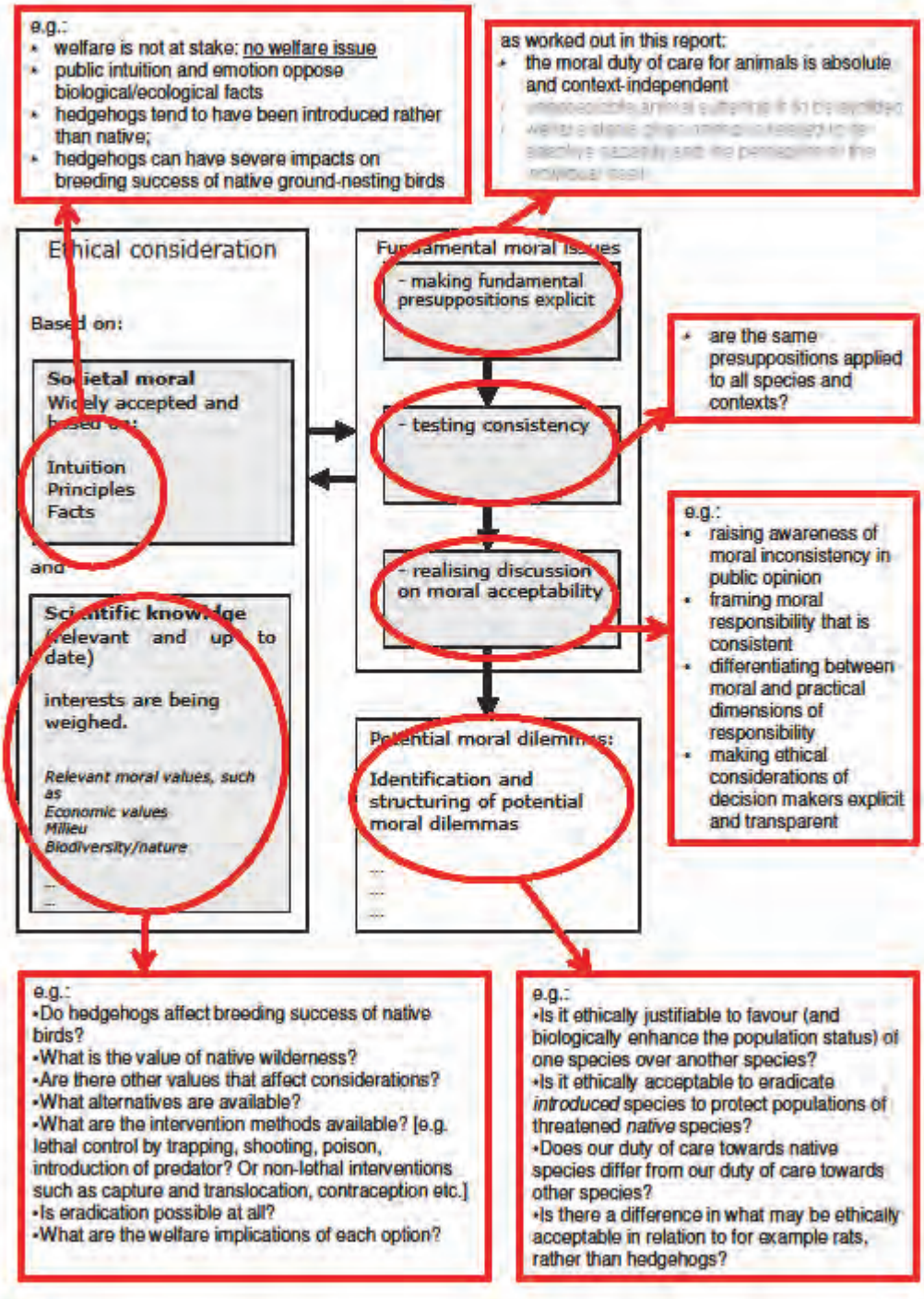
If such considerations of both biological and ethical factors result in a decision that population control is ethically justifiable (and likely to be effective in delivering the initial objective) then attention must turn to:

- What are the intervention methods available? (e.g. lethal control by trapping, shooting, poison, introduction of predator? Or non-lethal interventions such as capture and translocation, contraception etc) and

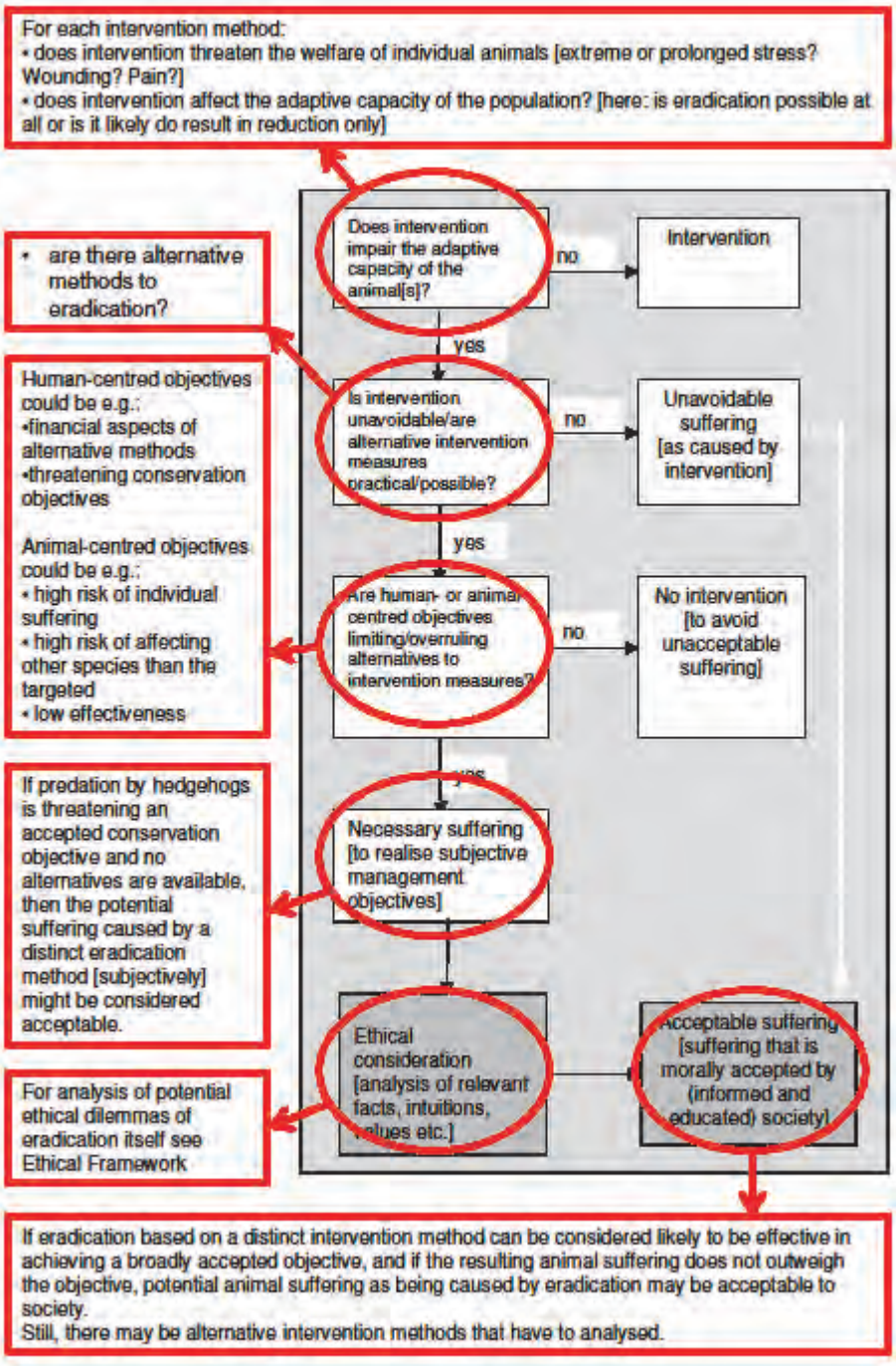
- What are the welfare implications of each option?

For each option, assessment should draw out in detail the biological welfare advantages and disadvantages; the 'ecological' advantages and disadvantages (in terms of their utility in delivering the declared overall objective); the economic advantages and disadvantages - and the ethical issues which are associated with each possible method (see Figure 4).

## Figure 3: Eradication of hedgehogs from the Uists



## Figure 4: Intervention methods - eradication of hedgehogs from the Uists



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## ANNEX 1: GLOSSARY OF TERMS

It remains one of the problems of any new area of enquiry - and the welfare 'area' is no exception -that successive authors tend to adopt words from common parlance and give them quite technical meanings. In order, therefore, to avoid misunderstandings and potential misinterpretation, we felt it might be useful to offer a glossary of terms to make clear what is meant by each term, by us or by others, when used in this report.

**Adaptive Capacity**
We use the expression: adaptive capacity, to describe the set of innate (physical and mental) abilities with which an animal is able to respond and 'adapt' to its environmental situation and any challenges it may encounter. Many features of this adaptive capacity have been acquired by a species through evolution; others may be developed by individual animals as a result of its own lifetime experience. The species-specific abilities form a basis, which is refined and developed in each individual. The adaptive capacity of an individual is not static; it continues to develop throughout an animal's life; in addition at any one instant of time it is dependent on the individual's internal state as well as on changing environmental conditions.

In considering the welfare of individuals of more social species, where the environment also includes other members of its social group, it is necessary to re-evaluate the adaptive capacities of an individual as being related to the functioning of a social group as a whole.

The adaptive capacity of a group describes the set of (physical and mental) abilities with which a group of animals is naturally endowed. The species-specific abilities of each group-member form a basis, which is refined and developed in each individual as a functional part of the whole. As with that of the individual, the adaptive capacity of a group is not static; it is dependent on the interactive functioning of group members as well as on changing environmental conditions.

**Adaptive response**
Welfare is in large part a function of an animal's ability to respond appropriately and in some adaptive way to its environmental circumstances. Adaptive responses thus are characterised by behavioural or physiological responses that enable and individual (or group) to react appropriately to both positive and potentially harmful (negative) stimuli (e.g. approach a food resource or avoid a potential danger).

**Appropriate adaptive response**
There may be considerable variation between individuals in their adaptive capacities (their actual behavioural or physiological abilities to respond adaptively), or in the actual coping strategy adopted. Different coping strategies may relate to what some authors describe as different underlying 'personalities' of individual animals, where some may be more active and others more passive in response. As a result there may be quite substantial variation in the way different individuals may respond to the same stressor and the ways in which they may cope with environmental or social challenge - not simply in relation to differences in the adaptive repertoire available to different individuals, but also in relation to coping strategy adopted. While it may thus be 'appropriate' for an actively coping individual to respond more pro-actively or aggressive to a given challenge, avoidance of that same stimulus might be appropriate for a more passively coping individual.

Depending on internal (e.g. hormonal or developmental) and external changes (e.g. season) an individual may respond differently even to the same stimulus at different times. While such different responses may all be adaptive, a distinct response may be more appropriate at a given juncture depending on prevailing internal and/or external circumstances: for example foraging behaviour clearly is adaptive as such; still, during harsh weather conditions

it might be more appropriate to seek shelter and to inhibit foraging behaviour. Thus, any meaningful assessment of the adaptive value of behaviour can never be done in 'absolute' terms but only in relation to prevailing circumstances.

**Welfare**

Welfare describes an internal state of an individual, as experienced by that individual. This state of welfare is the result of interplay between the individual's own characteristics and the environmental conditions to which it is exposed and cannot be assumed to be the same for all individuals placed within a given environmental situation. Human determination of an animal's state of welfare is only as good as the observer's perception of the signals that the animal emits. A negative state of welfare is perceptible via reactions that are aimed at changing the existing situation. A neutral or positive state of welfare is perceptible via lack of any reaction or reactions aimed at keeping the existing situation as it is.

The welfare state of an individual represents a function of its adaptive functioning within prevailing environmental circumstances. For social animals, that environment includes other members of the social group or population; a separate assessment of welfare at the group or population level may thus be determined as the adaptive functioning of the group as a whole in response to a given welfare challenge. The adaptive functioning of a group then is the result of the characteristics of that group, as well as the environmental conditions to which the group is exposed.

At the individual level we assume that welfare is defined by the animals' ability and freedom to adapt to environmental conditions. But we recognise that individuals may show significant variation in their perception of a given status and their 'decision' about how to respond to that perceived status. Thus we may expect that even under identical environmental conditions, different individuals within a group or population may perceive or experience their welfare status differently.

**Welfare status**

The term welfare status as used in this report refers to the factual, biological status of an animal or group of animals. As such it describes a biological status that may be bad, good or neutral, but is *per se*, neither morally bad, nor good. In our terminology, a welfare **problem** occurs if the adaptive capacities of an individual or group is being exceeded.

Whether or not the welfare status of an individual or group of individuals constitutes a welfare **issue**, implies a value judgement by an observer or by society. Throughout, we try to distinguish clearly between the biological status of an animal should be disentangled and that moral dimension that is brought in by a human observer who interprets and values any apparent animal welfare problem.

*Positive welfare*

Positive [or good] welfare describes the state in which an individual has the freedom adequately to react to the demands of the prevailing environmental circumstances, resulting in a state that the animal itself perceives as positive. With, in addition, a growing emphasis on the importance of positive experiences, good animal welfare is not ensured by the mere absence of negative states but requires the presence of positive affective states. At the group level, positive [or good] state of adaptive functioning describes the state in which a group has the freedom adequately to react to the demands of the prevailing environmental circumstances, resulting in a state that all individuals of that group perceive as optimum or at least satisficing.

*Negative welfare*

Welfare status is compromised (welfare status is negative or bad) when an animal or a group of animals have insufficient opportunity (freedom) to respond appropriately to a

potential welfare 'challenge' through adaptation by changes in its own behaviour (where environmental challenges exceed the adaptive capacity of the animal or the opportunities available are inadequate to permit the animal effectively to express the appropriate adaptive responses). Negative welfare, thus, describes a state that the animal itself perceives as negative but that still lies within the animals' adaptive capacity.

The adaptive functioning of a group is compromised ('welfare status' is negative or bad) when a group of animals have insufficient opportunity (freedom) to respond appropriately to a potential 'challenge' through adaptation by changes in behaviour (where environmental challenges exceed the adaptive capacity of the group as a whole or the opportunities available are inadequate to permit the group effectively to express the appropriate adaptive responses). Negative 'welfare' at the group level, thus, describes a state in which distinct individuals still may perceive their own state as positive but that does not allow for adaptive functioning of the group as a whole. In such a situation, it can be expected that the number of group members experiencing 'negative welfare' or 'suffering' will progressively increase over time.

**Suffering**

Suffering describes the negative emotional experience resulting from being exposed to a persisting or extreme negative state of welfare. Short-termed, negative welfare states such as suffering from hunger and fear serve as triggers for the animal to adapt its behaviour. They therefore serve a function. A brief state of negative welfare may fall within an animal's adaptive capacity, and would not necessarily require intervention. If an individual lacks the ability or the opportunity appropriately to react to suffering (for example, by escaping from a frightening situation), a challenge is created that may exceed the adaptive capacity of the individual. In such a case, the situation is one of suffering for which intervention is required.

*Unavoidable suffering*

There may be constraints on intervention that are posed purely by practicalities of intervention or mitigation. Thus effective intervention in the lives of free-ranging or wild animals may simply not be feasible; in a farm context, if livestock animals are kept outdoors (which may itself be warranted in terms of promoting positive welfare in other respects), they may be exposed to extreme weather that may cause transient suffering. Sudden changes of weather are neither predictable nor controllable and occasional suffering is *unavoidable* when animals are kept outdoors.

*Necessary suffering*

Other constraints may be posed by anthropocentric aims or human convenience, for example, efficiency of animal production in an agricultural context. In such cases, there may be mitigation options which are not implemented for reasons of efficiency or economics. Here, any suffering resulting from non-intervention may be considered avoidable (in theory) but *necessary* (because of distinct subjective/**individual** human interests).

*Acceptable suffering*

The more fundamental question, i.e. whether a distinct human interest and, thus, whether necessary suffering may be *morally acceptable*, still needs to be answered. Yet this returns us to our third axis of what is or is not acceptable to society as a whole, since there may in practice be a distinction between what a producer or manager deems necessary or unavoidable and what society as a whole considers acceptable. Final decisions must therefore be couched within what is the ethical view of contemporary society. As above, what is acceptable or unacceptable to society is inevitably a value judgement or ethical decision.

*Welfare issue*
A welfare issue arises when a welfare status is perceived as a moral problem by an outside observer who considers that the welfare status is unacceptable and needs to be addressed (the animal or animals are in a poor welfare state, or at least a state which might be improved upon).

*Self-perception [of an animal]*
In effect the 'decision' by any individual animal to accept its current status or to engage in behaviour designed to bring about some change of status must in part be determined by an assessment of physiological condition (hunger, thirst etc.) but also by an assessment of a sense of 'well-being'. Most commentators now agree that welfare is in large part a function of an individual animal's own perception of its internal status. While 'perception' thus does describe some cognitive processing of internal information, it does not necessarily imply a process of conscious reflection. Rather, self-perception in animals should be understood as a process of relating internal information to external stimuli.

**Emotional state**
It is clear that emotions play an important role in this assessment and in the performance of adaptive behaviours. There is a growing literature to suggest that much of the function of emotion or emotional status may indeed be to provide a convenient proximate surrogate to reinforce behaviours which are (or were) in some way adaptive, to make performance of these appropriate behaviours in some sense pleasurable or rewarding and thus promote their expression in appropriate circumstances.

When therefore we, or other authors, refer to an animal's emotional reaction to a given situation, we refer quite explicitly to those physiological and behavioural mechanisms which enable that individual to assess its internal and external situation and trigger appropriate adaptive responses.

***Maximising versus Satisficing***
It is perhaps self-evident that if some animal is perceived by the observer to be in a negative welfare status, but has opportunities (correct behavioural repertoire, appropriate environmental conditions) to improve its status, yet fails to take that action, then it may simply perceive its own status as satisfactory.

It seems probable that not all individuals necessarily seek to maximise welfare status at any given point, and that 'adequate' may at times be enough. "Satisficing" is an alternative to maximisation for cases where there are potentially many possible alternative options which cannot effectively be fully-evaluated. A decision maker who gives up the idea of obtaining an optimal solution but obtains the optimum he can compute under given time or resource constraints is said to satisfice. In this approach one sets lower bounds for the various objectives that, if attained, will be "good enough" and then seeks a solution that will exceed these bounds. The satisficer's philosophy is that in real-world problems there are often too many uncertainties and conflicts in values for there to be a realistic probability of being sure of obtaining a maximisation and thus that it is far more sensible to set out to do "well enough" (but better than has been done previously).

It is of note here that the welfare status of the **group** may be optimised while the (apparent) welfare states of its (satisficing) individual members may vary over a considerable range.

***Stress***
In general, physiological approaches have focused on the concept of measuring levels of stress experienced by individuals based on the belief that if stress increases, welfare decreases. However, there are a number of problems with such an approach. Short term stress responses are an inevitable part of the process triggering an adaptive response from

the animal and thus may be functional in maintaining a longer-term positive welfare status. In such analysis a more relevant measure might be evidence of chronic and ‘traumatic’ stress (that exceeds the individual’s adaptive capacity), something which is not trivial to differentiate by means of physiological measurements from acute stress.

***Stressor***

When we use the term stressor, we do not necessarily imply something which causes ‘stress’ that exceeds the individual’s adaptive capacity, but in effect denote any environmental or other force impinging on an individual animal or group; an environmental ‘challenge’ which has to be met.

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