- the relative importance of different animal welfare needs such as adequate food, opportunities for normal behaviour, and how they should be balanced in different systems and how constraints on any one need can be justified by benefits to another, for example, reducing sow mobility to increase piglet survival;
- society's changing expectations of the way animals should be treated;
- the impacts of climate change and other global changes; and
- the link between animal welfare and food safety.

NAWAC and MAF identify research priorities annually to take account of both strategic and current priorities. Both also work to identify and secure funding and encourage external funding or co-funding from both within and outside New Zealand. Recent examples of this research include an assessment of layer hen welfare on New Zealand farms (Black & Christensen, 2009), the development of indicators for on-farm welfare assessment of pigs (Vink *et al*., 2008) and the development of a novel system for providing pain relief during castration of lambs (Webster *et al*., 2010). While the focus is on the development of codes of welfare, the information gained from these studies is used in several ways, including to support the development of industry-led welfare assurance schemes and good practice guidance, and other related legislation such as the leg-hold traps regulations.

CONCLUSIONS

Animal welfare policy makers can apply a systematic approach, if not research, to all steps of the policy development process. Science and policy can be better matched by identifying and prioritising research needs in advance and thinking strategically when developing the list of research needs. Policy makers can also support research providers and put plans in place to allow for short-term urgent research when the need arises. Scientists and policy makers should work together to align research needs with researchers' areas of expertise, assuring that needs are met and that New Zealand's reputation as a provider of sound, internationally-relevant animal welfare science is maintained.

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The welfare of extensively farmed livestock

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ABSTRACT

Extensive farming involves husbandry of animals over a large area, animal performance, health and welfare dependent on ecology and farm management. Specific features providing both challenges and opportunities for good animal welfare include climatic, environmental and nutritional variation and extremes; infrequent human contact; greater freedom for animals to make choices affecting their well-being; a greater degree of natural selection; and fitter animals better able to cope with their environments. Stockmanship, in addition to drawing on personal experience and traits, requires an understanding of the constraints and opportunities afforded by the climate, the terrain and the biota. Intensification practices acting to increase productivity and efficiency need to be able to retain and enhance animal resilience to environmental changes. Animal welfare regulatory, monitoring and assurance expectations may need to acknowledge these distinctive features.

Keywords: extensive; welfare; farm animal; ecology; stockmanship; intensification; society.

INTRODUCTION

'We take care of the animals and the animals take care of us' is an affirmation central to traditional agriculture – the unwritten "domestic contract" (Kilgour, 1985; Rollin, 2008). However, some agriculture has changed from traditional management systems such as those characteristic of nomadic and settled extensive pastoralism to more intensive pastoral and even industrial-like systems.

Critiques of unacceptable welfare of animals kept in large numbers in confined, automated, and controlled conditions (Harrison, 1964) have been part of the "great humanitarian revival" of compassion towards animals (Preece, 2002), and in the growth of animal welfare science. Greater interest in those more intensive systems, in contrast with a more modest understanding of extensive farm animal welfare, brings a risk of societal expectations founded on the former being uncritically extrapolated to the latter (Appleby, 1996). The objective of this article is to consider the distinctive nature of the welfare of livestock in extensive pastoral farming systems and the implications for animal production and research.

EXTENSIVE FARMING

Extensive farming involves husbandry of animals over a large area, usually with relatively low levels of inputs, labour and resources and typically, in variable climates, and rugged or remote terrain. Animals, often with diverse characteristics such as different strains and breeds adapted to different locales, have space and behavioural freedom but are prone to the vagaries of climate and the environment from which they usually get all or most of their resources. One of the overriding influences on extensive farming is its ecological foundation (Stafford Smith & Foran, 1993) productivity dependent on managing grazing in time and space within the constraints imposed by variations in climate and terrain. While humans control and manipulate extensively farmed animals, the environment dictates aspects of their performance, health and welfare.

Extensively farmed animals have some of the attributes of free-living or wild animals. Although having choice of diet and considerable freedom of

TABLE 1: A summary of some the reports in the scientific literature describing the welfare of extensively farmed animals**.**

Important factors affecting the welfare of extensively managed dairy cattle (Hemsworth *et al*., 1995).
- Induced calving.
- Lameness.
- Transport.
- Thermal conditions.
- Human-animal interactions.
- Painful husbandry procedures.

Challenges to the health and welfare of extensively farmed beef cattle and sheep (Goddard, 1998).
- Infrequent human contact/lack of supervision.
- Transportation.
- Climate and nutrition.
- Disease pattern and veterinary care.
- Predation and neonatal survival.

The features of extensively farmed animals in New Zealand (Fisher & Scobie, 2003).
- Exposure to climatic, environmental and nutritional variation.
- Infrequent or reduced human contact or intervention.
- Relatively more freedom to make their own decisions about factors affecting their well-being.
- Greater degree of natural selection resulting in fitter animals better able to cope within their particular environments.

Main welfare issues faced by the beef cattle in northern Australia (Petherick, 2005).
- Climatic extremes and natural disasters such as floods and bush fires.
- Nutrition, especially during droughts and in areas deficient in minerals and trace elements.
- Health issues arising from diseases and parasites.
- Quality of stockmanship and mustering and handling.
- Painful husbandry procedures.
- Transportation.
- Predation.

Welfare issues in extensively farmed livestock in the United Kingdom (Webster, 2005; Dwyer, 2006).
- Animals in poor body condition, and dehydration in calves.
- Insufficient food or water to meet demands of growth or reproduction.
- Exposure to mud, cold and wet conditions resulting in hypothermia.
- External parasites.
- Absence of shade or shelter or a dry lying area.
- Lameness and diarrhoea in calves.
- Periods where injury or disease goes unobserved and untreated.
- Pain and distress associated with castration and dehorning.
- Infrequent contact with humans meaning management practices may be a source of fear and distress.

movement and behaviour, they are under some degree of human management (Kilgour, 1985; Fisher & Bryant, 1993; Deag, 1996). For example, social and kin structure may be distorted by culling and grouping, movement and migration may be limited or prevented, food and nutrients are often less varied in composition, parental care of young may be curtailed by weaning, and animals are usually less subject to predation and natural selection but increased artificial selection is likely. Furthermore, changes to pastures, animals and management such as paddock subdivision, improved soils and pastures; pasture rotations, supplementary feeding; heifer calving and artificial breeding are commonly used to minimise ecological constraints and improve animal and farm productivity and efficiency (Fisher & Stafford, 2007; Stafford & Gregory, 2008). Increasing production, a prerequisite of the growth of civilisation, is taken as intrinsically valuable by both farmers and scientists alike. It is reinforced by economic common sense, the virtue of hard work, the doctrine of grace and the myth of the garden (Thompson, 1995). However, and as predicted by the law of diminishing returns, intensification can be associated with compromised animal welfare and adverse environmental and social consequences (Thu & Durrenberger, 1998).

EXTENSIVE FARM ANIMAL WELFARE

A number of reports have dealt with different aspects of the welfare of extensively farmed animals (Table 1). Features as diverse as handling, transport, out-of-season breeding, genetic selection, intensification, and sustainability, have also been described (Appleby & Lawrence, 1996; Goddard, 1998, 2003, 2008; Fisher, 2004; Dwyer & Lawrence 2005; Goddard, *et al.,* 2006; Aparicio Tovar & Vargas Giraldo, 2006; Fisher *et al.,* 2009; Dwyer 2009). While some aspects, such as painful husbandry procedures, are essentially similar regardless of the farming system, extensive farming has specific features providing both challenges and opportunities for good animal welfare. They include: climatic, environmental and nutritional variation; infrequent human contact and intervention; greater freedom for animals to make choices affecting their well-being; a greater degree of natural selection; and fitter animals better able to cope with their environments. Although there are many facets, stockmanship, intensification and societal expectations are further discussed, albeit reflecting personal concerns of the pervasive, but generally unacknowledged, potential for these factors to affect farming and farm animal welfare.

STOCKMANSHIP

Stockmanship, widely regarded as important to the welfare of animals in any farming system, is a respect for the essence of the animal (Gatward, 2001) and arguably a relationship, not simply the behaviour of people working with animals. In extensive farming systems, stockmanship has three interrelated aspects. Firstly experience and learning where individuals typically draw on a lifetime of practical personal experiences with animals and farming such that stockmanship becomes second nature providing an intuitive feel for animals. Secondly personal qualities involving patience and empathy are traits or attitudes considered necessary when working with and being responsible for animals. Thirdly an understanding of the constraints and opportunities afforded by the physical environment including the climate, the terrain and the biota (Fisher & Stafford, 2007).

Given the breadth of knowledge which contributes to good stockmanship, the "feel" and experience which are valued as much as specialised knowledge and measures, society may need to assure that those qualities are not lost to the principles of efficiency, calculability, predictability and control; the "McDonaldization" principles of the fast-food restaurant management coming to dominate other sections of society (Ritzer, 2004). In addition to the attending to the needs of animals, Fisher and Stafford (2007) suggested that good extensive farm animal welfare might be ensured by giving attention to the following seven general principles.

1. Always ensuring animals and farming systems have adequate reserves to enable animals to cope with their changing and variable environments.
2. Ensuring animals are genetically suited and acclimatised to the environment and the production system.
3. Valuing and using the practical knowledge and experience people have of the interaction between the land, the animals and the people which give extensive farming its ethos.
4. Keeping the land, the climate, the animals and farm management expectations in equilibrium.
5. Providing the right environments, resources, and management for animals in order that they can "fend for themselves".
6. Attending to or minimising those aspects known to have a risk for animal welfare, and which are controllable, so that livestock can direct their resources or adapt to the stressors beyond the control of farm management.
7. Facilitating and encouraging those with responsibilities for the care of animals to have The time, opportunities and confidence to achieve these aims.

INTENSIFICATION

Intensification practices change animals' environments and make them more productive and efficient (Fisher & Webster, 2009). Animals in extensive environments have to cope with varied and changing stressors such as weather, varied nutrition and health risks. One of the more telling is the death of newborn lambs during "cold snaps" and storms. However, some extensively farmed strains and breeds of sheep can be more resilient when giving birth and raising young (Knight *et al*., 1988; Fisher, 2003; Dwyer & Lawrence, 2005). It would seem sensible then that whatever intensification practices are employed, they ensure that animals have the means or ability to behave appropriately in extensive environments, that is they have the genetic potential to seek favoured lambing sites and that they have suitable resources such as body condition providing resilience against periods of feed scarcity, access to adequate shelter. In other words, livestock need to be able to retain their natural capacity to adapt to environmental changes requiring a balance between productive and adaptive capabilities (Bocquier & González-García, 2010). Allostasis, the capacity to change (Korte *et al*., 2007), may be crucial to ensuring good extensive farm animal welfare and could be explored in breeding programmes.

SOCIETAL CONCERNS

Society expresses its concerns for animal welfare through regulations, standards and guidelines, identification and traceability, monitoring and quality assurance expectations. Many have grown out of consumer and marketplace concerns with intensive farming systems and may not necessarily be applicable to more extensive systems. In place of morbidity and mortality welfare audits, Turner and Dwyer (2007) suggested developing methodologies for extensive systems based on assessing key features of the environment, such as handling facilities, assessment of the skills, knowledge and planning of stockmen, and assessing the animal at key points in the production cycle when they are gathered. Similarly, Petherick and Edge (2008) suggested animal-based production measures such as live weight, fertility and body condition score, and resource-based factors such as provision of feed and water, may need to be used to assess animal welfare.

As stockmanship is suggested to be the key to extensive animal welfare (Fisher & Stafford, 2007), then perhaps animal welfare assurance could be based on identifying and supporting those skills. For example, the selection of animals suitable for particular environments and productive capacities, how they might be constrained or enhanced by particular production and practices and how factors beyond the ability of farmers to control, such as financial interest and international exchange rates and consumer preferences, affect the ability of those in charge of animals to care for them. If extensive animals have some of the attributes of free-living or wild animals, should society's animal welfare expectations reflect system- or ecological-specific standards? The key may be to ensure those responsible for animal care not only know their animals and their environments, but are able to fairly balance the demands that livestock have with those of the wider community.

DISCUSSION

It is suggested that respect for the essence of the animal, based on stockmanship and stewardship, is the key to understanding extensive farming. Knowledge of both the animals and the environment is the cornerstone of animal husbandry. Interestingly, perhaps the use of the term "animal science" in preference to "animal husbandry" has contributed to the development and growth of animal welfare. The belief that "animal welfare is becoming increasingly important" or that the role of stockmanship in livestock welfare and productivity "has only recently occurred" (Hemsworth, 2004), belie its continued importance in traditional animal husbandry systems.

Good extensive farm animal welfare raises a number of interesting issues. Firstly, because they inhabit a variable environment, are extensively farmed animals better at adapting to stressors (Kilgour, 1985)? In comparison to those raised in more uniform and barren environments, extensive animals may be less susceptible to stressors associated with transport and slaughter (Manteca & Ruiz de la Torre, 1996; Wechsler & Lea, 2007). A rich and diverse environment presenting the animal with the opportunity to explore, one of an animal's basic needs, may prepare it to better deal with challenges in its environment. It is hard to imagine that, for example, the mustering and yarding which characterise extensive farming, does not in some way contribute to animals becoming more adaptable to other handling routines. In keeping with this theme, do extensive animal farmers have a broader understanding and depth of risk management strategies than those farming intensively?

Secondly, if good extensive farming is good for animals, is it also good for humans? Does it provide a reminder of human fallibility; that technology and good practice cannot solve everything? Modern, intensive systems have replaced the ideals of animal husbandry with those of industrial agriculture. In doing so they have arguably distorted the "social contract" and resulting in the development of ethics

guiding those more industrial-like systems (Rollin, 2004). Despite humanity's long association with livestock, much of it in extensive circumstances, contemporary animal welfare is being increasingly guided by science founded on the more intensive systems. While not belittling its importance, especially in more intensive farming systems, viewing extensive and intensive farm animal welfare from the same perspective may ignore their fundamental differences. The former is constrained by ecology where the environment dictates some aspects of animal husbandry, the latter has sought to remove or at least limit those ecological constraints with the use of housing and the provision of regular feed. While essentially the same animal must adapt to either system, what welfare compromises are deemed as necessary and reasonable by society in order for humans to benefit, can be different.

Extensive farm animal welfare is of particular relevance to New Zealand as much of the country is extensively farmed. Furthermore, intensification will challenge some of the natural advantages of extensive systems, whilst other aspects of animal welfare will be enhanced. It is suggested that New Zealand, along with other countries reliant on extensive farming, continues to provide leadership through engaging in research appropriate to extensive animal welfare such as identifying the animal and husbandrt features required for adaptive or resilience systems. Similarly, ensuring animal welfare is considered within the context of other demands like food safety, environmental and financial sustainability, so that animal welfare recommendations and decisions are not made in isolation. Finally, consideration should be given to exploring the development of regulatory, monitoring and assurance expectations which reflect or acknowledge the distinctive nature of extensive farming.

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Heat stress in farm animals

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ABSTRACT

Heat stress affects production and welfare in farm animals. In warm weather animals will change their behaviour in order to cool down, for example by seeking shade or other cooler microclimates, and by altering activity patterns, body postures and feed intake. In addition to behavioural changes, physiological mechanisms will occur, such as increased respiration and body temperature. There is consistent evidence that the reduced productivity in association with heat stress can be alleviated by providing different types of cooling. However, more research is needed in order to explore how to best cool farm animals and appropriate cost benefit analyses of providing different types of cooling in New Zealand conditions needs to be carried out to improve profitability and welfare. Animals change their behaviour before changes in production can be detected, therefore animal behaviour can provide insight into when and how to cool animals.

Keywords: cattle; deer; heat stress; pigs; sheep.

INTRODUCTION

High ambient temperatures, solar radiation and humidity, and low wind movement are environmental factors that can cause heat stress in animals. If they are able to, animals will alter their behaviour in order to cool down, for example by seeking cooler microclimates and by changing activity patterns and body postures. In addition to behavioural adaptations, energy demanding physiological responses as well as a decrease in feed intake will occur to reduce heat production and maintain homeothermy. There is consistent evidence across farm species that hyperthermia is harmful to