finalreport

LIVE EXPORTS

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Developing alternative methods of measuring animal welfare on ships.

Stage One: Survey of Industry Opinion

Abstract

Mortality is the principal welfare indicator used within the Australian livestock export industry, but as this only measures extreme events, there is a need for additional indicators. A survey of stakeholders in the industry was conducted to evaluate their opinion of welfare indicators for ship-transported sheep and cattle, and sheep and cattle at pre-export assembly depots. Eighteen indicators were initially identified in consultations with two nominees of each identified stakeholder group (government officials, animal welfare representatives, animal scientists, stockmen, producers/pre-export assembly depot operators, exporters/ship owners and veterinarians). A total of 140 stakeholders completed the disk-based questionnaire, 48% of the total number of stakeholders invited to partake. The order of their declining preference for indicators (and importance values) was mortality (8.6 %), clinical disease incidence (8.2 %), respiration rate (6.8 %), space allowance (6.2 %), ammonia (6.1 %), weight change (6.0 %), wet bulb temperature (6.0 %), time in assembly depot (5.4 %), proportion of animals hospitalised (5.4 %), fodder intake (5.2 %), stress-related metabolites (5.0 %), proportion of feeding trough utilised (5.0 %), injuries (4.8 %), proportion of animals able to access the feeding trough at any one time (4.8 %), proportion of animals lying down (4.7 %), cortisol (4.5%), noise (3.9 %) and photoperiod (3.4 %). The results identify potential new welfare indicators for exported livestock that can be used to direct research efforts effectively.

Executive Summary

This report describes the results of a study to identify potential welfare indicators for sheep and cattle transported by ship and amassed at pre-export assembly depots. The key points of the study are:

- Members of nine stakeholder groups (animal transport scientists, animal welfare representatives, pre-export assembly depot operators, exporters, government officials, ship owners, stockpersons, producers and veterinarians) from the livestock exporting industry were asked via a computer-based questionnaire to consider 18 potential welfare indicators
- There was a 48 % (140/292) response rate to the questionnaire.
- The order of declining preference of the 18 indicators, together with the importance value for each indicator, was: mortality (8.6 %); clinical disease incidence (8.2 %); respiration rate (6.8 %); space allowance per head (6.2%); ammonia levels (6.1 %); body weight change over the voyage (6.0 %); wet bulb temperature (6.0 %); proportion of animals passing through the hospital pen (5.4 %); time spent in the pre-export assembly depot (5.4 %); fodder intake (5.2 %); proportion of trough utilised when feeding (5.0 %); stress related metabolites (5.0 %);proportion of animals that can access trough at any one time (4.8 %); debilitating injuries (4.8 %); proportion of animals lying down (4.7 %); cortisol (4.5 %); noise levels (3.9 %); and photoperiod (3.4 %).
- The top seven indicators (mortality to wet bulb temperature inclusive) received an above average relative importance score indicating these to be the key indicators for further consideration.
- Of the top seven indicators, four (mortality, clinical disease incidence, respiration rate and wet bulb temperature) are already in use, while body weight change would be difficult to obtain reliable results. Space allowance per head contained in the industry standards is currently used to determine pen stocking density.
- Ammonia level was identified as a potential new welfare indicator; however, further research is required to determine its appropriateness as a welfare indicator.
- While the respondent's stakeholder group did influence their preference for particular welfare indicators, no one stakeholder group differed greatly from the rest of the stakeholder groups in their preference for the various welfare indicators.

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1 Background

Mortality is currently the principal welfare indicator within the livestock export industry, but with current levels being very low (mortality levels for 2003 were 0.11 % for cattle and 0.99 % for sheep: LiveCorp/MLA, 2004), and mortality only measuring extreme animal welfare events, there is a need for additional indicators of welfare for continued improvement of animal performance. At present, it is mandatory for the stockperson assigned to long haul cattle shipments to report daily and at the end of the voyage on cattle and shipboard conditions (Ainsworth, 2003). For each deck, the stockperson reports the temperature and humidity levels, deck conditions, faeces characteristics and respiration rate. The daily reports also include average feed and water consumption per head, respiration character, sick pen report, mortality levels, wet bulb reading and the degree of heat stress. For sheep, however, mortality is the only measure that has to be reported daily. Other comments on sheep and shipboard conditions in the daily and end of voyage report are discussed where deemed relevant (Brightling & Lightfoot, 2003).

2 Project Objectives

The objective of this study was to identify potential welfare indicators for cattle and sheep transported by ship and amassed at pre-export assembly depots that can be used to measure less extreme welfare events. Ideally, the welfare indicators would also be effective during the preparation and transportation stages of a voyage. The types of welfare indicators under consideration related to animal health, behaviour and physiology, and the environment. Some of the indicators are already mandatory for the stockpersons to report on long haul voyages, while others are new. Using an adaptive conjoint analysis (ACA) to elicit stakeholder opinion on potential welfare indicators, a computer-based questionnaire was administered to stakeholders in the livestock exporting industry. Through a series of paired scenarios that stakeholders were asked to choose between, their preferences for the various welfare indicators were determined.

3 Methodology

3.1 Methodology – Questionnaire Development

Two representatives from each of nine identified stakeholder groups involved in the livestock export industry (animal transport scientists, animal welfare representatives, pre-export assembly depot operators, exporters, government officials, ship owners, stockmen, producers and veterinarians) were first consulted on possible welfare indicators that could be used.

Of the 84 nominated welfare indicators (see Appendix A), 18 were selected for inclusion in the questionnaire (Table 1). Selection of the 18 indicators was based on those that were most frequently nominated by the representatives, those that were most informative, with regard to the welfare of the livestock, and had potential to be practically measured on board ship and/or in the pre-export assembly depot. For each of the selected welfare indicators, three levels were identified that may potentially occur during the preparation and/or transportation of the livestock (Table 1). The levels ranged from those appropriate to the ideal preparation and transportation (best 5% of voyages) to those seen during the worst preparation and/or transportation in the bottom 5 % of voyages, respectively. The third, intermediate, level represented a typical preparation and transportation or,

where those data were not available, a level half way between the levels for the ideal and the worst transportation of livestock. For example, one welfare indicator is the “proportion of animals with debilitating injuries” and the three levels were 0 % (best), 0.05 % (intermediate) and 0.1 % (worst). Information on the worst 5 % of voyages with respect to mortality was supplied in confidence by LiveCorp. Levels of other indicators were obtained by consultation between the project team a live export veterinarian.

Table 1. Welfare indicators and the three corresponding levels.

Welfare indicator	Level
Proportion of animals with debilitating injuries:	0 % 0.05 % 1 %
Proportion of animals passing through the hospital pen:	0 % 1 % 2 %
Mortality rate:	0 % 0.5 % 2 %
Proportion of animals with clinical signs of disease:	0 % 1 % 10 %
Space allowance per head:	equivalent to the area physically occupied by the animal equivalent to the area necessary for an animal to lie down equivalent to the area necessary for an animal to lie down and to turn around
Proportion of animals lying down during the first week on the ship:	0 % 20 % 40 %
Proportion of animals that can access troughs at any one time:	10 % 20 % 30 %
Wet bulb temperature (as a combined measure of temperature and humidity):	25 ^{o}C 30 ^{o}C 35 ^{o}C
Ammonia levels:	negligible odour is detectable, but not causing the animals irritation causing the animals irritation

Noise levels:	60 dB 75 dB 90 dB
Daily amount of light:	24 hours of light 18 hours light/6 hours of dimness 12 hours light/12 hours dimness
Welfare indicators	**Level**
Proportion of troughs utilised by animals feeding (measured as a snapshot):	0 % 50 % 100 %
Fodder intake:	75 % of that necessary to maintain the animal in its current condition 100 % of that necessary to maintain the animal in its current condition 125 % of that necessary to maintain the animal in its current condition
Cortisol concentration (as a measure of stress):	normal levels two-fold increase above normal levels four-fold increase above normal levels
Other stress related metabolites:	low levels medium levels high levels
Respiration rate:	normal levels two-fold increase above normal levels three-fold increase above normal levels
Body weight change over the sea voyage:	5 % decrease No change 5 % increase
Time spent in the pre-export assembly depot:	0 days 5 days 10 days

3.2 Methodology – Participants

The two representatives from each of the nine stakeholder groups together nominated and provided contact details for up to 50 participants within their particular stakeholder groups to whom the questionnaire could be sent. As there were a relatively low number of members involved in some stakeholder groups, in particular the ship owners, stockpersons and assembly depot operators, an unequal number of participants were nominated in each stakeholder group (Table 2).

A letter describing the study (Appendix B), along with a computer disk, consent form (Appendix C) and a reply paid envelope, was sent to each of the nominated participants in early November 2004. Participants were given 11 weeks to complete and return the questionnaire. A reminder phone call or email was made to the participants several weeks prior to the closing date.

Ethical approval (Clearance No. 2004000565) was obtained from the Human Ethics Committee of the University of Queensland before commencement.

Over the course of the project, the research team met with a projective consultative committee on three occasions to discuss the results of the consultation process, the design of the questionnaire and the results of the study.

Table 2. Number of nominated participants in the nine stakeholder groups

Stakeholder group	Participants nominated
Animal transport scientists	24
Animal welfare representatives	29
Assembly depot operators	18
Exporters	46
Government officials	44
Producers	47
Ship Owners	19
Stockpersons	21
Veterinarians	44
TOTAL	292

3.3 Methodology – ACA questionnaire

The computer based questionnaire (issued on computer disk) was constructed using Sawtooth Software®.

The questionnaire consisted of four main sections:

i) *Background information*: respondents were asked to provide details on age, gender, whether they had lived in a rural area or a city/town, whether they had worked with sheep and/or cattle and experience with the livestock exporting industry. Respondents were also asked about their view on whether the Australian livestock export trade should be allowed to continue.

ii) *Ranking of welfare indicator levels*: respondents were asked to rank the three levels of each welfare indicator (attribute) in order from the level they felt represented the best welfare situation to the level which represented the worst situation.

iii) *Importance of the welfare indicators:* respondents were asked to rate the usefulness of the difference between the best and worst welfare levels from their perspective. The usefulness was rated on a nine-point scale, thereby allowing the ACA to learn enough about the respondent's values to construct initial utility estimates.

iv) *Trade-off comparisons*: respondents were presented with a series of customised, paired comparison trade-off questions (in the form of scenarios) and asked to choose between the two. Using the 13 most preferred indicators for each individual, as determined during section iii, the ACA constructed pairs by examining all the possible ways the levels can be combined and choosing pairs of options with similar utilities for which it expected responses to be indifferent (based on previous responses). The software used the information obtained from each paired comparison to update the estimates of each respondent's utilities and to select the next pair of options for trade-off. Final utilities were generated by the software.

3.4 Methodology – Statistical analysis

The ACA software determined the relative importance, expressed as a percentage, of each attribute (welfare indicator).

Using Minitab Statistical Software, a cluster analysis sorted each respondent's scores of relative importance for each attribute into cluster groups. The cluster groups represented respondents with similar preferences for the various attributes. Chi Square analyses (conducted in Minitab) were used to determine whether the respondents' age, gender, living environment, stakeholder group, experience with sheep and cattle, experience with the livestock exporting industry and views on the industry influenced their preference for particular cluster groups (i.e. preference for particular welfare indicators).

Paired *t*-tests (conducted in Minitab) were used to determine whether any visual differences in the relative importance scores of various attributes were statistically significant ($P < 0.05$).

4 Results and Discussion

Forty-eight percent (140/292) of the questionnaires were completed and returned. As there were a low number of questionnaires completed and returned by the pre-export assembly depot operators (4/18) and ship owners (7/19), the responses for the former were combined with those of the producer stakeholder group and the responses of the latter combined with the exporter stakeholder group in order to provide sufficient numbers for analysis and combine groups with similar interests. The response rate from each of the stakeholder groups was: animal transport scientists: 75 % (18/24); animal welfare representatives: 66 % (19/29); government officials: 52 % (23/44) producers/assembly depot operators: 48 % (31/65); stockmen 48 % (10/21); veterinarians 41 % (18/44), and; exporters/ship owners 32 % (21/65). The average time taken to complete the questionnaire was 39 minutes (range 14-109 mins). Due to defective computer disks, five of the questionnaires (two animal welfare representatives, one animal transport scientist, one veterinarian and one producer) were not included in the statistical analysis (reducing the sample size to 135).

4.1 Results and Discussion - Demographics

The total sample consisted of 32 females and 103 males. As shown in Table 3, a third of the respondents were aged between 41-50 years and another third between 51-60 years. The remaining third of the respondents were spread over the four other age categories.

Table 3: Age distribution of respondents in study.

Age (years)	Frequency	Percent
21-30	8	5.9
31-40	18	13.3
41-50	45	33.3
51-60	45	33.3
61+	17	12.6
Not disclosed	2	1.5
TOTAL	135	99.9

The majority of the respondents had spent at least part of the life living in both a rural area and in a city or town. Of the total respondents, 41 % (56/135) had lived most of their life a rural area, but had lived in a city or town and 38 % (51/135) had lived most of their life in a city or town, but had lived in a rural area. Twelve percent (16/135) had only lived in a rural area, while 9 % (12/135) had only lived in a city or town.

4.2 Results and Discussion – Experience with livestock and livestock exporting industry

Fifty-one percent of the respondents (69/135) worked primarily with both sheep and cattle, while 27 % (37/135) worked with just cattle and 8 % (11/135) worked with just sheep. Fourteen percent of the respondents (18/135) worked with neither sheep nor cattle.

The majority of the respondents had at least some experience with various stages of the livestock exporting process, as shown in Table 4. Seventy-nine percent of the respondents had been at least once to a pre-export assembly depot. Eighty-one percent of the respondents had seen livestock being loaded onto a ship at least once in real life, while 74 % of the respondents had been, at least once, on board a ship used to export livestock while the ship was still at wharf. However, only 34 % of respondents had been on at least one voyage in which livestock were being transported.

Table 4: Respondents prior experience with different stages of the livestock exporting trade.

	Never % (frequency)	**Once** % (frequency)	**Between two and ten times** % (frequency)	**More than ten times** % (frequency)
How many times have you been to a pre-export assembly depot?	21 (28/135)	7 (9/135)	24 (33/135)	48 (65/135)
How many times have you seen, in real life, livestock loaded onto a ship?	19 (26/135)	9 (112/135)	21 (28/135)	51 (69/135)
How many times have you been on a ship used to transport livestock, while it was still at the wharf?	26 (35/135)	10 (14/135)	21 (28/135)	43 (58/135)
How many times have you been on a voyage in which livestock were being transported?	65 (88/135)	8 (11/135)	16 (21/135)	11 (15/135)

4.3 Results and Discussion – View on whether the Australian livestock export trade should be allowed to continue

The majority of the respondents were in favour of the Australian livestock export trade continuing. Of the total respondents, 58 % (78/135) were in complete favour of the trade continuing in its current manner and 28 % (38/135) were in favour of the trade continuing as long as improvements are made. Thirteen percent (18/135) were against the trade continuing and 1 % (1/135) was undecided.

4.4 Results and Discussion – Respondent utilities

Mean utilities for each level of each attribute (welfare indicator) are presented in Table 5. Positive utility values represent levels preferred by the respondent, while negative utility values represent levels less preferred by the respondent. The larger the utility value, the stronger the preference for or against that particular level. Utility values are interval data and pertinent information is found in the relative differences between utilities.

Table 5: Utility value for each welfare indicator level.

Attribute	Level	Utility (mean ± SE)
Proportion of animals with debilitating injuries:	0 %	41.1 ± 1.5
	0.05 %	1.5 ± 1.1
	1 %	-42.6 ± 1.7
Proportion of animals passing through the hospital pen:	0 %	42.2 ± 2.3
	1 %	4.0 ± 1.0
	2 %	-46.2 ± 2.1
Mortality rate:	0 %	67.6 ± 2.9
	0.5 %	11.2 ± 1.1
	2 %	-78.9 ± 3.3
Proportion of animals with clinical signs of disease:	0 %	67.5 ± 1.6
	1 %	11.8 ± 1.1
	10 %	-79.3 ± 1.7
Space allowance per head:	Equivalent to the area physically occupied by the animal	-56.7 ± 2.0
	Equivalent to the area necessary for an animal to lie down	11.1 ± 1.3
	Equivalent to the area necessary for an animal to lie down and to turn around	45.6 ± 2.3
Proportion of animals lying down during the first week on the ship:	0 %	-33.0 ± 2.8
	20 %	6.3 ± 0.8
	40 %	26.7 ± 3.0
Proportion of animals that can access troughs at any one time:	10 %	-44.1 ± 1.5
	20 %	4.9 ± 0.8
	30 %	39.2 ± 1.6

Attribute	Level	Utility
Wet bulb temperature:	25 ºC	46.3 ± 2.1
	30 ºC	8.4 ± 1.1
	35 ºC	-54.7 ± 2.2
Ammonia levels:	Negligible	45.3 ± 1.3
	Odour is detectable, but not causing the animals irritation	16.3 ± 1.1
	Causing the animals irritation	-61.6 ± 1.7
Noise levels:	60 dB	32.2 ± 1.2
	75 dB	3.4 ± 0.8
	90 dB	-35.6 ± 1.4
Daily amount of light:	24 hours of light	-29.0 ± 1.6
	18 hours light/6 hours of dimness	7.5 ± 1.1
	12 hours light/12 hours dimness	21.5 ± 1.9
Proportion of troughs utilised by animals feeding:	0 %	-47.6 ± 2.0
	50 %	21.3 ± 1.4
	100 %	26.3 ± 2.3
Fodder intake:	75 % of that necessary to maintain the animal in its current condition	-40.4 ± 2.3
	100 % of that necessary to maintain the animal in its current condition	27.9 ± 1.8
	125 % of that necessary to maintain the animal in its current condition	12.5 ± 2.9
Cortisol concentration:	Normal levels	38.0 ± 1.4
	Two-fold increase above normal levels	3.1 ± 0.7
	Four-fold increase above normal levels	-41.1 ± 1.5
Other stress related metabolites:	Low levels	40.5 ± 1.7
	Medium levels	4.2 ± 0.8
	High levels	-44.6 ± 2.0
Respiration rate:	Normal levels	59.2 ± 1.3
	Two-fold increase above normal levels	3.7 ± 0.7
	Three-fold increase above normal levels	-63.0 ± 1.5
Body weight change over the sea voyage:	5 % decrease	-54.9 ± 2.1
	No change	13.4 ± 1.8
	5 % increase	41.6 ± 2.9

Time spent in the pre-export assembly depot:	0 days	-37.9 ± 3.1
	5 days	26.2 ± 2.0
	10 days	11.6 ± 3.3

For the majority of attributes, the intermediate level was neither the most nor least preferred level. The two exceptions to this were the attributes 'fodder intake' and 'time spent in the pre-export assembly depot'. For both attributes, the intermediate level ('fodder intake': 100% of that necessary to maintain the animal in its current condition; 'time spent in the pre-export assembly depot': 5 days) were the most preferred levels.

4.5 Results and Discussion – Relative importance of welfare indicators

The relative importance of each of the 18 welfare indicators for all respondents is plotted in Figure 1. The relative importance is a measure of the preference for particular welfare indicators. For example, mortality was the most preferred welfare indicator, while daily amount of light was the least preferred welfare indicator. The order of declining importance of the indicators, together with the importance value for each indicator, was mortality (8.6 %), clinical disease incidence (8.2 %), respiration rate (6.8 %), space allowance per head (6.2 %), ammonia levels (6.1 %), body weight change over the voyage (6.0 %), wet bulb temperature (6.0 %), proportion of animals passing through the hospital pen (5.4 %), time spent in the pre-export assembly depot (5.4 %), fodder intake (5.2 %), proportion of trough utilised when feeding (5.0 %), stress related metabolites (5.0 %), proportion of pen that can access trough at any one time (4.8 %), debilitating injuries (4.8 %), proportion of pen lying down (4.7 %), cortisol (4.5 %), noise levels (3.9 %) and photoperiod (3.4 %). The mean relative importance value was (mean ± sem) 5.56 ± 0.31 %. The top seven indicators (mortality, clinical disease incidence, respiration rate, space allowance per head, ammonia levels, body weight change over the voyage and wet bulb temperature) all had a relative importance value above the mean value.

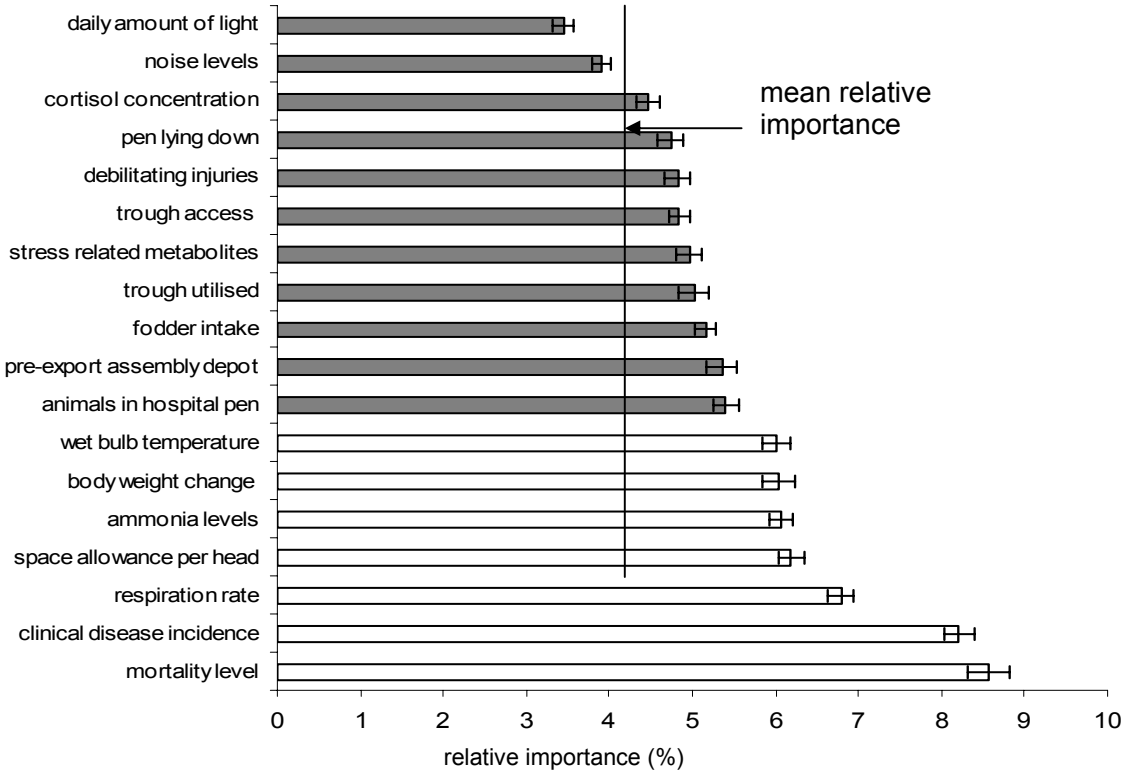

Figure 1: Overall relative importance of welfare indicators. Mean (± SEM) relative importance value for the 18 welfare indicators. Note that mortality, clinical disease incidence, respiration rate, space allowance per head, ammonia levels, body weight change over the voyage and wet bulb temperature (as indicated by the white columns) all had a relative importance value above the mean value.

Visual differences between adjoining welfare indicators were compared statistically with a paired *t*-test. A significant difference was found between "clinical disease incidence" and "respiration rate" (paired *t*-test: $T_{134} = 6.48$, $p = 0.001$) and between "respiration rate" and "space allowance per head" (paired *t*-test: $T_{134} = 2.66$, $p = 0.009$). There was also a significant difference between "wet bulb temperature" and "animals in hospital pen" (paired *t*-test: $T_{134} = 2.31$, $p = 0.02$), "cortisol concentration" and "noise levels" (paired *t*-test: $T_{134} = 2.97$, $p = 0.004$) and between "noise levels" and "daily amount of light" (paired *t*-test: $T_{134} = 3.08$, $p = 0.002$).

Overall, the different stakeholder groups were generally quite consistent with their preferences for the top seven welfare indicators (see Figures 2 - 8). All stakeholder groups rated "mortality" and "clinical disease incidence" as their top two indicators, while the order of the other top indicators varied slightly. All groups had at least five, and in most cases six or seven, of the overall top seven indicators as their top indicators. The animal transport scientists and the veterinarians had all seven of the overall top seven indicators as their top seven. Animal welfare representatives and government officials had six of the overall top seven indicators in their top seven; however, both stakeholder groups preferred "time spent in the pre-export assembly depot" to "body weight change". The exporters/ship owners and the producers/assembly depot operators also had six of the overall

top seven indicators in their top seven; however, both groups preferred “the number of animals in the hospital pen” to “wet bulb temperature”. The stockpersons’ responses were the least similar to the overall response, but they still had five of the overall top seven indicators in their top seven. The stockpersons preferred “time spent in the pre-export assembly depot” and “the number of animals with debilitating injuries” to “wet bulb temperature” and “ammonia levels”.

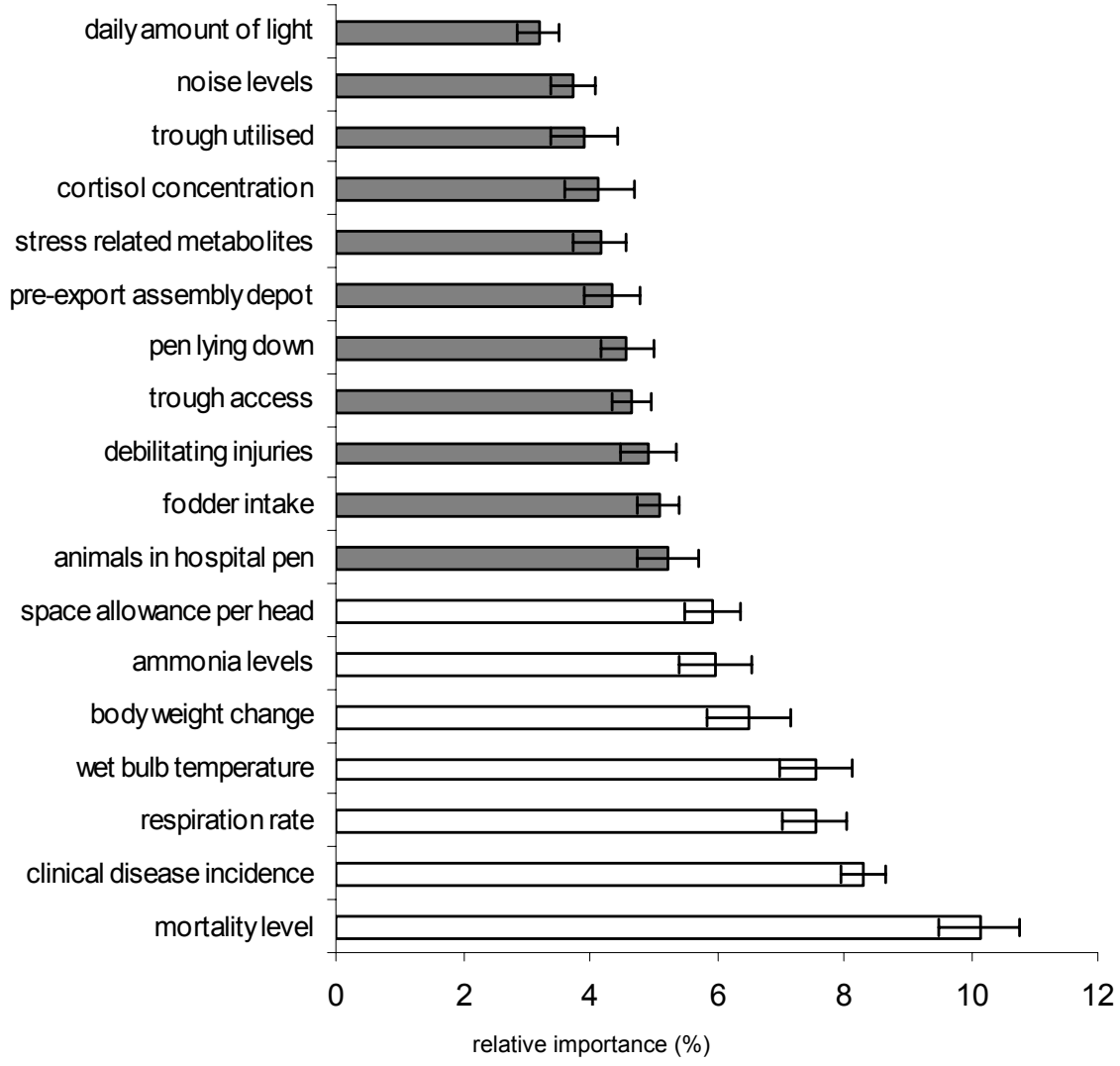

Figure 2: Animal transport scientists. Mean (± SEM) relative importance value for the 18 welfare indicators, as determined by the animal transport scientists. White columns indicate the overall top seven indicators as determined by all respondents. Note that the overall top seven indicators were the same as the animal transport scientists’ top seven indicators.

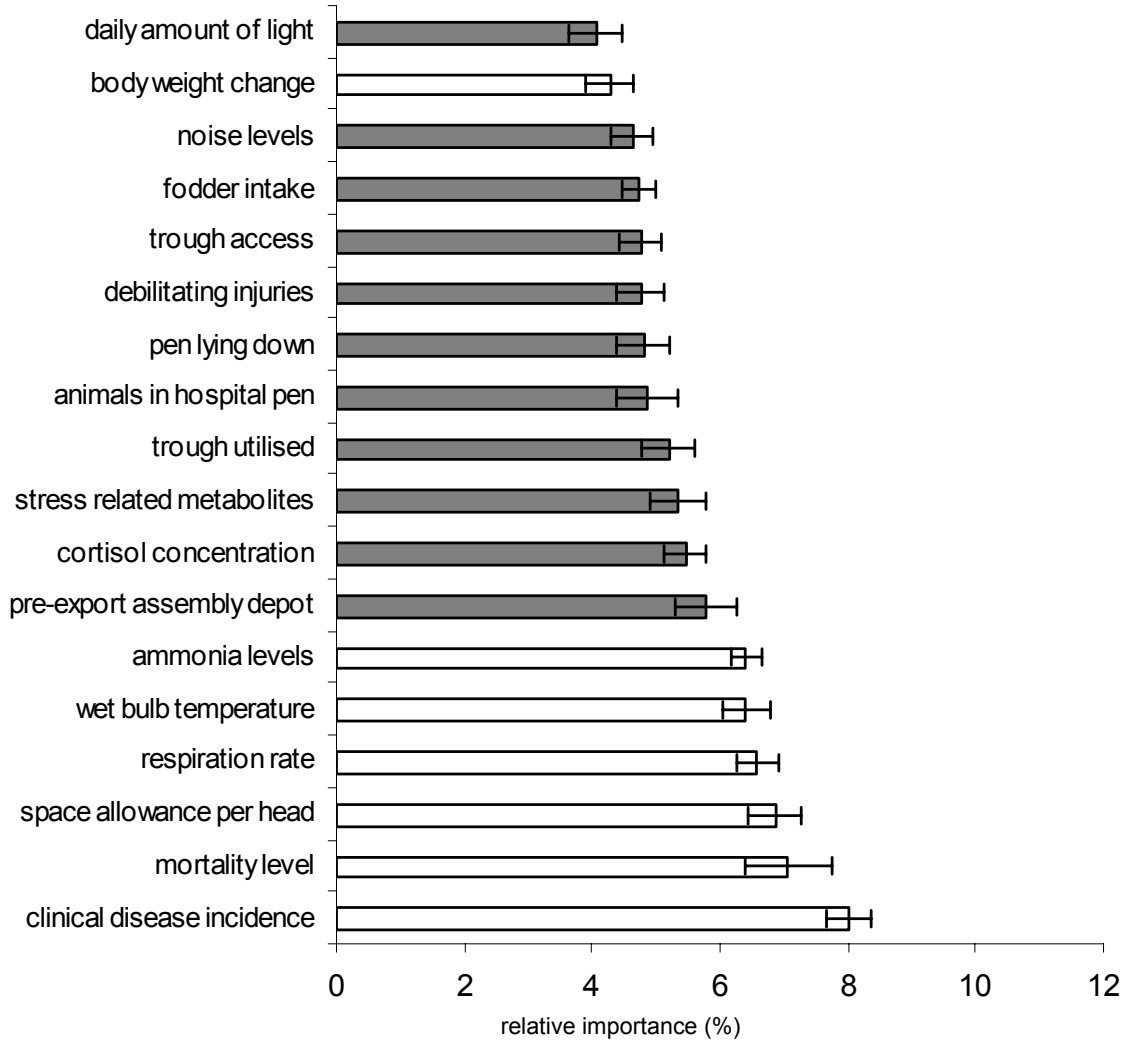

Figure 3: Animal welfare representatives. Mean (± SEM) relative importance value for the 18 welfare indicators, as determined by the animal welfare representatives. White columns indicate the overall top seven indicators as determined by all respondents. Apart from "body weight change" (ranked 17th), the remaining six indicators were same as the overall top seven indicators.

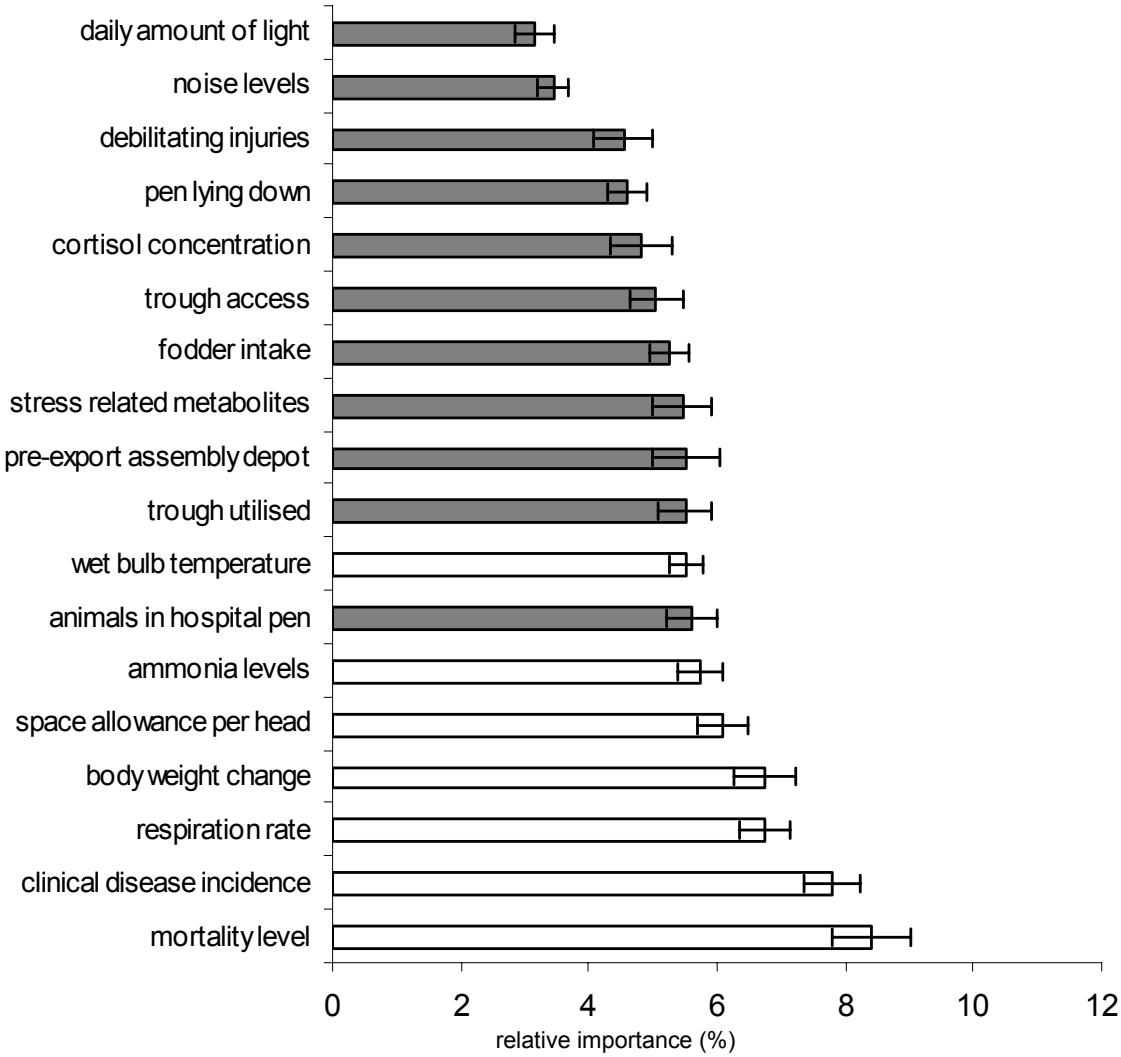

Figure 4: Exporters and ship owners. Mean (± SEM) relative importance value for the 18 welfare indicators, as determined by the exporters and ship owners. White columns indicate the overall top seven indicators as determined by all respondents. The response from the exporters/ ship owners was similar to the overall response although they did prefer "animals in hospital pen" slightly more than "wet bulb temperature".

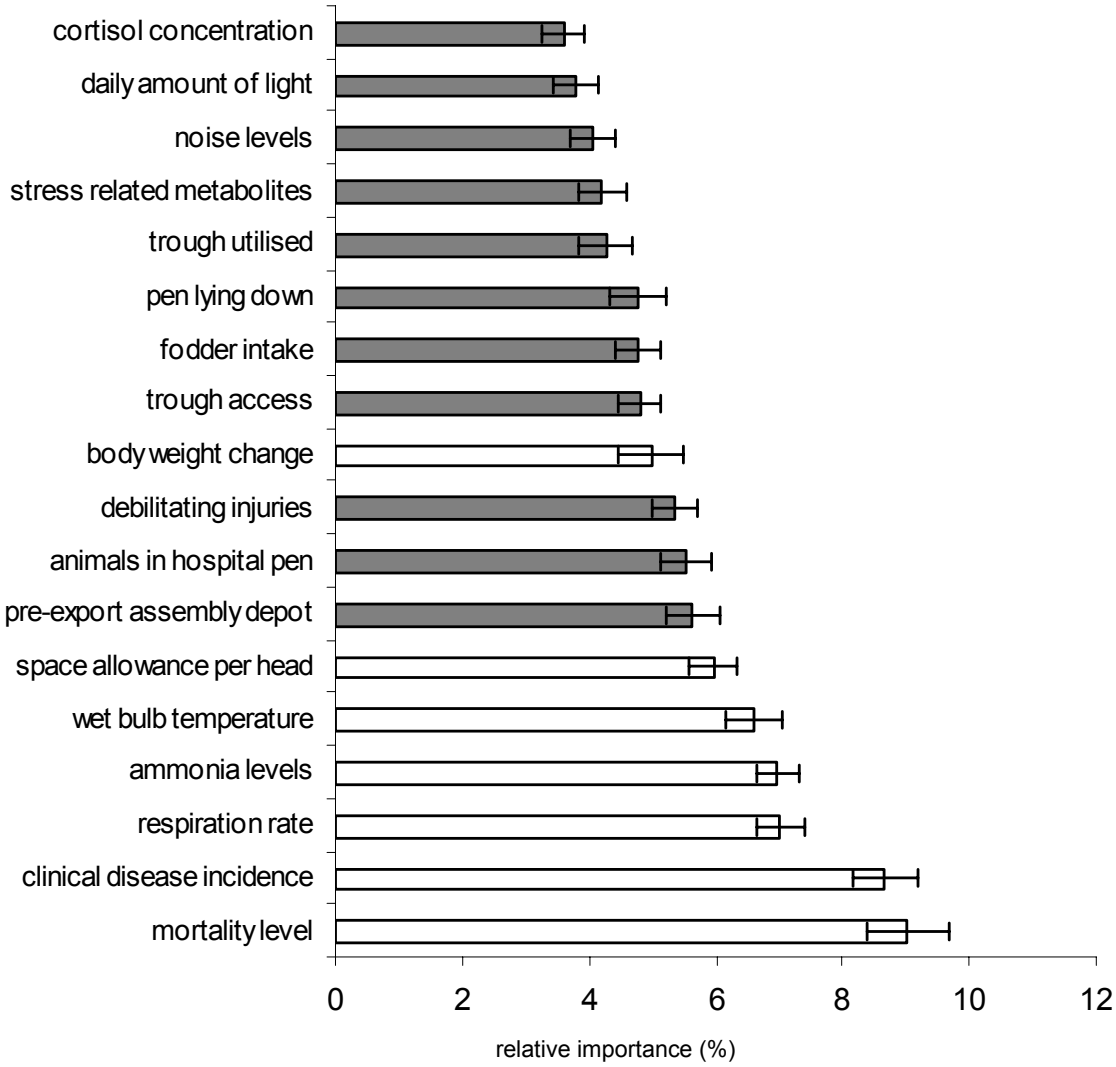

Figure 5: Government officials. Mean (± SEM) relative importance value for the 18 welfare indicators, as determined by government officials. White columns indicate the overall top seven indicators as determined by all respondents. Aside from "body weight change" (ranked 10th), the remaining six indicators were same as the overall top seven indicators.

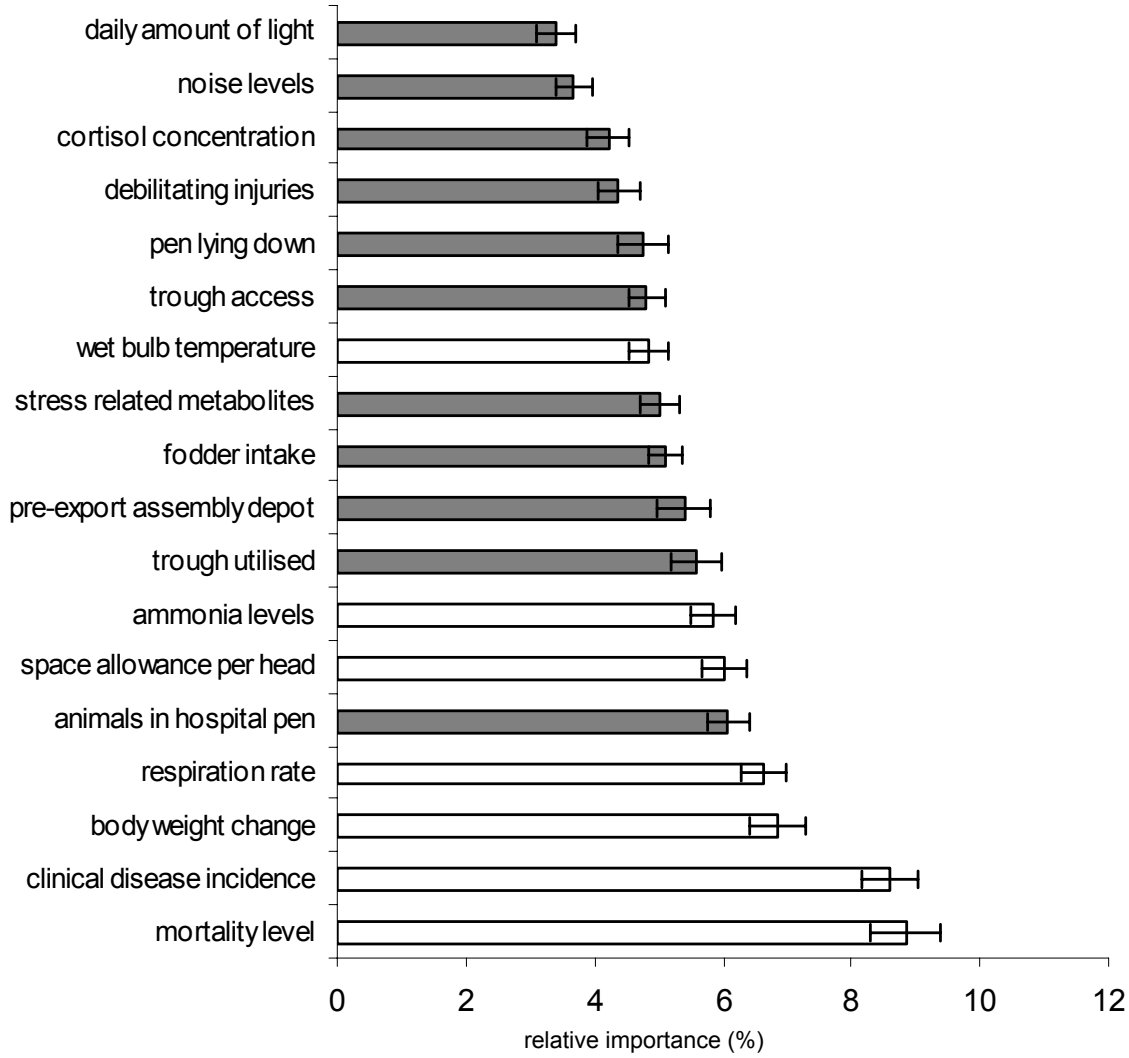

Figure 6: Producers and pre-export assembly depot operators. Mean (± SEM) relative importance value for the 18 welfare indicators, as determined by producers and pre-assembly depot operators. White columns indicate the overall top seven indicators as determined by all respondents. "Wet bulb temperature" (ranked 12th) was the only overall top seven indicator not to feature in the producers/pre-export assembly depot operators' top seven.

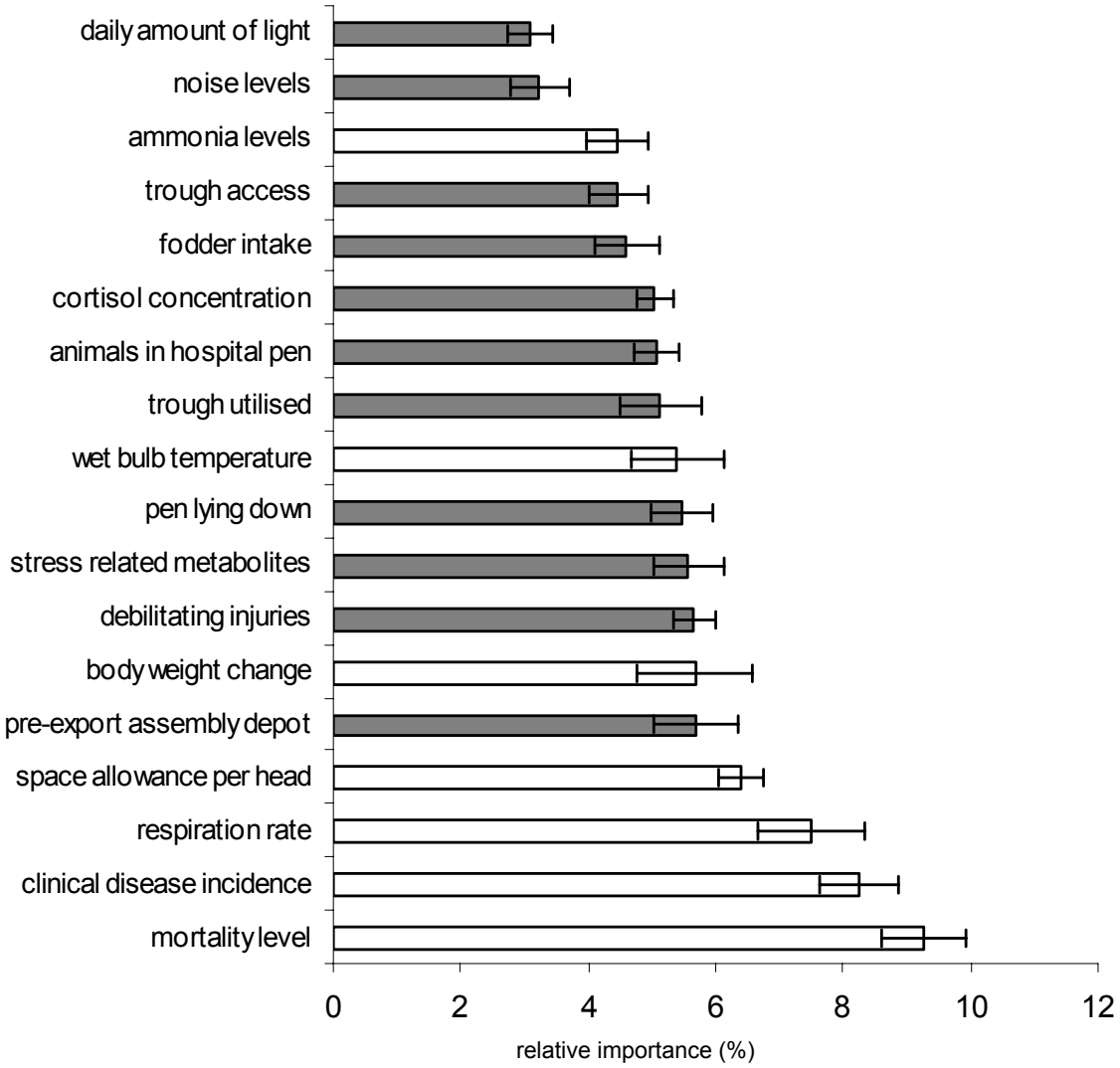

Figure 7: Stockpersons. Mean (± SEM) relative importance value for the 18 welfare indicators, as determined by stockpersons. White columns indicate the overall top seven indicators as determined by all respondents. "Wet bulb temperature" (ranked 10th) and "ammonia levels" (ranked 16th) were not ranked highly by the stockpersons.

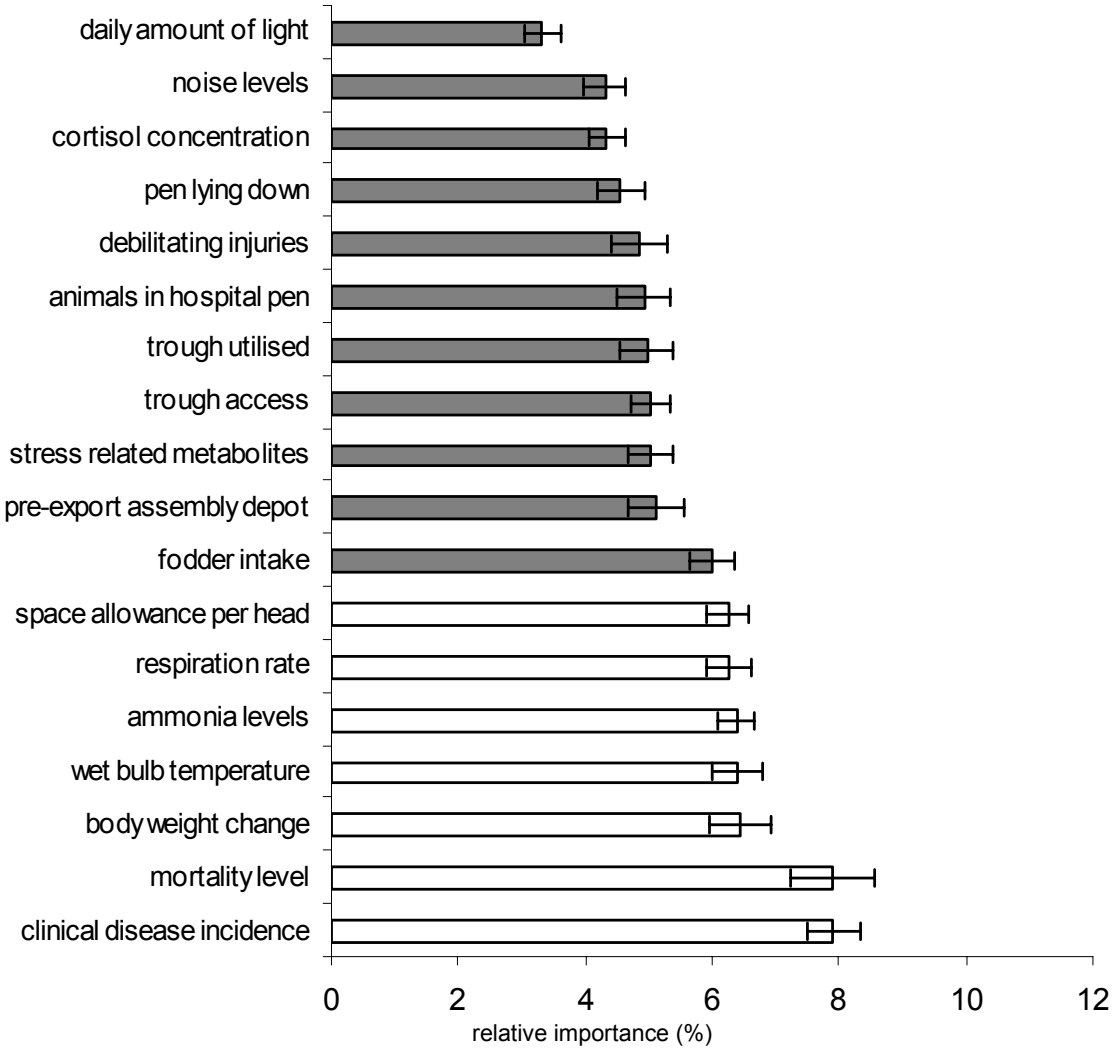

Figure 8: Veterinarians. Mean (± SEM) relative importance value for the 18 welfare indicators, as determined by veterinarians. White columns indicate the overall top seven indicators as determined by all respondents. Note that the overall top seven indicators were the same as the veterinarians' top seven indicators.

Cluster analysis revealed common responses to four groups of indicators. As Figure 9 shows, the preferences of the first cluster group are similar to the overall response except for two key differences; the first cluster group showed a stronger preference for "animals passing through the hospital pen" (6.6 %) and a weaker preference for "body weight change over the voyage" (3.9 %) compared to the overall response. The second cluster group (Figure 10) differed primarily from the total response in that they showed a stronger preference for "time spent in the pre-export assembly depot" (6.6 %) and a much weaker preference for "mortality levels" (5.2 %). The third cluster group was relatively similar to the overall response, although their preference for mortality was much greater than any other indicator (Figure 11). As shown in Figure 12, the fourth cluster group differed primarily from the overall results in that they showed a strong preference for "animals passing

through the hospital pen" (6.6 %) and a weak preference for "wet bulb temperature" (5.2 %) and "ammonia levels" (4.9 %).

Some stakeholder groups differed significantly in their distribution in these clusters (p = 0.001). Thirty three percent of the stockmen, 33 % of the animal transport scientists and 33 % of the animal welfare representatives were in the first cluster group. Fifty percent of the animal welfare representatives, 39 % of the exporters/ship owners and 30 % of the veterinarians were in cluster group two and 46 % of the animal scientists, 39 % of the veterinarians and 37 % of government officials were in the third cluster group. Thirty nine percent of producers/pre-export assembly depot operators, 33 % of stockmen and 30 % exporters/ship owners were in the fourth cluster group.

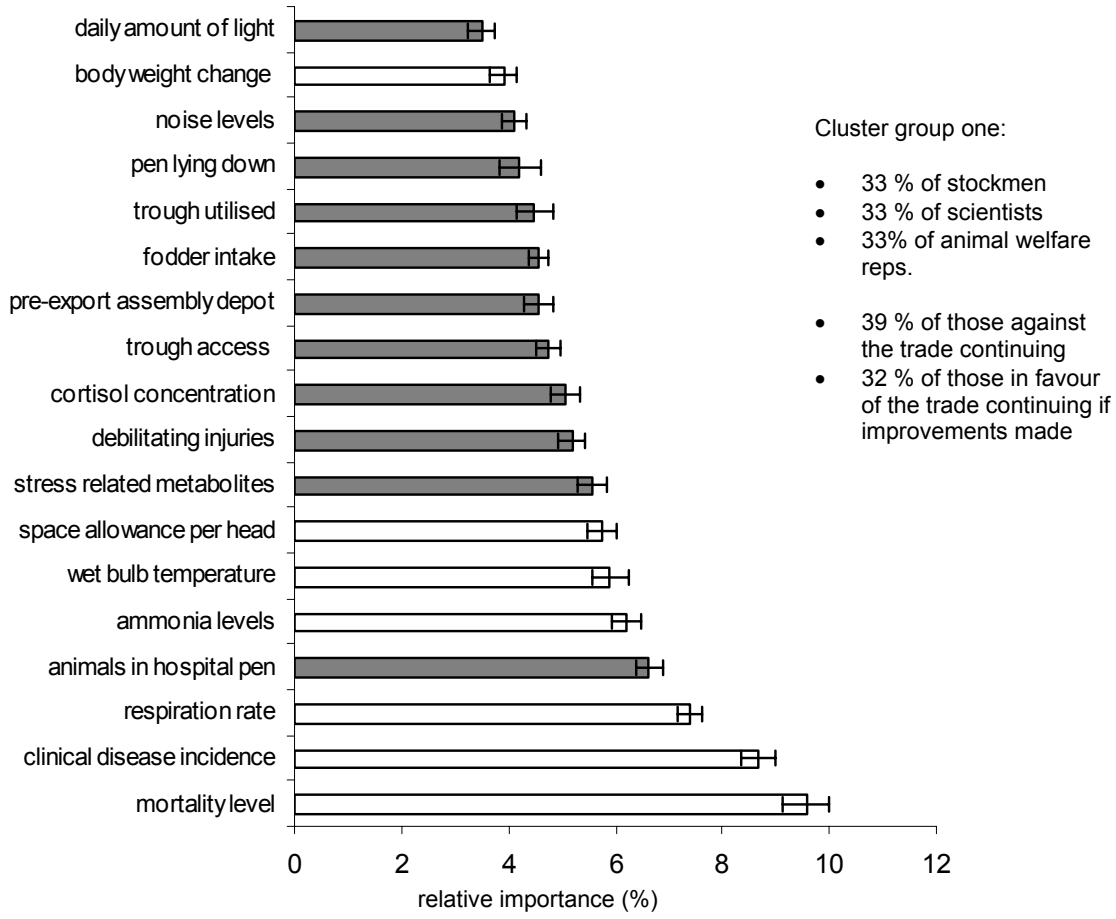

Figure 9: Cluster group one's relative importance of welfare indicators.

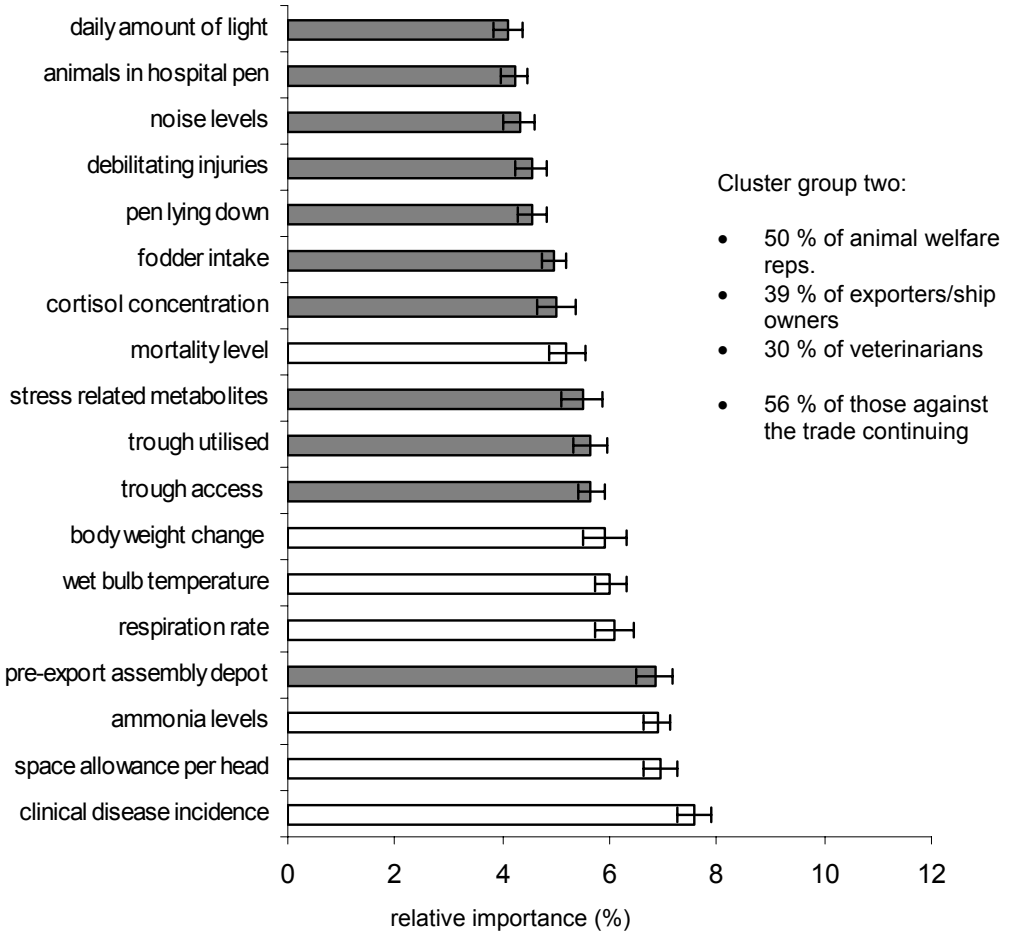

Figure 10: Cluster group two's relative importance of welfare indicators

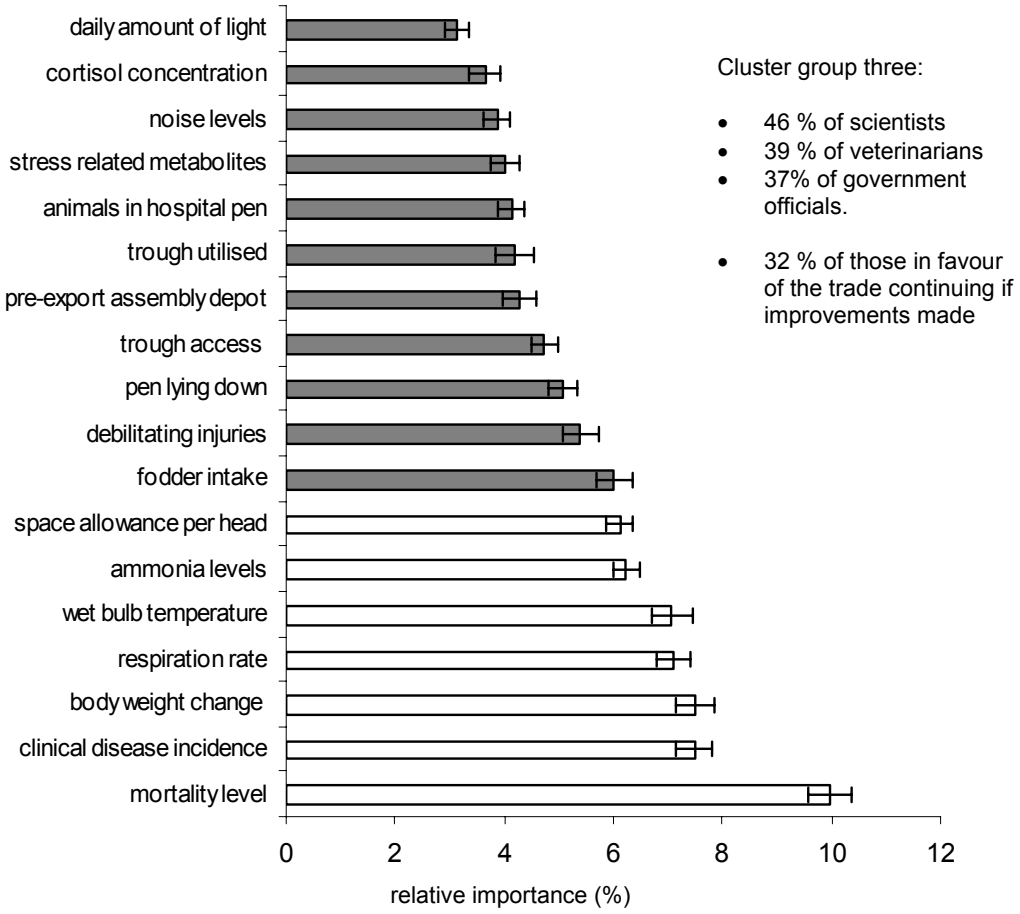

Figure 11: Cluster group three's relative importance of welfare indicators

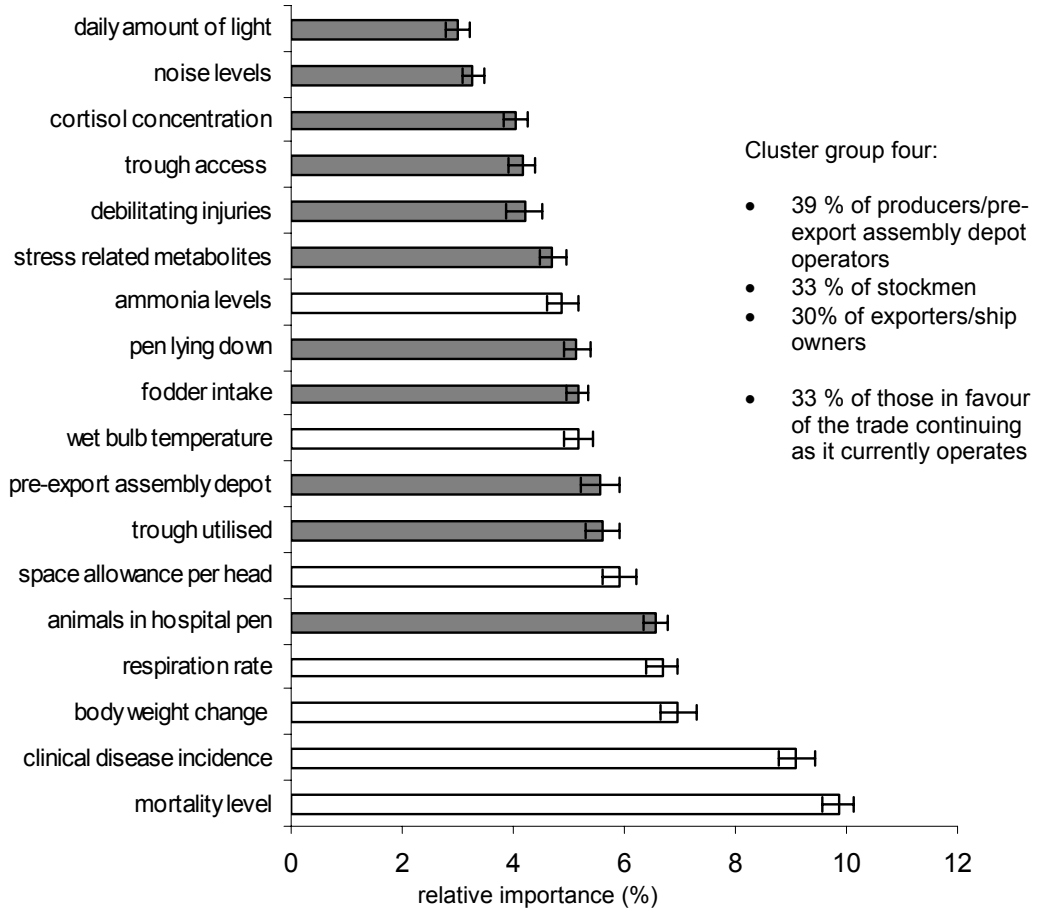

Figure 12: Cluster group four's relative importance of welfare indicators

The respondents view on whether the Australian livestock export trade should be allowed to continue was also associated with placement in these clusters (p = 0.001). Thirty nine percent of the respondents against the trade continuing and 32 % of the respondents in favour of the trade continuing as long as improvements are made were in cluster group one. Fifty-six percent of the respondents against the trade continuing were in cluster group two, while 32 % of the respondents in favour of the trade continuing as long as improvements are made were in cluster group three. Thirty three percent of those in favour of the trade continuing as it currently operates were in the fourth cluster group.

The respondent's age, gender, living situation, experience with livestock and experience with the livestock exporting industry did not significantly (p > 0.05) affect their placement in the cluster groups.

4.6 Results and Discussion – Discussion

The purpose of this study was to identify potential welfare indicators for cattle and sheep transported by ship and held in pre-export assembly depots that can be used to measure welfare problems less extreme than death.

Despite 50 % of animal welfare representatives, 39 % of exporters/ship owners and 30 % of veterinarians not rating mortality highly, mortality was still considered, overall, to be the most preferred welfare indicator for shipped sheep and cattle (relative importance of 8.6 %). There was also a very strong preference for one of the other health based indicators: "clinical disease incidence" (relative importance of 8.2 %). Respiration rate also featured highly (relative importance of 6.8 %). There was little difference in the respondents' preferences for "space allowance per head", "ammonia levels", "body weight change over voyage" and "wet bulb temperature" (relative importance ranged between 6.0-6.2 %). Indeed, these above mentioned seven indicators appear to be the outstanding welfare indicator preferences and were all above the mean relative importance value of 5.6 %. The remaining 11 indicators ("time spent in the pre-export assembly depot", "fodder intake", "proportion of trough utilised when feeding", "stress related metabolites", "proportion of pen that can access trough at any one time", "debilitating injuries", "proportion of pen lying down", "cortisol levels", "noise levels" and "daily amount of light") were disregarded because they had a relative importance score (ranging from 3.4-5.4 %) below that of the mean.

Four of the top seven preferred indicators ("mortality levels", "clinical disease incidence", "respiration rate" and "wet bulb temperature") approximate to indicators already mandatory to report on Australian cattle voyages to the Middle East. This would suggest that respondents had confidence in these indicators. While not used as a welfare indicator, the body weight of cattle may be measured (as a group) before loading or after discharge. Under the current operating conditions there is no control over how much food and water an animal receives prior to loading and before discharge; i.e. no control over "gut fill". Given that gut content can account for 12-25 % (Tarrant & Grandin, 2000) of the animal's live weight, body weight change may be an unreliable welfare indicator. Sheep are not generally weighed at discharge of the ship, so this is not a feasible indicator for sheep. Similarly, "space allowance per head" is not used as a welfare indicator but is currently used to determine pen stocking density. Little is known about the usefulness of "space allowance per head" as a potential welfare indicator, however, given that it had the fourth highest relative importance score, further research and development of this indicator is warranted.

Ammonia was the remaining indicator to score highly. There is some evidence to suggest that ammonia levels may be a valuable indicator. Cattle have been reported to show inflammatory responses when exposed to ammonia levels of 22 ppm (Costa et al., 2003). Moreover, Tudor et al. (2003) found evidence of bronchial alveolar lavages inflammation in cattle exposed for nine days to ammonia levels fluctuating between 13 ppm and 33 ppm. With ship board ammonia levels regularly reaching 30 ppm (MAMIC, 2001), and with little known about the impact of ammonia on sheep, further investigation into the effects of ammonia levels may be warranted.

Fodder intake and a hospital pen report, which would include details on the number of animals in the sick pen with injuries, are also reported by the stockpersons on cattle long haul voyages, but did not rate as high as the above-mentioned indicators reported by the stockpersons. This may indicate a lack of confidence in these indicators.

The three levels of each welfare indicator were ranked by the respondent in order from the level they felt represented the best welfare situation to the level which represented the worst situation. As expected, for most welfare indicators the intermediate level, representing either a typical preparation and transportation or a level half way in between the ideal and the worst transportation of livestock, was neither the most preferred level nor the least preferred level. There were, however, two exceptions to this: "fodder intake" and "time spent in the pre-export assembly depot". For both welfare indicators, the intermediate level ("fodder intake": 100 % of that necessary to maintain the animal in its current condition; "time spent in the pre-export assembly depot": 5 days) were the most preferred levels. Increasing fodder intake above 100 % increases metabolic heat production, potentially compounding any heat stress, and so it is not surprising that respondents preferred a fodder intake of 100 % to a fodder intake of 125 % of maintenance. Regarding the time in the pre-export assembly depot, there appears to be lack of consistency in individual's belief concerning the optimum amount of time livestock should spend in the pre-export assembly depot. The initial Australian Standards for the Export of Live-Stock (2004) recommend that sheep be kept in the assembly depot for between 3 and 5 days, dependent on whether the sheep had previously been kept in sheds or paddocks, the time of year and the location of the assembly depot. There are no set times for cattle. Due to the low number of respondents working with just sheep or just cattle (most worked with both) it was not possible to separate the data by experience with the two species. Nonetheless, the order of preference for the overall results, ranked from highest to lowest, was five days, 10 days and 0 days. These results suggest that the time spent in the pre-export assembly depot be for at least a 5-day period.

There appears to be some but not overwhelming differences between individuals in their preferences for particular welfare indicators. Cluster analysis revealed four distinct groups of responses. Importantly, of the top seven indicators, as determined by the overall results, six of them appeared in the top seven preferences for three of the cluster groups, while in one cluster group all seven indicators made up that particular group's top seven. Therefore, one can assume that there is a strong overall consensus as to these seven indicators being given the most credence for assessing the welfare of livestock.

Clustering of the responses was associated with the respondents' stakeholder group. A higher than expected number of members within each stakeholder group expressed a preference for certain welfare indicators over others. However, no one stakeholder group was unanimous in their preference for particular welfare indicators. For example 46 % of the animal transport scientists preferred the third clustering of welfare indicators, while 33 % preferred the first clustering. The remaining 21 % of the animal transport scientists preferred either the second or the fourth clustering. Moreover, no one stakeholder group differed dramatically from the rest of the stakeholder groups in their preference for particular welfare indicators. For example, within the second cluster group there were 50 % of the animal welfare representatives, 39 % of the exporters/ship owners and 30 % of the veterinarians. Indeed all stakeholder groups had at least five, and in most cases six or seven, of the overall top seven indicators as their top indicators. This would indicate that the views of any one stakeholder group are not greatly different from the others.

The respondents' view of the livestock exporting industry also influenced their preference for particular welfare indicators. The key group of respondents to contribute to the association between respondent views of the industry and cluster group preferences were those against the livestock export industry continuing. Fifty-six percent of those against the livestock export industry continuing ranked mortality 11th out of the 18 indicators. Yet, 39 % of those against the livestock export industry

continuing rated mortality 1st out of the 18 indicators. Clearly, those against the industry continuing are divided in their view of whether mortality is a suitable welfare indicator.

The majority of the respondents had some experience with the industry. Most, at some point, had visited a pre-export assembly depot (79 %) and witnessed livestock being loaded onto vessels (81 %). Only a third of the respondents had been on at least one voyage in which livestock were being transported, however, three-quarters of the respondents had been onboard a ship while it was still at the wharf. Moreover, 87 % of the respondents had worked with sheep, cattle or both. This provides confidence that the respondents were providing a degree of informed responses to the questionnaire.

Approximately three-quarters of the respondents were male. Thus the results will tend to be biased in favour of male preferences. However, analysis revealed no effect of gender on preferences for welfare indicators. Most respondents had lived in both a rural area and in a city or town and so it is unlikely that the results were biased in this way. The age distribution of the respondents was relatively evenly spread across all age brackets. Neither age nor living situation (in regards to living either in a city or rural area) affected the respondents' preferences for particular welfare indicators.

5 Success in Achieving Objectives

Six welfare indicators, mortality, clinical disease incidence, respiration rate, wet bulb temperature, space allowance per head and ammonia levels, have been identified as potential welfare indicators for cattle and sheep transported by ship and amassed at pre-export assembly depots.

6 Conclusions and Recommendations

The adaptive conjoint analysis questionnaire successfully identified seven welfare indicators that the majority of stakeholders in the livestock exporting industry consider to be important. Four of the top seven welfare indicators (mortality, clinical disease incidence, respiration rate and wet bulb temperature) are already in use, suggesting a confidence in these, while body weight change, under current operating conditions, may be difficult to implement and open to manipulation. Space allowance per head is currently used to determine pen stocking density; however, further research would be required before space allowance could be used as a welfare indicator. Ammonia level was identified as a potential new welfare indicator, but again, further research is required to develop this as a potential welfare indicator.

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8 Appendices

8.1 Appendix 1

Initial welfare indicators nominated by the two representatives from each stakeholder group

% body weight
access to fodder/water
air turnover
ammonia levels
amount of food eaten
animal having difficulty using the food system
animals “stirred up”
animals appear unhealthy
animals appear weak
animals away from mob
animals go down and don’t get up
behavioural indicators acting like a sheep
change in position
clinical signs of disease
CO2 levels
cold: sneezing coughing, shivering, pneumonia
competing to obtain food
competition
coughing
crowding towards air ducts, increased ammonia
deck conditions
dehydration
digestive upsets
discomfort
drooling
dull
dye band on rails
exposure to other stressors
faeces on animals
faecal production, character
feed intake
fighting/aggression
flightiness
go back onto food without any bloating
gut flora composition
hairless tail
heat stress
hollowness
hormonal indicators (eg metabolites)
humidity levels
immune functions
inanition
inappetence
injury
isolation
leg injuries
lighting
lying down (when all others get up)
maintaining condition or loss of condition
mortality
motion sickness
mounting
mucous discharge colouration
noise
nutrition
panic
pens design
photoperiod
pinkeye
pneumonia
posture
respiration character
respiration rate
salmonella
secondary infections
sheep segregated into clumps
shivering
size differences
space to lie down
speed of adaptation to new environment
stocking density
sulking
temperament
temperature levels
time at the feedlot
time taken to load
tired
tonguing
urine
ventilation
vocalisations
water consumption
wear on hind limbs
weight loss

8.2 Appendix 2

Letter Sent to Participants

CENTRE FOR ANIMAL WELFARE AND ETHICS

THE UNIVERSITY OF QUEENSLAND
Centre for Animal Welfare and Ethics,
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Gatton QLD 4343, AUSTRALIA
Email: m.pines@uq.edu.au
Telephone: +61 7 5460 1387
Fax +617 5460 1444
www.uq.edu.au/cawe

DEAR INTERESTED PARTY IN LIVE EXPORT,

DEVELOPMENT OF WELFARE MEASURES FOR LIVE EXPORT

The Meat and Livestock Australia (MLA) and LiveCorp have commissioned the University of Queensland, Centre for Animal Welfare and Ethics, to develop a detailed welfare assessment system for measuring the welfare of cattle and sheep during the preparation and transportation stages of a voyage.

We have developed a computer-based questionnaire designed to get information on the most appropriate welfare measures for exporting livestock. This questionnaire was developed with the involvement of representatives of different stakeholder groups linked to the livestock shipping industry (exporters, ship owners, producers, animal transport scientists, animal welfare representatives, veterinarians, stockmen, assembly depot operators and government regulators or administrators).

You have been carefully selected to respond to this questionnaire on behalf of your stakeholder group. The questionnaire takes approximately 45 minutes to complete.

Following our collection of data, all participants will be identified by number alone. You can receive the results of the study, if you wish, in a summary report that does not identify the individual participants. You are under no obligation to participate in this study and are free to approach me or any other member of the research team should you have any queries or concerns. The only risk we have identified, should you participate in this questionnaire, is that you may not wish to know the results. However, you may find this information useful. The data will not be used against you in any way, and the information returned to the MLA and LiveCorp will be in a generalised form that does not identify individual participants.

This study has been cleared by the human ethics committee of the University of Queensland in accordance with the National Health and Medical Research Council's guidelines. You are of course, free to discuss your participation in this study with project staff (contactable on 07 5460 1387). If you would like to speak to an officer of the University not involved in the study, you may contact the Ethics Officer on 07 3365 3924.

We hope you will agree to participate in the study, and if you do there is a consent form attached which I will be grateful if you could sign and return to me along with the completed questionnaire.

Kind regards,

Mat Pines

Before inserting the disk into the computer, please note that:

1. The software will only allow the questionnaire to be completed once.

2. Once started, the questionnaire cannot be stopped without risk of losing the results; i.e. the questionnaire needs to be completed in one sitting.

3. Allow yourself 45 minutes to complete the questionnaire.

4. Your thoughts are very important to us and to the livestock exporting industry, please consider each question carefully before answering.

5. The software only works on PCs. It does not work on Macintosh computers.

6. To start the questionnaire, insert the disk into the computer. Using the mouse, double click on the “My Computer” icon, and then double click on the “3½ Drive (A:)” icon. Finally, double click the “WinQue” icon to start the questionnaire. Note that there may be a delay while the program starts.

7. If you are having trouble loading the questionnaire onto the computer, or understanding what is required of you in the questionnaire, please phone Mat Pines (project Research Officer) on 07 5460 1387 for assistance.

8. Please place the completed questionnaire and consent form in the postage paid, addressed envelope provided and mail it to us ASAP.

8.3 Appendix 3

Participant Consent Form

I have read the above details of the project **Development of welfare measures for live export** and consent to participating in the study. I understand that I can withdraw from the study at any time without penalty and that the data provided is in full confidence. There will be no payment for participation in this study.

Signed_____ Please print full name in capitals_____

Date

Witnessed_____ Please print full name in capitals_____

Date_____

Please indicate, by ticking the relevant box, whether you would like to receive a summary report on the results of this study:

I do not wish to receive a copy of the summary report ☐

I do wish to receive a copy of the summary report ☐

(Please tick the relevant box)