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Animals Australia submission to the Heat Stress Risk Assessment (Issues Paper September 2018) by the Department of Agriculture and Water Resources (DAWR)

Animals Australia appreciates the opportunity to provide input in response to this Issues Paper regarding the appropriateness of the current heat stress risk assessment tools and arrangements for the live export of animals from Australia.

As you will be aware, Animals Australia is a peak animal protection organisation in Australia. We have been involved in animal welfare issues relevant to Australia's live export industry for over 30 years, and we are recognised as a key stakeholder in matters relating to animal welfare issues in the live export trade.

Animals Australia has also monitored, investigated, and scrutinised the live animal export trade for more than 30 years. Along with every animal protection society the world over, we advocate that all animals should be slaughtered as close as possible to their farm of origin, in order to avoid the unnecessary and immense suffering that is caused by additional transport and handling. This is particularly pertinent in the live animal export trade, where our evidence has consistently shown that animals are routinely subjected to unskilled and cruel handling methods, as well as long-haul transport in perilous conditions which results in suffering and often ends with inhumane slaughter practices.

Relevant to the Issues Paper, it is evident through almost 40 years of annual mortality statistics, the regulator's investigation reports of high mortality air and sea shipments, onboard veterinarians' reports, and more recently through the video documenting of appalling conditions onboard the MV *Awassi Express*, that heat stress causes dire welfare and life threatening impacts on animals being exported. Heat stress issues are not confined only to sheep travelling to the Middle East from May to October, but rather it affects the welfare of *all* live exported animals travelling from Australia across the equator at *any* time of the year.

Heat stress is only one of the many risks to animal welfare in this trade, and **Animals Australia therefore opposes live export outright**, and continues to advocate for a total ban on live animal exports. However, until such time as a ban is in place, we continue to engage in review processes which may mitigate some animal suffering. It is in this context only that the following input is provided.

The following comments are under the headings and in the order of the sections of the Issues Paper.

1 Introduction

The Introduction states:

Factors such as impacts on trading partners, broader implications for the trade and the farm gate price for Australian sheep were not taken into account in developing the findings and recommendations of the McCarthy review.

If this statement implies such factors are being considered by the Department of Agriculture and Water Resources (DAWR) during this consultation (though it is not again mentioned), we request leave to table two economic reports relevant to live sheep exports from Western Australia and South Australia, undertaken by consultants Pegasus Economics for Animals Australia earlier this year.

In terms of ‘impacts on trading partners’ it is important to understand that the major importing companies – Kuwait Livestock and Trading (KLTT) in Kuwait, and Hijazi and Gosheh (H&G) in Jordan, are also significant importers of Australian sheep meat.

KLTT imports both live sheep and carcasses from Australia. Since 2010 the number of sheep shipped to Kuwait has halved whilst there has been an 80% increase in sheep meat imports from Australia – Kuwait also imports meat from New Zealand and other countries. As shown by meat import statistics, Kuwait’s meat requirements can be met via chilled and frozen imports. Almost half of meat requirements are already being imported in carcass form.

KLTT and H&G are sophisticated, vertically integrated, multinational corporations that financially benefit from the value-adding associated with processing live Australian sheep through their own facilities in the Middle East. Both companies posted multimillion dollar profits in 2017, own and operate their own fleet of ships, and are in a financial position to implement and sustain significant reductions in stocking densities on ships while still retaining profitable businesses.

Any improvements implemented in shipping conditions will not impact on trading partners. They will retain the ability to access Australian live sheep plus the alternative that is increasingly becoming the preferred product – boxed meat, and air-freighted, chilled and bagged lamb.

1.2 Make a submission

The following are general responses to the points on page 6 of the Issues Paper, which indicate the areas for which feedback is particularly sought.

a. Collect evidence and factual data

Whilst existing shipboard mortality statistics have been reported for decades, rarely has that data been adequately analysed or considered in order to assess the true welfare cost to animals transported north during the Middle Eastern (ME) summer. Animals Australia has this year looked more closely at the publicly available data which, along with published industry and independent scientific research, and several decades worth of reports, shows conclusively that on-ship sheep mortalities are significantly higher (up to double) during the May to October period each year

compared to the other 6 months of the year. Mortality counts (as discussed later in this submission) are, 'at best', a blunt indicator of risk to the welfare of all other animals, but at this time we have little else.

At **Appendix A** we provide a table which is collated from DAWR records (from Masters' reports).¹ This table shows the monthly death figures/percentages of sheep exported to the Persian Gulf (from 2005 – 2017). It clearly shows the overall death rate escalating in May and reducing only after October. Similar figures, with the same pattern, are available for the Red Sea ports.

The graph provided at **Appendix B** is also collated from DAWR records (from Masters' reports),² and shows how many sheep shipments per month have exceeded 1,000 reported sheep deaths (most of which were **under** the then 2% reportable level, and so not further investigated). This graph again illustrates that high-risk shipments commence in May, and only begin to significantly reduce in November.

At **Appendix C** we provide a graph that was originally included with the National Annual 'Performance' Report compiled for MLA.³ The graph shows that a similar – almost doubling – rate of mortality on ships during those Middle Eastern summer months in 1985 to 1990 is evident; and that this pattern has not altered over time.

Ambient wet bulb temperature (**WBT**) graphs have also been provided in industry-funded research during the development of the Heat Stress Risk Assessment (**HSRA**) software, 'HotStuff'.⁴ As seen at **Appendix D**, the 50% mark (i.e. expected half the time) for WBT is close to 25 WBT degrees, rising to 28 WBT, for most ports from May to October.

Industry research has also indicated that 26 WBT degrees and over is a 'caution' zone for heat stress, and 29 WBT and over is the 'danger' zone⁵ (and Barnes et al indicates for wethers that the danger zone commences at 28 WBT degrees⁶). This is particularly concerning when it is known that **these figures (at Appendix D) are ambient temperatures**, and the livestock deck temperatures are known to be up to 6 WBT degrees higher than the ambient temperatures (between the inlet air, and outlet air from the vessel, i.e. heated from the livestock deck).⁷ As such, only a few degrees increment pushes the temperature on the livestock decks into the danger zone for sheep throughout those 6 months each year.

It is therefore clear the full period of May to October is a 'high risk period'. Animals Australia supports the clear position of the Australian Veterinary Association (AVA), which, based on substantive science and historic data, provided in its submission to the McCarthy Review that:

¹ DAWR, *Reports to Parliament*, <<http://www.agriculture.gov.au/export/controlled-goods/live-animals/live-animal-export-statistics/reports-to-parliament>>

² *ibid.*

³ Department of Agriculture and Food, Western Australia, *National Livestock Export Industry Sheep, Cattle and Goat Transport Performance Report*, Project Code W.LIV.0291 (2016), <<https://www.mla.com.au/download/finalreports?itemId=3328>>

⁴ Eustance, C. & Corry, S., *Revision of the Heat Stress Risk Assessment Methodology to Properly Incorporate Risk of Heat Stress While at Port* (Meat and Livestock Australia) Project Code B.LIV.0249 (2009) <<https://www.mla.com.au/download/finalreports?itemId=279>>.

⁵ MAMIC Pty Ltd, *Investigation of the Ventilation Efficacy on Livestock Vessels* (Meat and Livestock Australia) Project Number SBMR.002 (2001) <<http://www.livecorp.com.au/research-development/reports/investigation-of-the-ventilation-efficacy-on-lives>>

⁶ Stockman, C., Barnes, A., Beatty, D., Maloney, S., & Taplin, S., *Electrolyte Supplementation of Export Cattle, and Further Investigations in the Heat Stress Threshold of Sheep and Dairy Cattle* (Meat and Livestock Australia) Project Code LIVE.224 (2008) <<http://www.livecorp.com.au/LC/files/fe/fe617365-311d-466a-bd7a-e91ad228a78e.pdf>>

⁷ *ibid.*

*Irrespective of stocking density, thermoregulatory physiology indicates that sheep on live export voyages to the Middle East during May to October will remain susceptible to heat stress and die due to the expected extreme climatic conditions during this time. Accordingly, **voyages carrying live sheep to the Middle East during May to October cannot be recommended.***

b. Clarify possible impacts of implementing the McCarthy review recommendations related to HSRA

Our view is that this alternate question must instead be asked i.e. ‘What are the impacts of not implementing the McCarthy review recommendations?’ This is particularly pertinent in regard to the crucial move to measuring and using animal welfare indicators (rather than mortality) to reduce the risk of heat-stress suffering.

The clear answer to that alternate question is that more sheep will continue to be subjected to voyages on ships during parts of the year when temperatures and humidity exceed the sheep’s heat stress threshold, and they will suffer. This scenario (i.e. the status quo) is not in line with Australian community standards. A succession of national polls have consistently shown the overwhelmingly majority of Australians are concerned about the treatment of farmed animals and, in particular, want to see an end to the live export trade. An RSPCA-commissioned national poll of 1,500 people in 2018 found 3 in 4 Australians want an end to live export. Another national survey, commissioned by Animals Australia in 2018, revealed 89% of the 1,470 respondents supported sheep producers being assisted to transition away from live sheep exports.

Nor would a status quo position meet international standards. For example, the OIE Standards – which are referred to and purportedly implemented in ASEL – state that the space allowance on a sea vessel ‘should allow the necessary thermoregulation’ for each animal.⁸ Neither the current, nor recently adjusted, ASEL space allowances can provide this.

Further, the relevant OIE section states:

Article 7.2.5(2)(c): *Extreme weather conditions are hazards for animals undergoing transport and require appropriate vessel design to minimise risks. Special precautions should be taken for animals that have not been acclimatised or which are unsuited to either hot or cold conditions. In some extreme conditions of heat or cold, **animals should not be transported at all***^{9,10}

c. Successful livestock health and welfare initiatives relevant to HSRA for sheep

Unless refrigerated air conditioning can be developed, installed, and adequately deal with ventilation and temperature control in all parts of livestock vessels, then heat stress will not be avoided when travelling in equatorial waters or into the areas in the north, such as China and the Middle East. Ventilation alone cannot provide WBT at a level sufficient to enable adequate thermoregulation when sea temperatures, and ambient temperature and humidity, reach the tipping point. Such temperatures (from WBT 26 and above for some animals) are expected and

⁸ OIE, *Transport of Animals by Sea*, chapter 7.2, Article 7.2.5, 7(b).

<http://www.oie.int/fileadmin/Home/eng/Health_standards/tahc/current/chapitre_aw_sea_transpt.pdf>

⁹ *ibid*

¹⁰ Emphasis added.

will occur during the northern summer. The stocking density of a ship becomes irrelevant the instant dangerous temperature and humidity levels occur without relief.

d. Scientific papers describing relevant research findings

There are a large number of independent, peer-reviewed and published scientific papers (in addition to the MLA/Livecorp-funded paper) on heat stress related issues – listed at Appendix B of the Issues Paper. We are assuming those other important, independent papers are also available and known to DAWR; to rely only on industry-funded research would be unacceptable.

It is disturbing that this listed industry research (and its findings) over almost 20 years has not significantly altered the HSRA regime or shipping standards; heat stress continues to contribute to great suffering and higher mortalities every northern summer, and appalling ‘reportable’ mortality incidents still occur.

Concerns, criticisms and recommendations even within industry-funded research have been largely ignored, or any necessary action delayed. A major review of the HSRA software ‘HotStuff’ in 2008 (Ferguson et al¹¹) concluded that the scientific basis for the core elements were sound, but went on immediately to state that:

‘...rigorous monitoring of performance [of HotStuff was] the key recommendation of the panel. Specifically, the need for validation of existing assumptions and monitoring of the model’s predictions against actual aggregated voyage data is required.’

It was then in 2013, five years after that report, and 10 years after HSRA and ASEL were introduced, that a further a MLA report by Shiell et al¹² (to contribute to the first ASEL review) reported little progress. The following extracts relate directly to the HSRA:

“The fact that heat stress deaths are continuing to occur at levels that trigger mortality investigations suggests that there is scope for improving the way that export is managed to ensure that heat stress risk is maintained at lower levels....

There is ample scientific evidence to document the increased mortality risk for sheep exported from southern Australia in the period from May to October, and the association between this time period and the two major causes of death in export sheep, namely enteritis and heat stress. ...

The concept of additional risk management for sheep exported from Australia during the period from May to October therefore is warranted.”

It is misleading that this Issues Paper only ‘uses’ the Ferguson et al 2008 review (at page 14) to imply the HSRA model was judged sound. Research or data alone remain hypothetical and irrelevant unless decisions are made to **apply** outcomes of research to shipping standards to reduce heat stress and deaths. The failure to ‘validate’ assumptions, and to independently

¹¹ Ferguson, D., Fisher, A., White, B., Casey, R., & Mayer, B, *Review of the Livestock Export Heat Stress Risk Assessment Model (HotStuff)* (W.LIV.0262–0265). Prepared by CSIRO for MLA/LiveCorp. (2008) <<http://www.livecorp.com.au/LC/files/a3/a3a29b97-183c-4aad-8b6c-c90fb526dd06.pdf>>

¹² Shiell, K., Perkins, N., & Hewitt, L., *Export of Sheep from Southern Ports to the Middle East in Winter Months* (Meat and Livestock Australia) Project Code W.LIV.0284 110. (2013) <<https://www.livecorp.com.au/LC/files/fb/fb757bce-6bb7-42e0-bb7a-b7df3709bbd9.pdf>>

interrogate the calibrations of HotStuff over the past 15 years, is likely the cause of its failure to adequately reduce mortalities caused by heat stress. The industry, complicit and controlling of the research undertaken, and its application, has failed to meet community expectations in regard to onboard conditions.

There has been little ability for public or community scrutiny or input to the decisions around 'HotStuff', and until the MV *Awassi Express* footage, the community was also shielded from a full understanding of the suffering of animals involved with heat stress on ships. The reporting of 'mortality data' without welfare indicators, resulting in the 'normalisation' of deaths at sea, has occurred over the past decades. Notable is the change in the annual reporting (compiled for MLA/Livecorp by WA Agriculture) of industry mortality statistics in reports. In the 1990s and 2000s this reporting appeared under the title '*National livestock export mortality summary*' – and are now entitled '*National livestock export industry sheep, cattle and goat transport performance report*'. As there has been no material difference to the type of data reported in these documents (they are entirely focussed on mortality figures still), it is reasonable to assume this change is a deliberate public relations strategy.

Similarly, in regard to 'spin', Agriculture Ministers and industry often speak of the number of animals (i.e. over 99%) which survive the voyage – and even purport that all those unloaded are healthy and well¹³. This is unfounded, particularly as it is well known that deaths in ME feedlots occur at a relatively high rate in the week after arrival.¹⁴

The failure of independent input to the systems meant to mitigate heat stress in live exported animals is most evident in the 2003 industry 'decision' to determine ME summer shipping stocking density using HotStuff (software), calibrated only to predict (and perhaps avoid) a 2% chance of a 5% **mortality** from heat stress. That decision had no community, broader stakeholder, independent scientific or veterinary scrutiny, and took no account of the fact that heat stress (even severe but recoverable) could be suffered by all sheep on all voyages as long as only one shipment in 50 reached the industry-determined 5% death rate. Whilst stocking density is still only one exacerbating factor of shipment heat stress – it cannot prevent heat stress. This 'closed shop' industry decision – and HotStuff itself – has fashioned a contemptible public façade implying that animal welfare was not only being considered but also actively protected.

Animals Australia and other organisations (including the RSPCA Australia and the AVA) have provided comprehensive referencing and listings of relevant papers in recent submissions to the McCarthy Review and the ASEL Review, which are available to DAWR and known to the members of the 'panel'. We do not repeat them all here.

e. Details of perceived barriers and challenges to achieving effective HSRA during the export of sheep by sea

As the quote (see page 3) from the AVA's submission to the McCarthy Review indicates, the extreme climatic events in the northern hemisphere during the ME regions summer months are ever present, and it is simply not possible to achieve 'effective HSRA' for our animals during that

¹³ Gredley, R. *Most sheep fine after live export: Joyce*, Western Advocate (15/10/2018)

<<https://www.westernadvocate.com.au/story/5702325/most-sheep-fine-after-live-export-joyce/?cs=9397>> See, for example, former Minister for Agriculture Barnaby Joyce statements this week: "Ninety-nine-point-seven cent of sheep that go to live export go off the ship in a better or same condition,' Mr Joyce told the lower house."

¹⁴ Scharp, DW., 'Performance of Australian wethers in Arabian Gulf Feedlots after transport by sea', 69(2) *Australian Veterinary Journal* 42. (1992) <<https://onlinelibrary.wiley.com/toc/17510813/69/2>>

time. Live animals simply should not be sent by ship from our winter to the northern summer as their welfare will inevitably be impaired (in other words, they will suffer), even if most survive the journey. This is not an ‘opinion’, this is a geographical, climatic and animal physiological reality.

In addition to the historical climatic knowledge, it should be noted that, due to climate change, daily maximum temperatures in the Arabian Gulf appear to be increasing during the summer at a faster rate even than those in the winter months. The number of heatwave days will increase, and the exacerbating factor of increased minimum night-time temperatures will reduce the ability of animals to shed core body temperature, which is already a key risk factor in the region.¹⁵

The remainder of this submission (for convenience) is set out providing comments or information on the issues paper discussions in each section (3-5) and then comments on the ‘Questions’ posed in the Issues Paper (where still relevant).

3 HSRA Model: Mortality limit and heat stress threshold

Comment on Table 1 (3.1), page 14

It is notable and concerning that the Maunsell 2003 (LIVE.116) heat stress threshold WBT figures are still being used in the HSRA/HotStuff model today. Considerable published research since that time is available to refine those figures.

Comment on Ferguson et al (2008) (3.1), page 14

As indicated above, this review indicated a direct need to further monitor and assess the performance of the HSRA software against actual data (mortality). The paragraph on this on this page is misleading as it will leave a reader with the impression the *Ferguson et al* review simply gave HotStuff a tick.

Q. How should the effects of heat load on animals be defined?

Animals Australia is supportive of the many studies which indicate that adverse welfare impact commences when an animal’s core body temperature reaches 0.5°C above normal. The Veterinary Handbook produced by Meat & Livestock Australia defines heat stress as:

“a state where animals are responding to excessive heat load (EHL). Normal function of various tissues and organs within the body require that body temperature be maintained within a relatively narrow range. If body temperature is raised beyond the level that animals can tolerate then there is a risk of organ dysfunction, and even death.”¹⁶

Extensive literature supports the conclusion that the health, welfare, and physical needs of sheep will not be met if the sheep suffers from heat stress, even if that heat stress does not result in death. Initial physiological responses of heightened heat load leading to heat stress include vasodilation of skin blood vessels, and vasoconstriction of vessels supplying internal organs (i.e.,

¹⁵ Lelieveld J., Hadjinicolaou P., Kostopoulou E., Giannakopoulos C., Pozzer A., Tanarhte M., & Tyrllis E. *Model projected heat extremes and air pollution in the eastern Mediterranean and Middle East in the twenty-first century.* Regional Environmental Change 14, 1937–1949.

¹⁶ Jubb, T., Perkins, N. & Mellor, T., *Veterinary Handbook for Cattle, Sheep and Goats* (Meat and Livestock Australia and Live Export Corporation, 1.0 ed, 2018) <<http://www.veterinaryhandbook.com.au/>>.

redirection of blood away from internal organs to the skin).¹⁷ There will be increased sweating, and therefore increased electrolyte loss with sweat.¹⁸

The water intake of heat-stressed animals correspondingly increases, at least in sheep who can access water.¹⁹ This causes increased urination, which (together with humidity) causes the faecal pad in on board pens to become sloppy or boggy.²⁰ Ammonia content of the air increases in hot and humid conditions, strongly irritating mucosal tissue (eyes, respiratory tract, etc).²¹ Sheep will stand or lie in the sloppy or boggy faecal pad and become coated in faeces, further limiting thermoregulation. These hot and humid conditions also correlate with increased prevalence of inanition and enteritis.

Q. How would you detect heat load in the animal?

Animals Australia supports the McCarthy Review approach using a ‘Panting Score’ as it is consistently observable. However, we do not accept that a sheep’s respiratory rate (RR – breaths per minute) of 80-100 can be described as ‘normal’. As soon as a higher than usual or increased respiratory rate is observed (Heat Stress Score 1 in Table 2), it should be described as such: Elevated RR.

Q. What level of heat load is tolerable/acceptable?

Whilst not endorsing any level of extra heat load caused by the practice of long distance live export (as it is unnecessary), it is our strong view that once sheep enter the panting stage (Heat Stress Score 2), with a rapid RR up to 160, they are clearly entering the danger zone and are at least in the ‘discomfort’ zone and likely suffering stress. This should be avoided and is not considered acceptable.

Q. Are the model standard Merino estimates for heat stress threshold (30.6°C WBT) and mortality limit (35.5°C WBT) appropriate/accurate or are there other estimates, supported by the available science that should be considered?

It has been difficult to find a scientific source for the 30.6 WBT threshold for heat stress, likewise the mortality limit. No original source was cited for those figures, and they are not supported by research conducted by the live export industry. MAMIC Pty Ltd gives, instead, these figures:²²

Wet Bulb Temperature Risk Range		
Safe	Caution	Danger
< 26° C	26–29° C	> 29° C

¹⁷ Stockman, C., et al, *Physiology of heat stress in cattle and sheep (Meat and Livestock Australia & Livecorp) Project Number LIVE.0209* (2004), at 6.

¹⁸ Barnes et al (2004), at 6.

¹⁹ Barnes et al (2004), at 3.

²⁰ See, e.g., Pines, M., & Phillips, C., “Accumulation of ammonia and other potentially noxious gases on live export shipments from Australia to the Middle East” (2011) 13 *Journal of Environmental Monitoring* 2798.

²¹ MAMIC Pty Ltd, *Investigation of the Ventilation Efficacy on Livestock on Livestock Vessels* (Meat and Livestock Australia) Project Number SBMR.002 (2001), page 9; see also Phillips, C., & Santurtun, E., “The welfare of livestock transported by ship” (2013) *The Veterinary Journal* 309 at 312, Phillips, C., et al, “Physiological and behavioural responses of sheep to gaseous ammonia” (2014) 90(5) *Journal of Animal Science* 1562.

²² MAMIC Pty Ltd (2001), p 25.

Moreover, DAWR reports support the view that mortality occurs at a level far below 35.5°C WBT. For example, an AQIS report into a high-mortality voyage in June and July 2011 recorded that, “[h]igh temperatures and humidity experienced in the Arabian Gulf contributed to the mortality rate exceeding the reportable level,”²³ and that there were 743 mortalities (a rate of 2.46 per cent)²⁴. This was despite the WBT never exceeding the “mortality limit” of 35.5°C.²⁵

Similarly, an AQIS report into a high-mortality voyage in August 2010 recorded that, “[t]he main cause of mortality in the sheep was heat stress due to high temperatures and humidity experienced in the Persian Gulf,”²⁶ and that there were 1,407 mortalities (a rate of 2.04 per cent),²⁷ despite WBT never exceeding the “mortality limit” of 35.5°C.²⁸ Indeed, although 35.5°C was never exceeded, “[t]he veterinarian also reported that the entire consignment experienced ‘severe heat stress’ ... which resulted in very high sheep mortalities.”²⁹

A range of WBT for heat stress in an analysis by Stockman et al (2011) found that increases in core temperature commenced at well below 30°C WBT – closer to 23–25°C.³⁰ So, too, does the *Veterinary Handbook* describe temperatures “approaching or exceeding 30°C” as favouring the development of heat stress.³¹ This is supported by other research, including that commissioned by the live export industry.³²

It is also supported by the daily veterinary reports and recordings as to temperatures encountered on the MV *Awassi Express* on four voyages in 2017 (May-Oct) – see **Appendix E** – and the reported respiratory rate of the sheep and death rates (already available to DAWR).

Q. Are there other physiological indicators linked to effects of excessive heat on sheep that could be measured and considered for inclusion in the HSRA model?

The responses above will largely indicate the physiological indicators that are measurable – i.e. the panting score inclusion on the daily veterinary reports.

However, further key data should be collected on the health and welfare of sheep in importing country feedlots in the weeks after arrival. Independent skilled observations and reporting should be instigated to record illness, feeding and drinking behaviour, heat stress indicators and mortality rates (and cause). Such information will give a more accurate indication of the lasting effects of heat stress on arriving sheep. This data should be provided to the regulator, and considered in addition to the (upgraded and recalibrated) HotStuff software.

²³ AQIS Investigation Report 40, “Investigation into the reportable sheep mortality level on a sea voyage from Portland, Victoria to Qatar, Kuwait and Bahrain in June and July 2011” (2011), p 1.

²⁴ *ibid*, p 2.

²⁵ *ibid*, (2011), p 3 Figure 1. Comparison of Figure 1 with the table on Page 2 of the Report suggests that, while substantial mortalities were occurring between around days 12 and 18, the WBT on various decks varied between around 26 and 28 or 29° C.

²⁶ AQIS Investigation Report 38, “Investigation into the reportable sheep mortality level on a sea voyage from Fremantle, Western Australia to Bahrain, Kuwait and the United Arab Emirates (UAE), August 2010” (2010), page 1.

²⁷ *ibid*, p 2.

²⁸ *ibid*, p 4, Figure 1.

²⁹ *ibid*, p 5. Comparison of the table on page 2 with Figure 1 shows that the highest mortality occurred between around days 14 and 21, during which times the WBT on various decks varied between around 27 and 34° C (one deck on one day appeared to touch 35°C WBT).

³⁰ Stockman et al (2011) p 136 Figure 1, 139 Figure 3.

³¹ Jubb et al, “Heat Stress” in *Veterinary Handbook*, see also Phillips (2016), p 81.

³² See A Barnes, D Beatty, C Stockman, S Maloney, R Taplin, *Electrolyte Supplementation of Export Cattle, and Further Investigations in the Heat Stress Threshold of Sheep and Dairy Cattle* (Meat and Livestock Australia) Project Code LIVE.224 (2008), p 2–3; Maunsell Australia Pty Ltd, *Development of a Heat Stress Risk Management Model* (Meat and Livestock Australia) Project Code LIVE.116 (2003), p 79.

4.1 Stocking densities – McCarthy review recommendation 4

Animals Australia supports this recommendation (4) by McCarthy, and we consider it unacceptable that it was not adopted for the 2018 northern summer. The only reason sheep were spared the suffering caused by heat stress (and likely high death rates) these past months was due to the virtual suspension of shipments after Animals Australia's legal challenges, subsequent regulatory steps, and commercial decisions due to enforced lower stocking densities.

To significantly reduce the suffering caused by heat stress, the HSRA model must be recalibrated as McCarthy has recommended.

Note: *the Stacey Agnew paper entitled 'Effect of livestock heat stress risk standard on stocking density for sheep on live export vessels' (work commissioned by MLA/Livecorp) does not appear to have been published, and therefore the information in this section cannot be adequately evaluated.*

As has been acknowledged in the Issues Paper (Stage 2) accompanying the current ASEL review,³³ mortality rates are a blunt and thus inadequate measure of animal welfare. The obvious deficiency inherent in a focus on mortality rates is that it would be *prima facie* acceptable for all animals to suffer on a live export voyage, so long as the number of actual mortalities does not exceed the reportable limits (2%, now 1%). Similarly HotStuff's focus on mortality (i.e. the 2% risk of a 5% mortality event) essentially **approves** of animal suffering save that only 1 in 50 shipments should not exceed that mortality rate. Such arbitrary measures are out of step with community expectations.

The McCarthy Review rightly provided therefore that the industry should focus not on mortalities, but on 'measures that reflect the welfare of the animal'.³⁴ The Secretary of DAWR, Daryl Quinlivan, has also acknowledged that 'mortality outcomes are not a sufficient measure of the performance of the trade and certainly not of the welfare of the animals involved'.³⁵

We again note that stocking density reductions *alone* cannot provide a panacea on sheep shipments headed into the northern summer (as the AVA has concluded). However, high stocking density presents the dual problem of a greater number of sheep in a pen/on a deck contributing a higher metabolic heating mass and, simultaneously, presenting a block to ventilation and air movement systems³⁶. Similarly, the earlier work of Barnes (2004)³⁷ indicates concern in regard to the effect of stocking density in hot conditions:

Thus, environmental conditions on the ships can be more extreme for the animals, which have little opportunity to escape the conditions. Depending on the stocking density, there may be limited scope for behavioural modifications to decrease heat gain or improve heat loss.

³³ Technical Advisory Committee, *Stage 2: Issues Paper* (August 2018) p 12.

³⁴ McCarthy, Dr M, *Review of conditions for the export of sheep to the Middle East during the northern summer*, (2018). <<http://www.agriculture.gov.au/SiteCollectionDocuments/biosecurity/export/live-animals/mccarthy-report.pdf>>

³⁵ See, for example, Hansard Senate Estimates of 24/5/18 of the Senate Committee on Rural and Regional Affairs and Transport Legislation Committee, p 123. <http://parlinfo.aph.gov.au/parlInfo/download/committees/estimate/379a774f-da23-45c2-8021-4d0c29a583cf/toc_pdf/Rural%20and%20Regional%20Affairs%20and%20Transport%20Legislation%20Committee_2018_05_24_613_1_Official.pdf;fileType=application%2Fpdf#search=%22committees/estimate/379a774f-da23-45c2-8021-4d0c29a583cf/0000%22>

³⁶ Shiell, K., Perkins, N., & Hewitt, L., *Export of Sheep from Southern Ports to the Middle East in Winter Months* (Meat and Livestock Australia) Project Code W.LIV.0284 (2013).

³⁷ Barnes A., et al, *Physiology of Heat Stress in Cattle and Sheep* (Meat and Livestock Australia & Livecorp) Project Number LIVE.0209 (2004).

A further compounding factor is that higher stocking density also means a faster build-up of the faecal pad on sheep shipments. As sheep faeces are not removed during voyages, if high WBT is experienced, the subsequent greater water intake and urination will also further contribute to the moisture of the pad. Unless ventilation/airflow can dry the pad, a deepening boggy, sloppy pad will develop. This can further exacerbate heat stress and sheep health issues through heat generated by the pad itself, through ammonia and other toxic gases, and sheep will also become coated with faeces – further preventing thermoregulation.

Q. How should the probability settings used in the HSRA model be determined?

As indicated in the McCarthy Recommendation 4 – i.e. a 2% probability of 5% of the sheep on a shipment becoming affected by Heat Stress Score 3 (onset of heat stress/open mouth panting). As indicated above, whilst even this level of suffering is unnecessary and thus not endorsed by Animals Australia, it should be in place as a minimum during a phase-out period, prior to complete cessation of this trade.

As the primary outcome of the HSRA modelling is stocking density adjustments, a tighter risk calibration (McCarthy Recommendation 4) will likely reduce the exacerbating factors of high stocking densities discussed above, and thus reduce heat stress and suffering.

Q. How might the change from mortality to heat load be incorporated in the mathematical model?

The technical details of HotStuff are not publicly available (nor the Agnew Stacey paper quoted in this section), and so we can make no detailed technical assessment. Regardless, Figure 2 (page 17) indicates the clear significant stocking reduction required when the animal criterion is reduced from the mortality limit ‘25% of the way to the heat stress threshold’. We support this approach as it clearly reflects the relative climatic extremes of the June to September highest heat months, and thus would surely reduce suffering and deaths.

Q. What other probability settings might be considered for inclusion in the HSRA model and on what basis?

Shipboard factors should be further enhanced in the HSRA model. Incremental changes flagged to be addressed in the *Australian Maritime Safety Act, Marine Orders 43*, i.e. the phase out of ships or shipboard facilities which carry livestock on more than one tier; mechanical ventilation on open decks; and air distribution requirements across enclosed livestock pens, must be urgently incorporated. These important changes have (through political design, not scientific evidence) been delayed until 2020 – any further delay when these factors are known to affect animal welfare is unacceptable. Ships that still fail to adopt these changes must not be permitted to take sheep during the northern summer.

Furthermore, currently the heat stress assessment has been applied only to the Persian Gulf and Red Sea destinations (during May-October). However, recently there have been two high-mortality cattle voyages to China that have been the result of heat stress. The first was on a voyage from Fremantle to China in late May this year, where 46 cattle died (1.45%) from Bovine Respiratory Disease and heat stress on the 17-day voyage. Immediately after that unacceptable shipment outcome a further high mortality 'event' with 33 cattle deaths was encountered on the next voyage by that exporter, ship and destination – despite additional processes put in place for the voyage.³⁸

ASEL and the HSRA must be amended to also include cattle shipments from southern Australian ports to China during the Australian winter (May-October).

4.2 Allometric stocking densities

The space provided to animals on-board is directly related to some key animal welfare outcomes, heat stress exacerbation being only one of those outcomes. In determining appropriate stocking densities, Animals Australia strongly supports the use of an allometric model, which enables proper consideration of the space required by each animal to ensure their most basic welfare needs are met.³⁹ This support for using an allometric stocking density model is irrespective of heat stress, and it must be deployed regardless of climatic conditions.

To enable adequate movement, rest, and other basic physical and social requirements, the appropriate applicable allometric k -value is **0.047**, unrelated to class, species or voyage length. This is the k -value that is required for all animals sharing a pen to be able to simultaneously rest in full recumbency, and to freely move through assembled others in order to reach food and water. The current k -value of 0.033, used during the 2018 northern summer, is insufficient, as it only permits animals to 'time share' adequate lying space, or else be forced to rest on their sternum.

Our position is also supported by the OIE animal welfare standards, which clearly state in the *Guidelines for the Transport of Animals by Sea* that 'when animals lie down, there should be enough space for **every** animal to adopt a normal lying posture'.⁴⁰ A k -value of 0.047 also minimises the possibility of disturbance to neighbouring animals and, at the same time, serving to increase the ease of each animal's free movement and their ability to access food and water troughs. Importantly, the ASEL Position Statement also *expressly* provides that the animal welfare standards 'developed in Australia take into account OIE animal welfare guidelines and in most instances exceed these'.⁴¹ Therefore, a k -value of *less* than 0.047 would be inconsistent with OIE standards, and contrary to the stated objectives of the ASEL.

According to scientific research by Petherick and Phillips (2009), a k -value of 0.033 is the threshold below which 'behaviour, productivity and some indicators of stress are adversely affected'.⁴²

³⁸ See the DAWR 'Secretary's actions statement', <<http://www.agriculture.gov.au/export/controlled-goods/live-animals/livestock/regulatory-framework/compliance-investigations/investigations-mortalities/actions-delegate-jantojune2018>>

³⁹ Petherick, C., & Phillips, C, 'Space allowances for confined livestock and their determination from allometric principles' 117 *Applied Animal Behaviour Science*, 1. (2009)

⁴⁰ OIE, chapter 7.2 (Transport of Animals by Sea), Article 7.2.5, 7(b).

⁴¹ DAFF, *Australian Position Statement for the Export of Livestock*, 4.2. (2011)

<<http://www.agriculture.gov.au/SiteCollectionDocuments/animal-plant/animal-welfare/standards/version2-3/australian-standards-v2.3.pdf>>

⁴² Petherick, C., & Phillips, C. (2009). 'Space allowances for confined livestock and their determination from allometric principles' 117 *Applied Animal Behaviour Science*, 1.

Animals Australia’s view therefore is that a *k*-value of 0.033 should be read as a bare *minimum*, and that a higher *k*-value is required to achieve acceptable onboard animal welfare outcomes – a position often promised by the live export industry, and a position expected by the Australian community.

Given that a *k*-value of 0.047 is required for *all* animals to simultaneously lie down, a lower *k*-value makes the problematic assumption that animals will comfortably ‘time share’ the available space for the purposes of resting, moving around and accessing food and water. Such an assumption is problematic when animals are exposed to the perils of live export. Relevant to this Issues Paper topic, northern summer weather conditions may result in animals becoming heat stressed and needing increased rest and space to ensure adequate thermoregulation. In addition, during adverse weather and rough seas – when balancing becomes difficult for animals whilst standing – it is critical that all animals can comfortably and safely lay down at the same time without disturbing, trampling or crushing others.

Q. How can allometric stocking densities most effectively be used?

ASEL must incorporate the allometric stocking densities requirement (*k*-value of 0.047) in its onboard requirements (Standard 5). The further considerations added in July 2018⁴³, being a curfew adjustment (12%) and including an additional weight consideration of 40 grams per voyage day weight gain, is also required to ensure sheep receive their full space allowance throughout the long journey.

Q. What *k*-value (constant) should be used in the allometric equation and what is the scientific basis for this choice?

As outlined above, Animals Australia supports the use of a *k* coefficient of 0.047, on the basis that this coefficient ensures the best possible animal welfare outcomes (given the limitations of the shipboard system), and complies with OIE animal welfare standards and ASEL objectives. Our strong view is that an allometric model (*k*-value of 0.047) for determining space allowances should be used for all voyages and for all species of exported animals.

5 HSRA Model – future versions

5.1 McCarthy review recommendation 5

It is unacceptable that this McCarthy recommendations in May 2018 to *immediately* upgrade the HSRA to Version 5 was not enacted. Those changes (in addition to the other recommendations in the McCarthy review) to HSRA 4 were to include the addition of new ports and routes and refinements to the crosswind parameters.

5.2 McCarthy review recommendation 7

The discussion in this section again highlights the high risk to animal welfare of heat load build-up during the northern summer, particularly related to the duration of exposure, and the failure of ventilation systems to relieve extreme – but regular and predictable – climatic conditions. As indicated in the text, Stockman et al (2011) found that repeated exposure would likely lead to

⁴³ See Export Advisory Notice 2018-06: *Legislation amendments for the export of sheep by sea (EAN 2018-6)*

more severe physiological conditions (failure to recover as well as previously). The nature of the ME environment, where there is little diurnal temperature/humidity relief, plays into the accumulation (failure to alleviate) heat load for sheep. As indicated above, this is set to become a more extreme problem due to climate change.

5.2.1 Prolonged High Heat Load Exposure and Destination Ports

Q. How might potential duration and repeated exposure to high heat loads be incorporated into the HSRA model?

Q. How might minimum daily temperatures be factored into the HSRA model?

Q. How might multiple discharge ports be taken into account when assessing heat stress risk?

Each of the issues raised in these 3 questions merely serve, in our view, to illustrate the multiple factors (known from research and data assessment) to contribute to heat stress risk, and the virtually insurmountable problem of how to address them to prevent heat stress. Even if each additional factor (duration of exposure, minimum temperatures and the risk posed by multiple port discharges and thus longer voyages) were able to be (technically) incorporated into HSRA 5 or future versions – shipments permitted to leave could still not be guaranteed to avoid heat stress unless (temperature controlled) air conditioning was installed on ships.

5.2.2 Vessel Configuration, and 5.2.3 Ventilation and air quality

As indicated above, unless refrigerated air conditioning is able to be provided on live animal ships, there can be no reasonable prospect of avoiding heat stress. Evidence suggests that the ventilation on board live export vessels is currently wholly inadequate, and is contributing to heat stress suffering and mortalities.⁴⁴

Ventilation outlets and fans are inadequate, and essentially result in little more than the movement of hot and humid air which provides no relief from the climatic extremities. High stocking densities also inhibits air flow on decks. If sheep were provided adequate room to lie down (by reducing stocking densities by 50%), ventilation and airflow would be improved.

However, the only way to adequately reduce temperatures on decks is to introduce a requirement for the use of refrigerated and dehumidifying air conditioning systems. In 1983, Temple Grandin reported on conditions on board Australian export vessels, and stated '*serious consideration should be given to using refrigeration equipment to control heat build-up*', particularly in the context of container ships and car carriers being converted into livestock carriers.⁴⁵

Given the fact the vessels travelling to the Middle Eastern ports encounter ambient WBTs which exceed those at which sheep begin to suffer and die (as discussed above), refrigerated air conditioning (in conjunction with a stocking density reduction of 50%) is essential. This is especially critical for those decks that sit below the waterline and which encounter even higher temperatures due to high sea temperatures in the equatorial and ME regions.

⁴⁴ Caulfield, M., et al, '*Heat stress: A major contributor to poor with long-haul live export voyages*' (2014) 199(2) *Veterinary Journal* 223, 224-225.

⁴⁵ Grandin, DR T., 'A survey of husbandry practices and facilities used in the export of Australian Livestock.' *Australian Bureau of Animal Health*, (1983). [Hardcopy available from Animals Australia].

Page 24 of the Issues Paper refers to the McCarthy recommendation that vessels be fitted with “automated continuous environmental monitoring equipment” (e.g. temperature and humidity loggers). It is quite surprising that this is not already in place, and instead little more information than a single (before noon) indication of WBT is currently recorded on the daily report to DAWR, which underlines the lack of urgency given to assessing and validating the performance of HSRA on shipments to date. The environmental monitoring recommended by Dr McCarthy should be instigated immediately on all livestock ships to assist to refine HotStuff (as also emphasised by Ferguson et al (2008)).

Q. What elements or factors contribute to good ventilation performance on a vessel?

The current HSRA focusses solely on pen air turnover (PAT scores) which can only measure the volume of air into and exiting the ship ventilation shafts (total air changes, volume an hour). However, what is of most/more importance to vulnerable livestock is that the (new) air mixes with the (stale) existing air in the pens, moves it across the pens and then out of the ship. Only this mixing and movement of the air mass can ensure the extraction from the animals’ immediate environment of excessive heat, humidity and ammonia/noxious gases with it. Therefore the existing MO43 requirement for newer ships (from 2004 vintage onward) of an air speed/velocity across the pens of at least 0.5 metres/second must be immediately extended to all ships, rather than the current regulations that indicate 1/1/2020 introduction.

Animals Australia understand there are some 7 livestock ships transporting Australian animals that were built or converted prior to 2004, which currently do not have to comply with this minimum air speed across pens. To allow those ships to transport livestock again in 2019 without this minimum air velocity will knowingly thwart the broad *purpose* of the MO43 Order for the ‘safe’ operation of the ships, and also ASEL (Standard 5), that the ‘*Onboard care and management of the livestock is adequate to maintain their health and welfare throughout the voyage*’.

As with the other grandfathering provisions for these old ships (under MO 43 of the Australian Maritime Safety Act) it is unacceptable for regulators to be fully aware of the clear need for improved ventilation on ships; to have data showing the greatly increased suffering and deaths from heat stress on live export vessels during the northern summer (exacerbated by poor ventilation); and to then still allow deficient vessels to depart with live animals during the northern summer periods.

Q. How might ventilation performance be incorporated into the HSRA model?

In addition to PAT, the minimum air speed across pens (i.e. at least 0.5 metres/second) must be an absolute requirement.

Q. How might we ensure ventilation design delivers efficiency/performance/output requirements?

Both PAT and air speed must be independently and expertly assessed/audited at least quarterly; when fully loaded with animals; *and* in varied locations and weather patterns.

5.2.4 Open Decks

Open decks must have mechanical ventilation to ensure compliance with minimum standards, as with enclosed decks, during voyages through varied weather conditions, wind directions and speeds.

Q. How should open decks be treated for the purposes of assessment in the model?

Whilst on-board studies regarding the effect of different deck conditions seem to be rare, we note an example of an AQIS high mortality voyage report (No. 33) of the *MV Al Shuwaikh* voyage to the Middle East in August 2009. This high mortality report stated that *'the veterinarian commented that the sheep most affected by the heat were those loaded in the centre rows of **the open decks and rams**'* [emphasis added].

Such an observation was not the first for the *MV Al Shuwaikh*. Another example is found in the AQIS high mortality voyage report (No. 17) of July to August 2007. A high number of deaths 'were mainly associated with hot humid conditions on the open decks in the sheep previously effected by enteritis'.

An AQIS high mortality voyage report (No. 16) of the *MV Maysora* in July 2007 experienced hot and humid weather in the Persian Gulf. An AQIS recommendation in that report was for voyages *'to the Middle East on open decks during May to October'* have *'mechanical pen air turnover [as] in the HSRA'* (being the Heat Stress Risk Assessment model).

Further, in report No. 19, being a different consignment of sheep on the same high mortality voyage as No. 16, it was stated in the recommendations that *'Industry considers the stocking density of sheep to the Middle East during May to October or other methodologies to manage the risk of heat stress **especially in open decks**'*. [emphasis added]

These examples indicates a long-standing knowledge and concern in regard to several of the old vessels' open deck facilities. Any delay now in requiring all vessels (regardless of age) to include mechanical ventilation on these open decks would be negligent, as it will contribute to greater suffering and deaths on future shipments.

Similarly to the grandfathering (exempting) of the older vessels from the requirement to immediately provide a minimum air speed across pens, the mechanical ventilation on open decks must be implemented immediately (not delayed until 2020). Efficient ventilation of all livestock pens is crucial all year round, but for animals on long haul voyages, and particularly during the northern summer, inefficient systems prove invariably deadly.

Thank you for the opportunity to provide input to this important review. Please contact me if you require any further information or clarification in relation to our submission.

Yours sincerely,

A handwritten signature in blue ink, appearing to read 'Glenys Oogjes', is displayed on a light beige background. The signature is fluid and cursive, with a long horizontal stroke extending to the right.

Glenys Oogjes
Chief Executive Officer

E: Googjes@AnimalsAustralia.org

Appendix A

Mortality records by month:

The following table is collated from DAWR records (from Masters' reports)⁴⁶, showing the monthly death figures/percentages of sheep to the **Persian Gulf** (from 2005-2017): It clearly shows the overall death rate **escalating in May, and reducing only after October**. Similar figures, with the same pattern, are available for the Red Sea ports.

Departure Date (Month)	Count of Departure Date	Sum of Sheep Load	Sum of Sheep Loss	% Mortality
Jan	20	1,387,323	11,269	0.81%
Feb	20	1,328,866	10,098	0.76%
Mar	18	1,513,746	9,026	0.60%
Apr	22	1,753,119	9,572	0.55%
May	15	1,129,375	10,233	0.91%
Jun	15	1,152,907	12,488	1.08%
Jul	18	1,175,237	13,328	1.13%
Aug	26	2,043,785	28,816	1.41%
Sep	15	1,289,667	12,923	1.00%
Oct	23	1,648,512	16,600	1.01%
Nov	25	1,787,220	15,293	0.86%
Dec	21	1,649,088	11,021	0.67%
Grand Total	238	17,858,845	160,667	0.90%

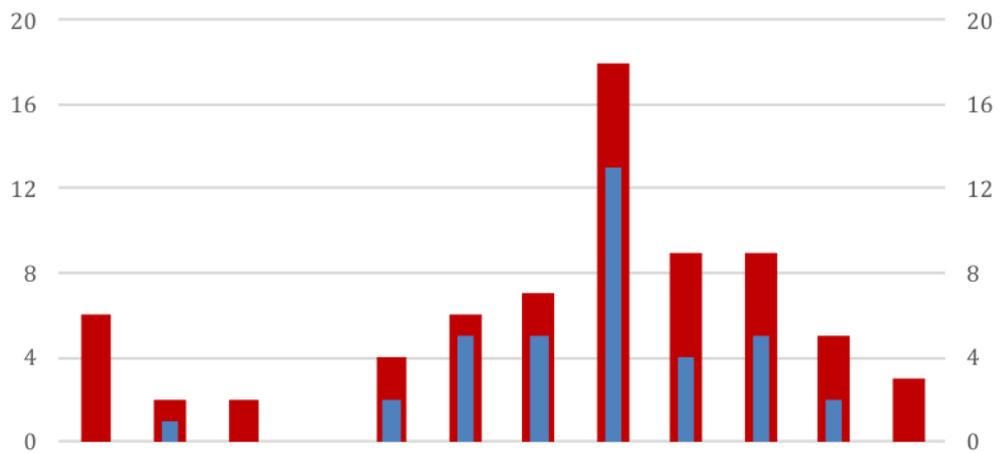
⁴⁶ DAWR, *Reports to Parliament*. <<http://www.agriculture.gov.au/export/controlled-goods/live-animals/live-animal-export-statistics/reports-to-parliament>>

Appendix B

Voyage mortality which exceeds 1,000 sheep deaths:

The following graph is also collated from DAWR records (from Masters' reports)⁴⁷ and shows how many sheep shipments per month have exceeded 1,000 reported sheep deaths (most of which were under the 2% reportable level). These high-risk shipments commence in May and only start to reduce significantly in November.

2005 - 2017



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
Emanuel/EMS/ILE: Mortalities >1000	0	1	0	0	2	5	5	13	4	5	2	0	37
All Exporters: Mortalities > 1000	6	2	2	0	4	6	7	18	9	9	5	3	71

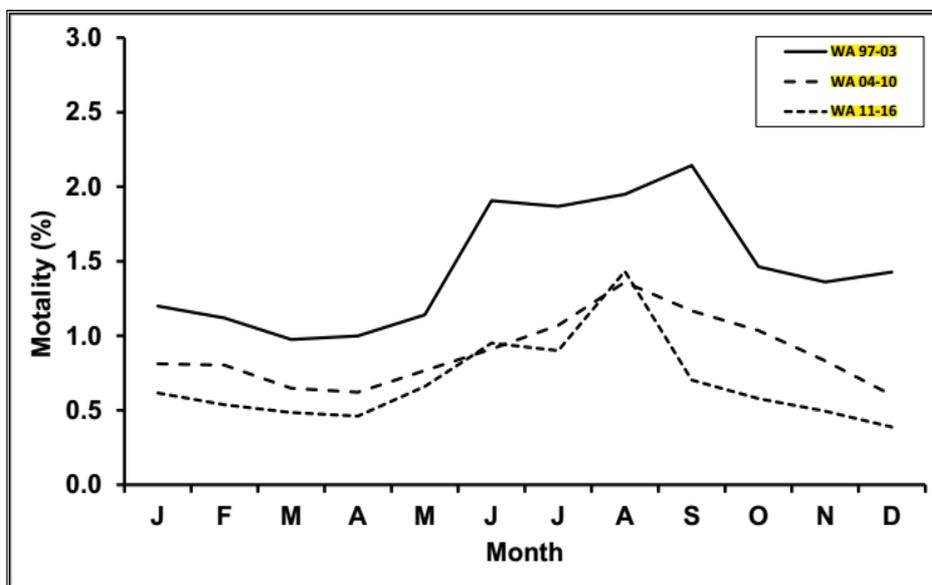
⁴⁷ DAWR, *Reports to Parliament*. <<http://www.agriculture.gov.au/export/controlled-goods/live-animals/live-animal-export-statistics/reports-to-parliament>>

Appendix C

Historically, a similar – almost doubling – of the mortality on ships in those ME summer months back in 1985 to 1990 is evident: the pattern has not altered. This is evidenced in the national annual ‘performance’ report compiled for MLA⁴⁸ (noting wethers are the predominant type of sheep exported), showing that the June-September period particularly has significantly higher mortalities (both before HotStuff in 2003, and after). Mortality % ramps up in May, and only starts to reduce from October each year.

Figures 12 and 13 show monthly mortality rates (total mortality as a proportion of total loaded for each month) over three periods, 1997-2003, 2004-2010 and 2011-2016, for Adult Wethers and Adult rams respectively. While the overall pattern for Adult Wethers has reduced more noticeably over time, these periods demonstrate the enduring stability of the seasonal difference.

Figure 12 Average monthly mortality rate (%) for Adult Wethers for three periods



⁴⁸ Department of Agriculture and Food, Western Australia, *National Livestock Export Industry Sheep, Cattle and Goat Transport Performance Report*, Project Code W.LIV.0291 (2016) <<https://www.mla.com.au/download/finalreports?itemId=3328>>.

Appendix D

Ambient WBT temperature graphs have been provided in industry-funded research⁴⁹ during the development of HotStuff. As seen below, the 50% mark (i.e. expected half the time) for WBT is close to 25 WBT degrees, rising to 28 WBT, for most ports from May to October. Industry research also indicated that 26 WBT degrees and over is a 'caution' zone for heat stress, and 29 and over is the 'danger' zone⁵⁰ (and Barnes et al indicates for wethers that danger zone commences at 28 WBT degrees).

This is particularly concerning when it is known that **these are ambient temperatures**, and the livestock deck temperatures are known to be up to 6 WBT degrees higher than the ambient temperatures (between the inlet air, and outlet air from the vessel, i.e. heated from the livestock deck).⁵¹ As such, only a few degrees increment pushes the temperature on the livestock decks into the danger zone for sheep throughout those six months.

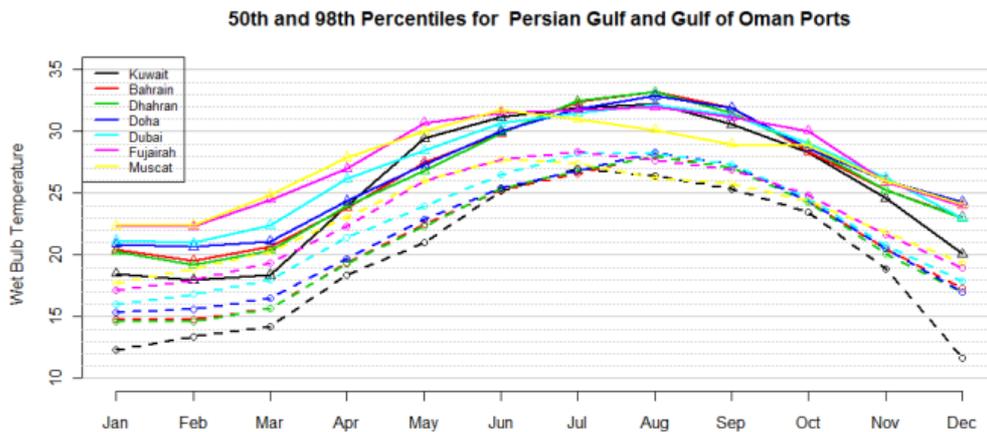


Figure 3-4: Annual port-specific wet-bulb temperature distributions for the Persian Gulf region

⁴⁹ Eustance., & Corry, S., *Revision of the Heat Stress Risk Assessment Methodology to Properly Incorporate Risk of Heat Stress While at Port* (Meat and livestock Australia) Project Code B.LIV.0249 (2009)

<<https://www.mla.com.au/download/finalreports?itemId=279>>

⁵⁰ MAMIC Pty Ltd, *Investigation of the Ventilation Efficacy on Livestock Vessels* (Meat and Livestock Australia) Project Number SBMR.002 (2001) <<http://www.livecorp.com.au/research-development/reports/investigation-of-the-ventilation-efficacy-on-lives>>.

⁵¹ *ibid.*

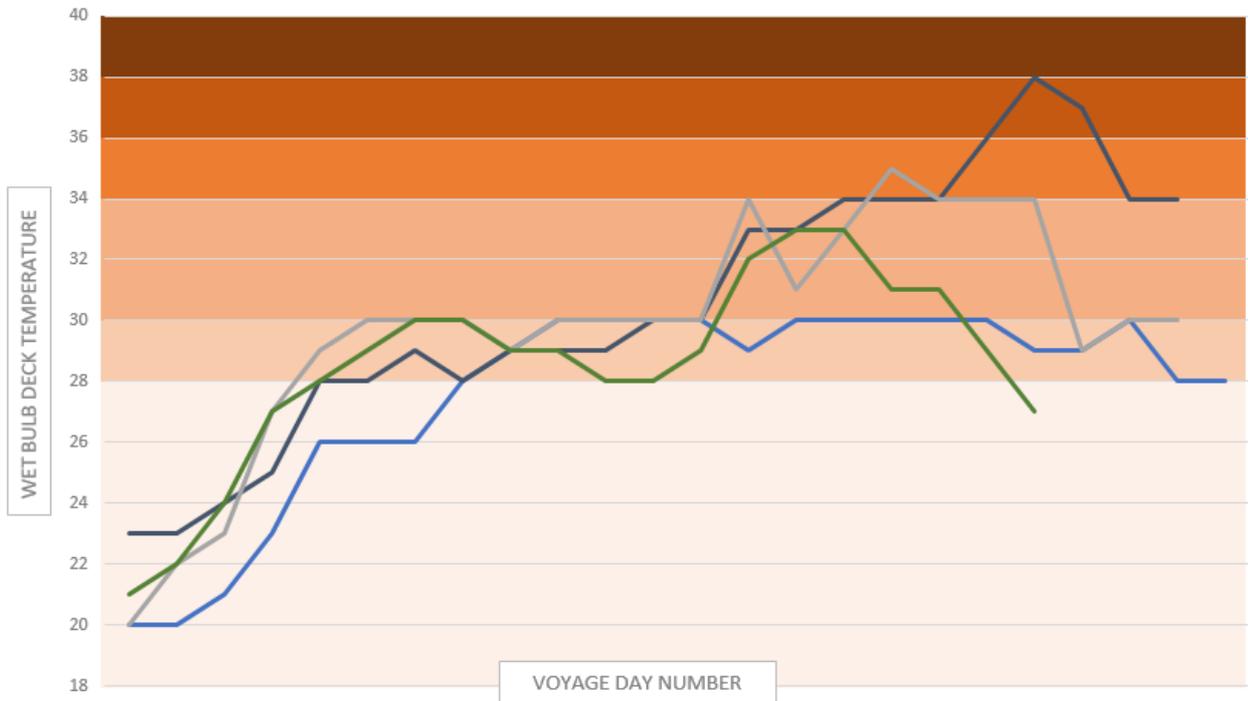
Appendix E

Temperatures encountered on the MV *Awassi Express* on four voyages in 2017 (May-Oct)

This table is compiled from figures on the daily veterinary reports. Published studies support the veterinary reports' findings of high respiratory rates from WBT 28 C and increased deaths. The graph shows:

- 4 voyages and the daily recording of the deck WBT – taken at 11.00am each day, and therefore not an accurate indication of the highest WBT each day.
- WBT: Average of WBT on all livestock decks.
- WBT 28 degrees Celsius occurs in May-October within 8 days of the voyage commencing.

AVERAGE WET BULB DECK TEMPERATURE PER VOYAGE



		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
May-Jun	23L	20	20	21	23	26	26	26	28	29	30	30	30	30	29	30	30	30	30	30	29	29	30	28	28
Jun-Jul	24L	23	23	24	25	28	28	29	28	29	29	29	30	30	33	33	34	34	34	36	38	37	34	34	
Aug	25L	20	22	23	27	29	30	30	30	29	30	30	30	30	34	31	33	35	34	34	34	29	30	30	
Sep-Oct	26L	21	22	24	27	28	29	30	30	29	29	28	28	29	32	33	33	31	31	29	27				