Live Sheep Exports to the Middle East - Policy Options Discussion Paper October 2019

Submission from the

Australian Veterinary Association Ltd

www.ava.com.au

Middle East Sheep Exports Policy Options Discussion Paper

Submission from the Australian Veterinary Association

About Us

The Australian Veterinary Association (AVA) is the national organisation representing veterinarians in Australia. Our 9000 members come from all fields within the veterinary profession, including clinical practitioners, government veterinarians, and those who work in industry, research and teaching. Veterinary students are also members of the AVA.

Executive summary

The AVA has provided comment and supporting material on the 4 policy options proposed by the Department of Agriculture.

None of the options go far enough on their own to prevent adverse outcomes in the highest risk months.

The AVA proposes alternate recommendations which should be able to achieve acceptable animal welfare outcomes, based on the science of heat stress in sheep. These are in line with AVA's previous key recommendations in the body of work we have submitted on this issue to date.

The AVA has relied upon limited resources to provide recommendations, including:

- Legislated 6-monthly summaries of live animal export
- Department of Agriculture Mortality Investigation Reports
- Limited peer-reviewed scientific papers
- Non-peer reviewed, Live Export Industry-funded project reports with data omissions
- Heavily redacted AAV Daily Shipboard Reports attained under FOI
- IO Report Summaries heavily abridged by the Department of Agriculture
- Heavily redacted IO Final Reports and Daily Reports attained under FOI.

The AVA is aware of a large amount of research that has been done on heat stress in sheep over several decades by industry, but which remains unpublished. The AVA strongly recommends that all this research data be made available, so that scientists can evaluate thermoregulation and heat stress in livestock crossing the equator and beyond at all times of the year, without the need for further research. This would allow for immediate improvements, and prevent a delay in data-gathering, which will put livestock welfare at risk unnecessarily.

In previous submissions, the AVA has stated:

"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."

The AVA maintains this position. The AVA refers the Department back to the previous AVA submissions and the data on which this statement was based.

Until recently, prolonged exposure of sheep to heat and humidity has been accepted as being part of a 'normal' voyage because mortality rate was the only trigger for investigation. It is apparent that even on low mortality shipments, there can be extended periods where sheep are suffering significant and prolonged heat stress.

The AVA supports and applauds the paradigm shift recommended by Dr McCarthy for a move away from risk assessment based on mortality, to a risk assessment based on animal welfare. AVA supports the recommendation of the Heat Stress Risk Assessment (HSRA) Review, for a risk assessment based on 2% probability that deck temperatures could exceed a sheep's HST.

The AVA's recommended approach for heat stress risk assessment is to determine likely WBTs for locations throughout the voyage including discharge points, based on historical and predicted meteorological data. If the predicted environmental WBTs are likely to exceed the calculated HST for the particular group of animals, the conclusion should be that the voyage does not proceed. Where there is insufficient or inconclusive meteorological data, the precautionary principle should always be employed to ensure the welfare of the animals is prioritised. Certain times of the year are a known risk (May to October). Further, this heat stress can occur at any time of the year when shipments cross the equator, and for that reason the HSRA (HotStuff) model should be applied to all voyages to the Northern Hemisphere, in all months of the year.

Policy option 1 – this option proposes a 3-month prohibition to live export of sheep to the Middle East during the hottest period of the northern summer.

This option is not supported by the AVA, as a 3-month pause is too short to avoid adverse welfare outcomes. A 3-month ban from June to August inclusive would be insufficient to protect sheep welfare, as the shipping routes and Middle Eastern ports are generally hotter and more humid in September than June.

Policy option 2 - in accordance with AVA's previous recommendations, the AVA supports (in part) the 2019 implementation of cessation in shipping of sheep to or through the Middle East between 1 June and 22 September (inclusive). However, this should be modified to ensure that granting of export permits ceases on a date in May such that sheep are not on the water for any days in June.

The AVA also supports the requirement for exporters to place automated data (WBT) logging equipment on board vessels and report that data to the department, at least for the months May to October (inclusive), and in all months on any voyages crossing the equatorial zone. WBTs should be recorded in a range of locations across the decks to ensure data from the hottest locations is also captured. This data, as well as past accumulated data, should be used to further validate the HSRA model.

Policy option 3 – this option proposes that a revised HSRA model would be adopted where risk settings were based on heat stress thresholds (HSTs) or an approach based on agreed animal welfare indicators.

The AVA supports adoption of Option 3, provided that:

- Risk settings are based on heat stress thresholds (HSTs), and
- The risk assessment is based on 2% probability that deck temperatures could exceed a sheep's HST, and
- Option 3 is implemented in combination with the modified version of Option 2 that AVA has recommended.

Policy option 4 - this option proposes that there is no prohibition, and that the existing HSRA model would continue to be used only to determine stocking densities for voyages. This represents a return to conditions before 2018 and is not supported, as it represents an unacceptably high risk to sheep welfare.

Introduction

Export of livestock from Australia by ship has been occurring since the 1960s. During this time, the Australian community has expected the federal Department of Agriculture (the Department) to judiciously carry out its role to regulate the live animal export industry to ensure that acceptable animal welfare standards were being met. This includes both in Australia during preparation and loading of livestock, during voyages of ships bound for equatorial and northern hemisphere countries, and during handling and slaughter in destination countries.

The AVA has a policy on Live Animal Export which was formulated with input from all members, and which states:

> *"Ideally, Australian food animals should be slaughtered as close to the site of production as practicable to minimise transport and handling stress, and to ensure they are protected by appropriate and enforceable animal welfare and slaughter standards."*

It also states that, where live export occurs:

> *"Effective operational protocols must be in place at all times to safeguard the welfare of exported animals. These protocols must ensure humane animal transport, handling and slaughter practices in accordance with best practice; and include accreditation of abattoirs, training of employees and the implementation of an independent animal welfare auditing process.*
>
> *Animals should not be subjected to prolonged land transport prior to exportation" 1*
>
> (Date of ratification by AVA Board 29 July 2016).

The unacceptable images of dead and dying sheep taken from five different live export voyages from Australia to the Middle East in 2017, shown on the television program *60-Minutes*[2] in April 2018, revealed failures by the Department and industry to meet Australian animal welfare standards, Australian community expectations, and even OIE animal welfare requirements[3].

The AVA, as the largest national body representing veterinarians in the country, has since undertaken a large amount of work and prioritised our resources in order that we could articulate sound, science-based recommendations for animal welfare improvements in the live export industry.

In the last 18 months, the AVA has produced a number of detailed submissions into the government's reviews of the Australian Standards for the Export of Livestock (ASEL)[4] and HSRA[5] model. To do this, we have relied upon live animal export data that is intermittently uploaded to the Department website, such as reports to parliament on livestock shipping statistics[6] and desk-top-generated Mortality Investigation Reports[7], limited numbers of peer-reviewed scientific papers, Live Export Industry-funded projects of unknown scientific rigour[8] and heavily redacted freedom-of-information (FOI) data.

To date we have submitted the following body of work:

1 Source: https://www.ava.com.au/policy-advocacy/policies/miscellaneous-welfare-issues-animal-export/live-animal-export/
2 Source: https://9now.nine.com.au/60-minutes/sheep-ships-and-videotapes/5c6e8bce-b910-4287-87f7-2ac7fa5a80eb
3 Source: https://www.oie.int/en/animal-welfare/animal-welfare-at-a-glance/
4 Source: https://haveyoursay.agriculture.gov.au/review-asel
5 Source: https://haveyoursay.agriculture.gov.au/hsra-review
6 Source: http://www.agriculture.gov.au/export/controlled-goods/live-animals/live-animal-export-statistics/reports-to-parliament
7 Source: http://www.agriculture.gov.au/export/controlled-goods/live-animals/livestock/regulatory-framework/compliance-investigations/investigations-mortalities
8 Source: http://www.livecorp.com.au/research-development/report and https://publications.mla.com.au/login/redirectFrame

- A short review of space allocation on live export ships and body temperature regulation in sheep[9]
- AVA submission to the ASEL Stage 2 Issues Paper[10]
- AVA Submission to the Heat Stress Risk Assessment (HotStuff) Issues Paper[11]
- AVA Submission to the Draft Report by the Heat Stress Risk Assessment (HotStuff) Technical Reference Panel[12]
- AVA Submission to the Proposals and Conditions for Live Sheep Exports during the Northern Hemisphere Summer[13]
- AVA Submission to the Proposed Conditions for Live Sheep Exports during September and October 2019[14]

Difficulties in accessing live export industry data

Historically there has been a lack of transparency in the live animal export industry[15] which has hindered scientists and the public in accessing the data that has been generated in land-based research and during livestock voyages for many decades[16]. We are aware of a large amount of research that has been performed on heat stress in sheep, but which remains unpublished. Publication of all this previously inaccessible data is recommended in order to assist in current decision making to optimise welfare outcomes for livestock.

Two reports have been instigated by the Department as part of the ASEL and HSRA (HotStuff) reviews. Both reports recommended that further research is necessary:

- *Literature review of scientific research relating to animal health and welfare in livestock exports*, (Collins, Hampton et al. 2018), which concludes:

  > *"Further scientific investigation is required to identify avenues for reducing the incidence of harmful heat load events in live export … Studies that can describe and validate a list of welfare indicators that incorporate morbidity and behavioural measures relevant to cattle and sheep and be applicable across the whole of the live export chain, are required."*

- *Final report by the Heat Stress Risk Assessment Technical Reference Panel* (Barnes, Phillips et al. 2019), which concludes:

  > *"These recommended refinements to the heat stress risk assessment (HSRA) model are accompanied by a parallel and ongoing need to measure and accurately record environmental conditions and sheep responses to the conditions, during the voyage. The data should be used in a feedback loop for future use in the HSRA model, and to enable effective, objective, defensible and transparent monitoring and protection of animal welfare of transported sheep. There is a need to deploy well maintained monitoring equipment (such as to monitor wet bulb temperature) at a sufficient number of relevant locations on the livestock decks of ships transporting sheep."*

The LiveCorp and MLA websites contain many industry-funded reports on research into live animal export. However only a limited number of peer-reviewed articles have been derived from these and published in scientific journals. Scrutiny of the reports reveals that much of the research requested above, has already been undertaken, but remains largely unpublished (see **Figure 1**, **Figure 2**, **Figure 3 a-c**, **Figure 4** below).

9 Source: https://www.ava.com.au/siteassets/advocacy/ava-literature-review-live-sheep-export-may-2018_final_1.pdf
10 Source: https://www.ava.com.au/siteassets/advocacy/ava_comment_on_asel_stage-2-issues-paper.pdf
11 Source: https://www.ava.com.au/siteassets/advocacy/ava-hotstuff-submission.pdf
12 Source: https://www.ava.com.au/siteassets/advocacy/improving-animal-welfare/ava-response-to-hsra-technical-panel-review-1-03-19.pdf
13 Source: https://www.ava.com.au/siteassets/advocacy/improving-animal-welfare/ava-response-to-proposed-2019-summer-trade-arrangements_final.pdf
14 Source: https://www.ava.com.au/siteassets/advocacy/improving-animal-welfare/ava-response-to-options-for-sep-oct-2019.pdf
15 Source: http://www.agriculture.gov.au/animal/welfare/export-trade/independent-review-of-regulation
16 Source: http://www.agriculture.gov.au/SiteCollectionDocuments/export/moss-review-submissions/australian-veterinary-association.pdf

Information was collected on nine voyages during the period April to October 2004. These voyages generated 79 discrete data sets for subsequent analysis. Analysis of this data was outside the scope of the current project and needs to be completed.

Provided statistically significant findings are made, it is recommended that onboard monitoring be continued. It is not envisaged that monitoring be conducted on all long-haul voyages to the Middle East, rather it is suggested that monitoring be conducted on an opportunistic basis, when lines of livestock are identified as being of particular interest. This will require the monitoring to be actively managed (see 7.1 Recommendation 3).

Because of the many contributing factors to heat tolerance, it was necessary to collect a considerable amount of information to ensure that the data collected could be interpreted. The

Figure 1. This excerpt from 2005 illustrates that climatic and animal data collected over 9 voyages remains largely unpublished (McCarthy 2005).

National livestock export industry sheep, cattle and goat transport performance report 2015

The objectives of the more recent Monitoring and Evaluation Project were:
1. Review the HotStuff model and information that has been made available by industry in order to establish a framework and methodology that will form the basis for ongoing assessment and performance of the model.
2. Based on findings from objective one, implement and maintain a data collection system that can be used to validate the HotStuff model over a two year period.
3. Based on the data collected over the two year period, evaluate the HotStuff model predictions and provide recommendations for enhancement to the model.

The project completed the review of data and established the data collection system over the years 2012-2013. During this time, research officers deployed loggers measuring dry bulb temperature and relative humidity on board the animal decks of ships carrying livestock to the northern hemisphere.

Evaluation of environmental data and corresponding daily mortality records for the 35 voyages monitored led to the following recommendations:

1. That the Project data be first discussed with the HotStuff developers to resolve some issues identified. From this discussion a consensus should be formed on the most appropriate measures of:
   (i) 'on-deck maximum temperatures', which would then be compared against the '5%-mortality' temperatures assumed in HotStuff for different classes of animal, and
   (ii) 'heat rise due to animals' so that estimation of 'effective' deck ventilation can be made. These statistics would then be checked against the values used in the HotStuff model, and perhaps cause ventilation values to be changed.
2. Once the first recommendation has been resolved, Project methods and results will be presented and discussed at an Exporters' seminar. Further monitoring to 'audit' the ventilation rate of each deck of current livestock vessels can be decided upon.

The Project was completed in 2013, however release of the findings is pending completion of recommendation 1, the further evaluation of findings with the HotStuff developers.

This project will no longer be updated in future publications of this report.

Figure 2. This excerpt illustrates that data collected over 35 voyages remains largely unpublished. (Norman 2016).

National livestock export industry sheep, cattle and goat transport performance report 2013

6.1.5 Heat load in sheep exported to Middle Eastern feedlots

The objectives of this project are:
1. To record the internal temperatures of sheep and their environmental conditions as they undergo routine transition from Australia into Middle Eastern feedlots, during 4 shipments (2 winter and 2 summer).
2. Gather data on the pathophysiology of any sheep clinically affected by disease during shipment and at the post-shipment feedlot, along with blood and pathology sample analysis, recorded clinical signs and the history of individual animals.
3. Gather data on other stressors (such as feeding, management, infectious disease) during the process, by tracking individual sheep through the pre-embarkation feedlot, during road transport to the port, on-board during the voyage to the Middle East, and then during their stay at the feedlot prior to slaughter.
4. To examine causes of morbidity and mortality by relating any sheep morbidity / mortality to the gathered internal / environmental data.
5. Use findings to improve risk management and to make recommendations that limit compromise to the health and welfare of the sheep, and that help minimise losses.

Researchers aim to monitor 50 sheep per shipment for at least two summer-to-winter and two winter-to-summer shipments through to the point of slaughter.

Currently one summer-to-winter, and two winter-to-summer shipments have been monitored. A winter-to-summer shipment specifically targeting a higher-humidity Middle Eastern port has also been monitored, with an intended follow-up summer-to-winter shipment planned for the same port before the project finishes in late 2014 - early 2015.

Figure 3a. (Norman 2014).

50 sheep per shipment for two summer-to-winter, and four winter-to-summer shipments have been monitored. Two of the winter-to-summer shipments and a follow-up summer-to-winter shipment specifically targeted a higher-humidity Middle Eastern port.

The data is currently being analysed, with a final report expected to be available later in 2015.

Figure 3b. (Norman 2015).

6.1.3 Heat load in sheep exported to Middle Eastern feedlots

To date the project has:
1. Gathered data on the internal temperatures of groups of sheep from a total of 6 shipments and the environmental conditions that they experienced as they undergo transition from Australia into Middle Eastern feedlots.
2. Gathered data, for the monitored shipments, on the pathophysiology of sheep clinically affected by disease during this transition and at the post-shipment feedlot, with blood and pathology samples analysed along with clinical signs and history of individual animals.
3. Gathered data on other stressors such as feeding, management, and infectious disease during the process, by tracking of individual sheep through the pre-embarkation feedlot, during road transport to the port, on-board during the voyage to the Middle East, and then during their stay at the feedlot prior to slaughter.
4. Related morbidity and mortality of the sheep to the gathered data, to surmise causes.

Phase two of this work has now commenced, firstly with the focus of supplementing sheep, which experience sustained heat loads throughout the live export process into a hot, humid destination in the Middle Eastern summer, with electrolytes.

Secondly, Middle Eastern environmental conditions will be monitored and also the responses of sheep given different shade types and other measures proposed to cool them.

All data collected from phases one and two will be utilised to inform risk management and recommendations to limit compromises to health and welfare of the sheep, and to minimise losses.

Preliminary data collected during phase two indicates positive results have been achieved by the cooling methods trialled. The full analysis of this data is currently underway.

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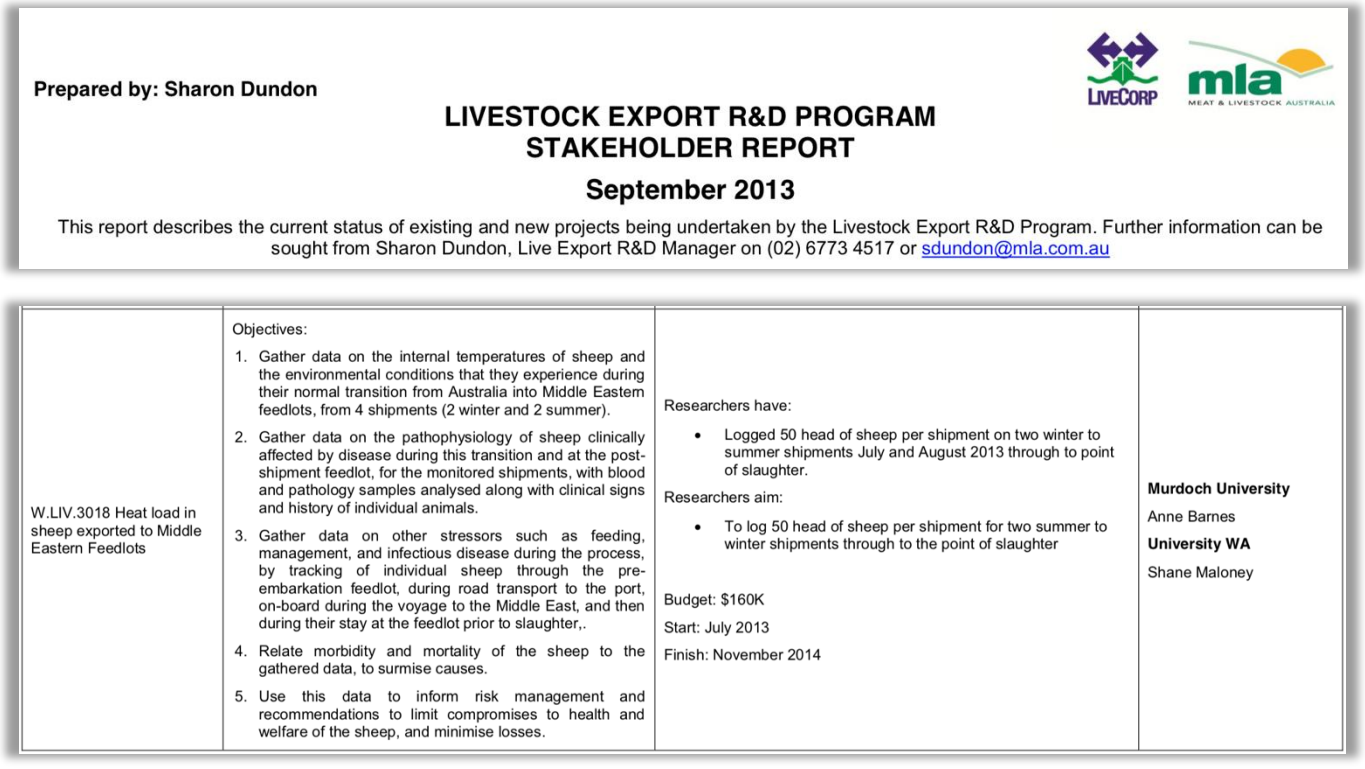
Figure 3c. This group of 3 excerpts of studies from 2013 (Norman 2014), 2014 (Norman 2015) and 2015 (Norman 2016), respectively, illustrates that much data has been collected but remains unpublished.



Prepared by: Sharon Dundon

LIVESTOCK EXPORT R&D PROGRAM
STAKEHOLDER REPORT

September 2013

This report describes the current status of existing and new projects being undertaken by the Livestock Export R&D Program. Further information can be sought from Sharon Dundon, Live Export R&D Manager on (02) 6773 4517 or sdundon@mla.com.au

W.LIV.3018 Heat load in sheep exported to Middle Eastern Feedlots	Objectives: 1. Gather data on the internal temperatures of sheep and the environmental conditions that they experience during their normal transition from Australia into Middle Eastern feedlots, from 4 shipments (2 winter and 2 summer). 2. Gather data on the pathophysiology of sheep clinically affected by disease during this transition and at the post-shipment feedlot, for the monitored shipments, with blood and pathology samples analysed along with clinical signs and history of individual animals. 3. Gather data on other stressors such as feeding, management, and infectious disease during the process, by tracking of individual sheep through the pre-embarkation feedlot, during road transport to the port, on-board during the voyage to the Middle East, and then during their stay at the feedlot prior to slaughter,. 4. Relate morbidity and mortality of the sheep to the gathered data, to surmise causes. 5. Use this data to inform risk management and recommendations to limit compromises to health and welfare of the sheep, and minimise losses.	Researchers have: • Logged 50 head of sheep per shipment on two winter to summer shipments July and August 2013 through to point of slaughter. Researchers aim: • To log 50 head of sheep per shipment for two summer to winter shipments through to the point of slaughter Budget: $160K Start: July 2013 Finish: November 2014	**Murdoch University** Anne Barnes **University WA** Shane Maloney

Figure 4. LiveCorp/MLA project summary taken from the Livestock Export R&D Stakeholder Report 2013 describing the project in Figure 3 (Source: https://agforceprojects.org.au/file.php?id=214&open=yes).

Some findings in these industry reports have been summarised succinctly, for example: *"the onset of stress based on observations of the breathing rate taken across the whole pen was generally consistent with the onset of stress as seen by rectal temperature"* (Maunsell-Australia 2004). However, it is not possible to locate the data itself, nor the final project reports or scientific papers that should have been generated following completion of this research. Should this data be made available, it could assist in current decision-making and potentially circumvent the need for the further research recommended in the two above-mentioned reports.

LiveCorp and MLA have historically claimed that research data collected during export of livestock is "commercial-in-confidence". However, these studies are co-funded (50%) by the Federal Government. In a 2017 survey of the general public, a desire was expressed to know the results of data collected in the live export industry ["*The majority of the surveyed public believe that data collected on animal welfare should be made public*" (Wickham, Fleming et al. 2017)]. The AVA recommends that the data should be made available so that scientists can evaluate thermoregulation and heat stress in livestock crossing the equator and beyond at all times of the year, without the need for further research. This would allow for immediate improvements, and prevent a delay in data-gathering, which will put livestock welfare at risk unnecessarily.

Proposed policy options

In the Department's *Middle East sheep exports policy options discussion paper*[17] a question is posed as to whether there is a policy option that will both support a sustainable live sheep export trade and meet the high animal welfare standards expected by the Australian community. In the discussion below, the AVA provides comment on the 4 options proposed by the Department, and proposes alternate recommendations which should be able to achieve acceptable animal welfare outcomes. These are in line with AVA's previous key recommendations in the body of work we have submitted to date, i.e:

Key AVA recommendation 1

"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".[18]

The AVA refers the Department back to the previous AVA submissions and the data on which this statement was based.

Key AVA recommendation 2

"Heat stress can occur at any time of the year when shipments cross the equator, and for that reason the HotStuff Model should be applied to all voyages to the Northern Hemisphere, in all months of the year. Even summer-acclimatised sheep travelling in the cooler months of the Northern Hemisphere are at risk of heat stress while crossing the Equator".[19]

The data available from Mortality Investigation Reports, Independent Observer Report Summaries and FOI documents clearly show that heat stress occurs in sheep as they cross the equator at all times of the year, and in the Middle East during the months of May to October[19]. Unpublished data, [such as that cited in McCarthy (2005) and Norman (2014, 2015, 2016) and Independent Observer, climatic and sheep physiological data collected during 2018 and 2019 voyages] supports the limited published data.

Policy option 1

Policy option 1 proposes a 3-month prohibition to live export of sheep to the Middle East during the hottest period of the northern summer.

This option is not supported by the AVA, as a 3-month pause is too short to avoid adverse welfare outcomes. A 3 month ban from June to August inclusive would be insufficient to protect sheep welfare, as the shipping routes and Middle Eastern ports are generally hotter and more humid in September than

17 Source: https://haveyoursay.agriculture.gov.au/47315/documents/116897
18 Source: https://www.ava.com.au/siteassets/advocacy/ava-literature-review-live-sheep-export-may-2018_final_1.pdf
19 Source: https://www.ava.com.au/siteassets/advocacy/ava-hotstuff-submission.pdf

Policy option 2

In accordance with Key AVA Recommendation 1, above, the AVA supports (in part) the 2019 implementation of cessation in shipping of sheep to or through the Middle East between 1 June and 22 September (inclusive). However, this should be modified to ensure that granting of export permits ceases on a date in May such that sheep are not on the water for any days in June. This is because:

- **Mortality risks in June**. Historically, mortalities in sheep travelling to or through the Middle East have been greatest in June to September, whether month of voyage commencement (Figure 5) or discharge (Figure 6) is examined. Voyages that begin in May and end in June have historically resulted in a higher proportion of shipments with ≥ 0.5% mortality compared with voyages undertaken wholly in May (Figure 7).
- **Heat stress risk May to October**. The equatorial waters (latitudes 5°S to 5°N) of the Indian Ocean, extending to 15°N are at their maximum in May-June during the northward transit of the sun and prolonged periods of light winds, and "*heat and humidity levels rapidly build across all Middle Eastern ports during the period from May through to June*" (Maunsell-Australia 2003). There are excessively high wet bulb temperatures from May to October in Persian Gulf (Doha, Dubai and Kuwait, Strait of Hormuz, Persian Gulf) and Red Sea destinations (Aqaba, Bab el Mandeb Strait, Red Sea; Figure 5) with southernmost ports first affected in May, extending northwards in June (Maunsell-Australia 2003, Stacey 2017, Stacey 2017). October is a transition month but still exhibits spells of hot and humid weather (Maunsell-Australia 2003). Therefore, sheep that do not die will suffer moderate to extreme heat stress for days to weeks during any voyage to the Middle East in May to October.

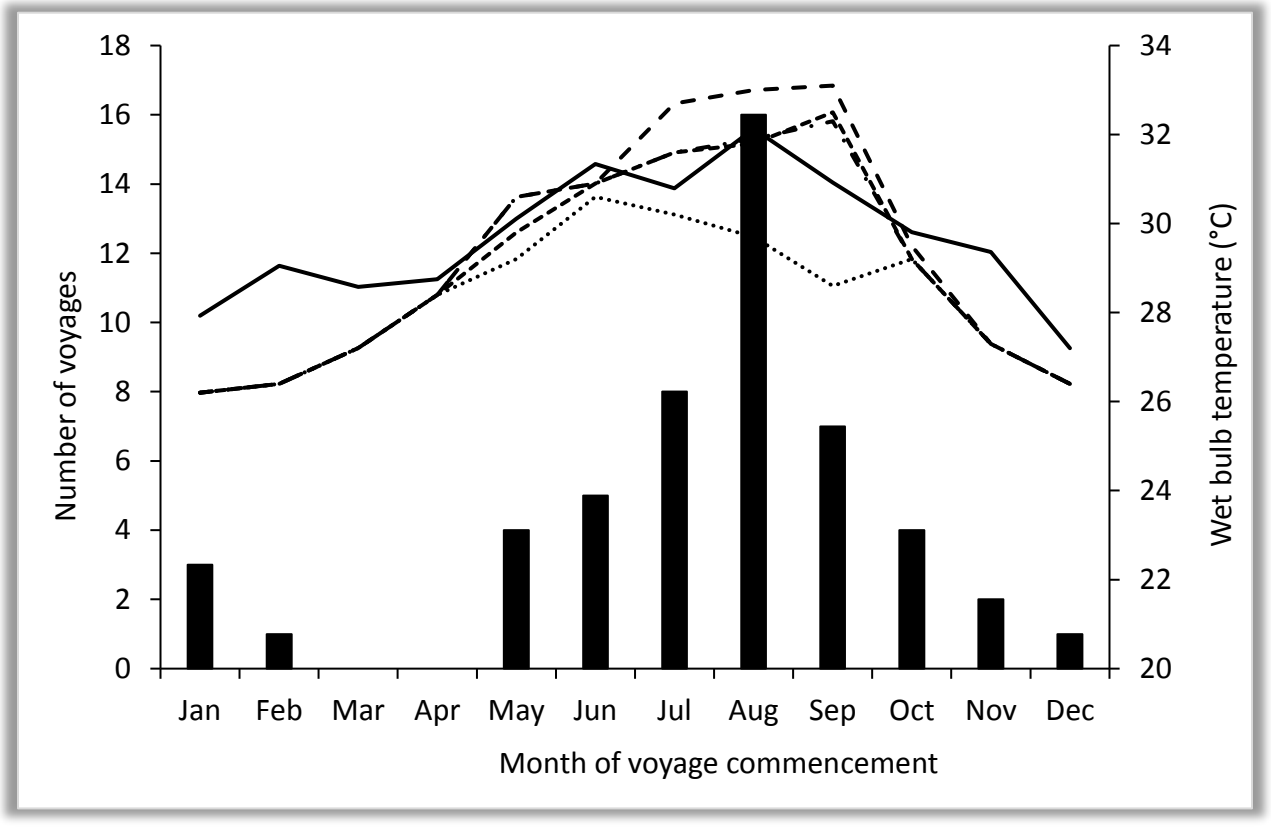


Figure 5. Number of voyages (n=51; black columns), by month of voyage commencement, when there were > 15,000 sheep on the ship from Australia to the Middle East between 2005 and 2017 and total sheep mortality rates were ≥ 1.5% and voyage weather 98th percentile wet bulb temperatures for Kuwait (— • —), Doha Qatar (— — —), Dubai UAE (- - - -), Muscat Oman (••••) and Aqaba Jordan (——). (Source: https://www.ava.com.au/siteassets/advocacy/ava-literature-review-live-sheep-export-may-2018_final_1.pdf and (Stacey 2017)).

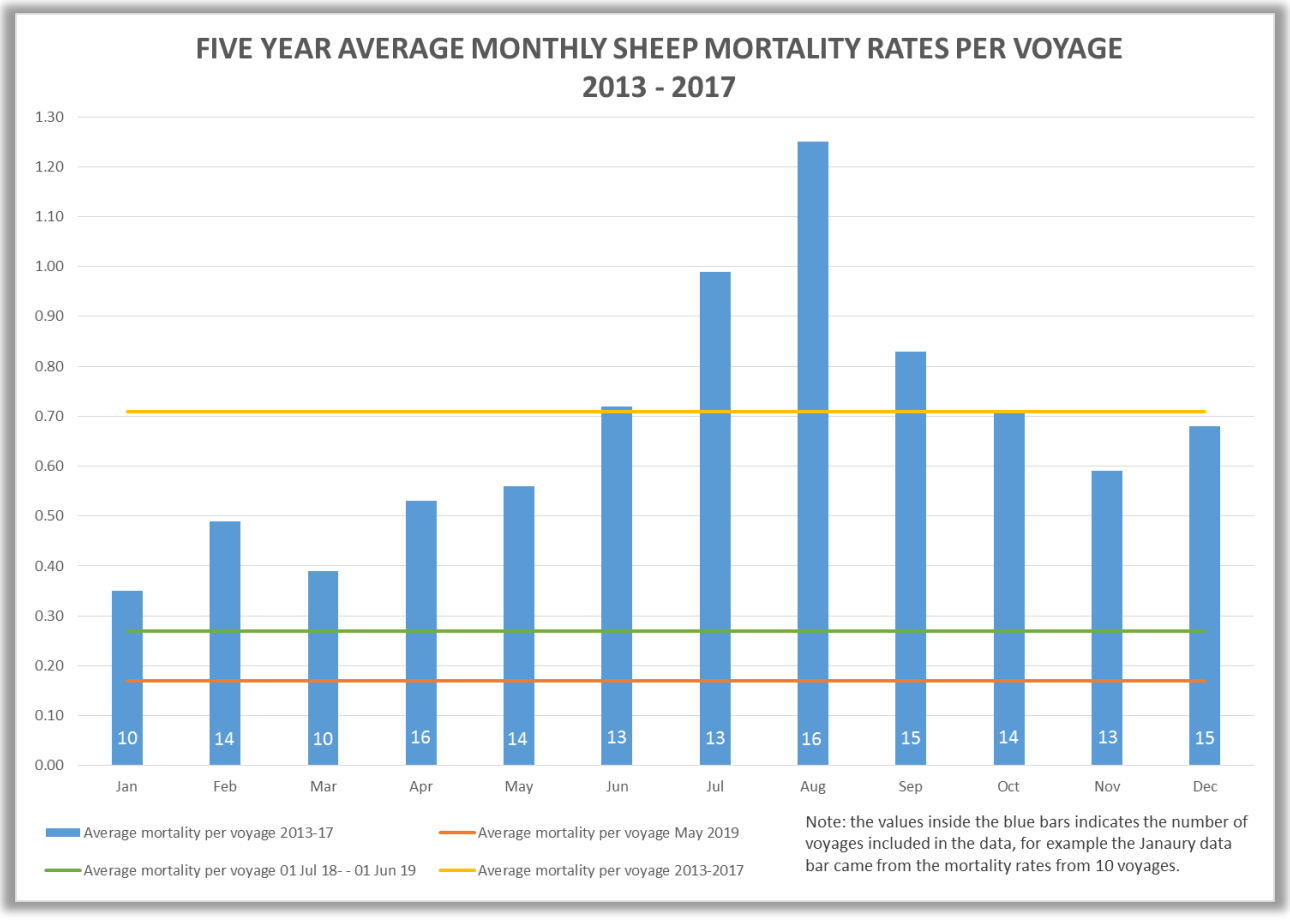


Figure 6. Five Year Average Monthly Sheep Mortality Rates Per Voyage. Data for the graph is drawn from the Reports to Parliament on Live Exports which reports voyages by month of discharge rather than date of departure. The graph represents 163 voyages from Australia to Middle-Eastern destinations as indicated by the values inside the blue bars. (Source: DAWR Proposed Conditions for Live Sheep Exports to the Middle East during September and October 201920).

20 Source: http://www.agriculture.gov.au/export/controlled-goods/live-animals/livestock/history/review-northern-summer/sheep-middle-east

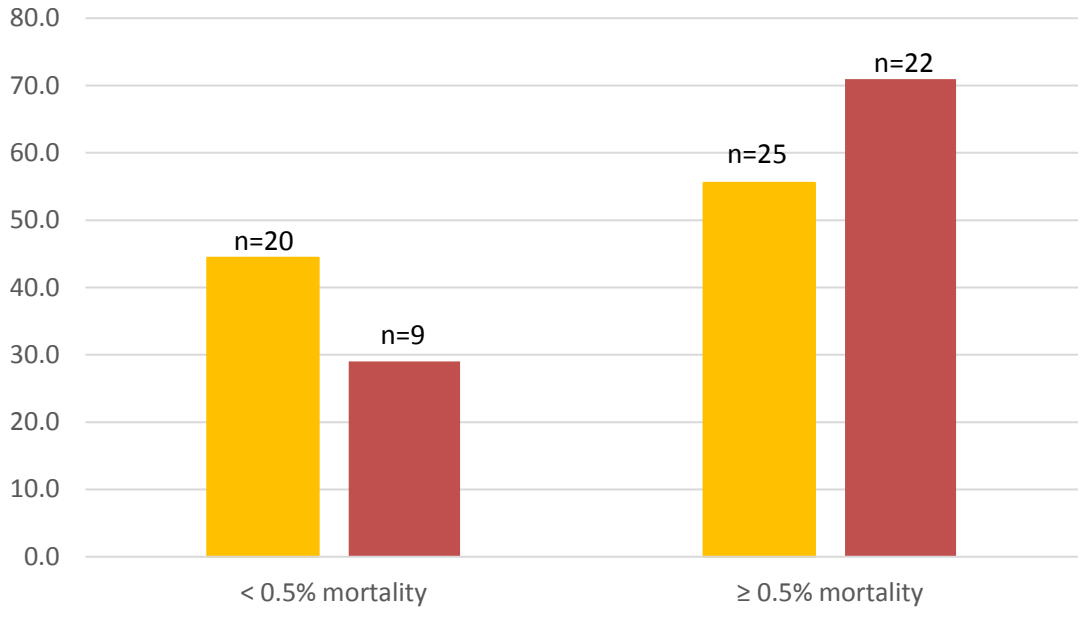


Figure 7. Proportion of voyages to/through the Middle East exhibiting < 0.5% or ≥ 0.5% sheep mortalities in any May arrivals (yellow columns) vs May departures with June arrivals (red columns) between 2005 and 2018.

Supporting information from 2018 and 2019 voyages

In the AVA's submission to the Department, *Proposals and Conditions for Live Sheep Exports During the Northern Hemisphere Summer*[21], it was recommended that data gathered by Independent Observers (IOs) during 2018 and 2019 voyages could be used to assist in making decisions on the safety and welfare of sheep for proposed future voyages to or through the Middle East in various months of the year.

It has been disappointing that the AVA has not been able to obtain IO reports in full. Instead, we have had to rely on (a) summaries of IO Reports published on the Department's website[22] and (b) IO Final Reports heavily redacted by the Department and obtained under FOI, in order to better understand shipboard conditions during voyages in 2018 and 2019, and to formulate recommendations for future sheep exports to or through the Middle East.

Using what has been made available, IO Reports have been summarised by the AVA and include general and sheep-specific observations. Pant Scores have been approximated by AVA from comments made by IOs. Cattle data has largely been ignored. The data indicate that sheep suffer heat stress during April, May and June voyages (Table 1 to Table 9, Figures 7a-7d). Data from 2019 was derived solely from Departmental summaries of IO Final Reports (Table 9).

In the Final Report by the IO on travelling on the MV Bahijah to the Middle East in June 2018, it was noted that "the sheep visibly struggled with the heat on board", "a degree of heat stress existed … from the equator until the passage of the Suez Canal" and " … a degree of heat stress occurred on part of the journey … *unavoidable in the conditions*" (FOI LEX-755 p794-818). This aligns with AVA's previous analysis and conclusion that the month of June is essentially too hot, and sheep should not be on voyages to or through the Middle East on any day in June.

The AVA agrees with the conclusion in the HSRA Review, that one avenue for reducing animal health and welfare risks without requiring engineering solutions is to undertake "*voyages timed to encounter the least aversive environmental conditions"* (Collins, Hampton et al. 2018).

Summaries follow (Table 1 to Table 9, Figures 7a-7d).

21 Source: https://www.ava.com.au/siteassets/advocacy/improving-animal-welfare/ava-response-to-proposed-2019-summer-trade-arrangements_final.pdf

22 Source: http://www.agriculture.gov.au/export/controlled-goods/live-animals/livestock/regulatory-framework/compliance-investigations/independent-observations-livestock-export-sea

Table 1. Voyage 1 with Independent Observer (IO): MV Maysora V114 to Turkey in **April 2018** where 315 of 73,836 sheep (0.43%) died (Source FOI LEX-755 pages 1-104). The adjusted HST for a 43.6 kg adult Merino sheep sourced from Zone 2 is 29.96°C WBT. Note deck WBT will be 2-4°C higher than bridge WBT. The normal rectal temperature for a sheep is 39.0±0.5°C (Stockman 2006).

Date	Day ex-Adelaide	Ship location	Day ex-Freo	Sea temp (°C)	Bridge WBT (°C)	Relative Humidity (%)	*Approx Pant Score*	Comments on voyage in general and sheep in particular by IO in final report (with redactions by DoA)
3/4/18	0	Adelaide					*0*	"The dry and wet bulb temperatures recorded at some stages in this voyage were questionable"
4/4/18	1	Adelaide					*0*	"they need regular cleaning to maintain their accuracy"
5/4/18	2	Adelaide					*0*	
6/4/18	3	Adelaide					*0*	
7/4/18	4						*0*	
8/4/18	5						*0*	
9/4/18	6						*0*	
10/4/18	7	Fremantle					*0*	
11/4/18	8	Fremantle					*0*	
12/4/18	9	Fremantle	0				*0*	IO boarded ship in Fremantle
13/4/18	10		1	21	15.3	68	*0*	Deck 8 WBT 17.7°C
14/4/18	11		2				*0*	
15/4/18	12		3				*0*	
16/4/18	13		4				*0*	"The readings are routinely taken 4 times each day at 6 hourly intervals from midnight… Extra reading (5th) … taken … at 3pm…were often hotter and more humid than the 12 noon readings" from Day 4 until Suez Canal
17/4/18	14		5	27	25.7	71	*1-2*	Deck 8 WBT 27.9°C. Sheep ">70% progressed to Stage 1 panting" "<1% sheep were in stage 2 panting"
18/4/18	15		6				*1-2*	
19/4/18	16		7		1°C cooler	rain, wind	*1*	Days 7-8: "minor break in weather… allowed sheep … to reduce the panting…"
20/4/18	17	Equator	8	30	1°C cooler	rain, wind	*1*	
21/4/18	18	Equator	9	30	28.2	~ 70%	*1-3*	Day 5-16: "During this stage more than 90% of sheep mostly stayed in Stage 1 panting (slight panting, mouth closed), and around 5-7% progressed to Stage 2 (fast panting) with occasional mouth opening. Only 1% exhibited sustained open mouth panting"
22/4/18	19		10		28.2	~ 70%	*1-3*	
23/4/18	20		11		28.2	~ 70%	*1-3*	
24/4/18	21	Gulf of Aden	12		28.2	~ 70%	*1-3*	Zig-zagged through the Gulf of Aden
25/4/18	22		13		28.2	~ 70%	*1-3*	Regularly checked sheep rectal temps:
26/4/18	23		14		28.2	~ 70%	*1-3*	"during this voyage the max (sheep rectal) temp recorded was 40.2°C, which is at the high end of normal"
27/4/18	24		15		28.2	~ 70%	*1-3*	
28/4/18	25		16				*1-2*	
29/4/18	26	by Jedda	17				*0*	"sheep respiration returned to a normal resting pattern with a panting score of 0"
30/4/18	27		18				*0*	The 3pm readings stopped after passing Jedda when temperatures and humidity reduced to a safe zone
1/5/18	28		19				*0*	
2/5/18	29	Turkey	20				*0*	

Table 2. Voyage 2 with Independent Observer (IO): MV Al Messilah V160 to Middle East in **May 2018** where 222 of 65,334 sheep (0.34%) died (Source FOI LEX-755 pages 118-147). The adjusted HST for a 55 kg adult Merino sheep sourced from Zone 3 is 29.31°C WBT.

Date	Location	Day ex-Freo	Sea temp (°C)	Bridge WBT (°C)	Relative Humidity (%)	*Approx Pant Score*	Comments on voyage in general and sheep in particular by IO in final report (with redactions by DoA)
1/5/18	Fremantle	0	NIL	NIL	NIL		Extended time in feedlot so BCS≥3 "no healthier and better conditioned sheep have departed Australian ports in recent times"
2/5/18		1					"Each deck is serviced by ONE only dry and wet bulb thermometer ... read once daily... between 10:00 & 11:00 hours"
3/5/18		2					
4/5/18		3				*1*	"17.5% above ...ASEL density ... allowed enough space for at least 50% of sheep ... to sit or lie down"
5/5/18		4				*1*	"1600 & 1700 hrs ... the hottest part of the day ... difference 0.5-2°C" from temp at 1000-1100 hrs "must be concluded that official recordings for each deck are unlikely to be the hottest temperature experienced during any particular day"
6/5/18		5				*1*	
7/5/18		6				*1-2*	"generally there was a noticeable increase in the respiration rates" "increased respiration looked to be energy draining"
8/5/18		7				*1-2*	"less than 30 animals ... could have been given a pant score of 2" (in this report PS=2 photo depicted mouth open)
9/5/18		8				*1*	
10/5/18		9				*1*	
11/5/18		10				*1*	
12/5/18		11				*1*	
13/5/18		12				*1*	
14/5/18	Kuwait	13				*1*	
15/5/18		14				*1*	
16/5/18	Qatar	15				*1*	
17/5/18		16				*1*	
18/5/18		17				*1*	
19/5/18	UAE	18				*1*	
20/5/18	UAE	19				*1*	

Table 3. Voyage 3 with Independent Observer (IO): MV Bader III to Middle East in **May 2018** where 169 of 62,668 sheep (0.27%) died (Source FOI LEX-755 pages 148-418). The adjusted HST for a 55 kg adult Merino sheep sourced from Zone 2 is 28.98°C WBT.

Date	Day ex-Adelaide	Ship location	Day ex-Freo	IO daily report WBT (°C)	Mean deck WBT (°C)	Relative Humidity (%)	*Approx Pant Score*	Sheep deaths	Combined comments on voyage in general and sheep in particular by IO (with redactions by DoA)
27/4/18	0	Adelaide					*0*		"Stocking density was ... 17.5% below ASEL ... allowed stock ... sufficient spacing even when the very hot day of 34°C WBT was encountered"
28/4/18	1	Adelaide					*0*		No sheep PMs performed, but deaths apparently due to enterotxaemia
29/4/18	2						*0*		
30/4/18	3						*0*		
1/5/18	4						*0*		
2/5/18	5	Freo	0				*0*		
3/5/18	6	Freo	1				*0*		
4/5/18	7		2	24		72	*0*	0	
5/5/18	8		3	26	23.6	84	*0*	5	WBT range 21-26C
6/5/18	9		4	30	27.6	92	*1*	5	"Hot". "Equatorial conditions" 70 kg "Rams were a little panty" (adjusted HST 28.44°C). "Areas of possible heat retention have started to be indentified and extra fans are being wired into place"
7/5/18	10		5	28	27.0	85	*1*	1	
8/5/18	11		6	30	28.2	92	*2-3*	3	"Starting to show signs of open mouth breathing at 30 WBT" Ship zig-zagged to increase airflow.
9/5/18	12		7	31	28.9	92	*2-3*	12	Sea temp 30°C. Ship zig-zagged to increase airflow. Faecal pad softening ("doughy") "There has been no real sign of heat stress of any significance" "There is a very small amount of mouth breathing mostly in the merino type sheep"
10/5/18	13		8	31	30.0	92	*2-3*	8	"Ship is still zig-zagging every 3 hours" Increased water intake and faecal pad softening. Fans added to ram pens Sea temp 30C. Heat-related death of steer "... more signs of heat related issues today...nothing really major but general panting was up" "Animals faring pretty well but the heat is having more of a presence today than before"
11/5/18	14		9	31	29.7	85	*2-3*	9	"still zig-zagging the ship every 3 hours" Animals drinking a lot. Faecal pad like "clay" "... no more signs of heat related issues today than yesterday" "... heat is having more of a presence today than before"
12/5/18	15		10	32	29.6	85	*2-3*	9	Faecal pad "increase in tackiness" like "clay". "heat is having more of a presence today than before" Too hot to move sheep with pinkeye "due to the stress of the weather conditions at the present"!
13/5/18	16		11	30	28.3	86	*1-2*	8	Faecal pads "boggy". **Lamb** born to Merino ewe in wether pen "There are no issues with possible heat stress to this point today. It is a welcome relief from the continuous heat and humidity"
14/5/18	17		12	30	28.5	85	*1-2*	6	Faecal pads "crumbly" to "muddy"
15/5/18	18		13	30	28.1	85	*1-2*	5	Faecal pads like "putty". Sudden drop in wind at 5pm ... WBT to 31C
16/5/18	19	Horn of Africa	14	31	29.2	85	*1-2*	6	Faecal pads "friable/crumbly". "... very calm seas. The stock has not really got tired."

Table 3. Voyage 3 with Independent Observer (IO): MV Bader III to Middle East in **May 2018** where 169 of 62,668 sheep (0.27%) died (Source FOI LEX-755 pages 148-418). The adjusted HST for a 55 kg adult Merino sheep sourced from Zone 2 is 28.98°C WBT. (*Table continued from previous page*).

Date	Day ex-Adelaide	Ship location	Day ex-Freo	IO daily report WBT (°C)	Mean deck WBT (°C)	Relative Humidity (%)	*Approx Pant Score*	Sheep deaths	Combined comments on voyage in general and sheep in particular by IO (with redactions by DoA)
17/5/18	20	Gulf of Aden	15	31	28.4	85	*1-2*	6	Much rain overnight. Faecal pads "muddy/crumbly". **Lamb** born to Damara ewe in Damara wether pen
18/5/18	21	Start Red Sea	16	31	27.4	85	*1-2*	8	Much rain overnight. Faecal pads "friable" to "muddy" dt flooding of open decks
19/5/18	22	Red Sea	17	34	33.1	95	*2-3*	*32 Deaths not reported for this day, so figure was calculated as the difference between total and sum of other daily deaths*	WBT 31-32°C RH 95% around 5am. Up to 34°C WBT "Today we suffered a very severe heat event ..." "significant heat stress in a proportion of animals" "... boat zig zagging every 15 minutes ..." "All the decks ... severely hot... alot (sic) of panting ... where the breeze was less" "Severe test of animals/crew/management with WBT of 34°C" "The heat and humidity were foul with it being a severe test for the stock and crew just to cope." "... 10% of the sheep panting significantly ... 50% hot and increased respiration rates" "...sheep often were panting and at times there was open mouth breathing." "Even when the WBT reached 34°C at 92% humidity there was no dramatic signs of heat stress" Faecal pads "crumbly" to "muddy". "The breeze came in from the port side around 4.30pm and the temperatures started to decrease ... still hot 30-31°C WBT." "Today we were in the very severe heat stress areas of the heat curves on the verge of the dying animals section...On this trip the sheep at a 17.5% reduction have plenty of room. **They had room and no amount more would have made much difference**."
20/5/18	23		18	31	28.3	85	*2*	8	"...weather is a huge improvement this morning." "... 2 heat stress related bull deaths." Faecal pads "friable", "crumbly" or "muddy"
21/5/18	24	Gulf of Aqaba	19	30	28.3	85	*2*	8	Faecal pads "friable" to "thick". "...long hot humid trip... equatorial types of heat and humidity since 3rd day out of Freo."
22/5/18	25	Israel	20	28	27.7	66	*1*	5	Faecal pads drying out. Damara **lamb** & Merino **lamb** born. "...bit of panting on deck 5 upper..." "... a full line of empty water troughs on deck 5..."
23/5/18	26	Israel	21	28	27.7	66	*1*	11	**2 lambs** born
24/5/18	27	Jordan	22	25	26	65	*0*	8	**Lamb** born. 2 lambs died
25/5/18	28	Jordan	23	27	26.3	65	*0*	4	
26/5/18	29	Jordan	24	25	24.8	65	*0*	2	1 lamb died

Table 4. Voyage 4 with Independent Observer (IO): MV Yangtze Fortune to Middle East in **May 2018** where 46 of 15,326 sheep (0.30%) died (Source FOI LEX-755 pages 438-462). The adjusted HST for a 55 kg adult Merino sheep sourced from Zone 3 is 29.31°C WBT. Note deck WBT will be 2-4°C higher than bridge WBT.

Date	Ship location	Day ex-Freo	Bridge WBT (°C)	Relative Humidity (%)	*Approx Pant score*	Comments on voyage in general and sheep in particular by IO in final report (with redactions by DoA)
3/5/18	Fremantle	0			*0*	Temperatures taken around 0930hrs: WBT ranged 18-31C, RH 74-80%
4/5/18	Fremantle	1			*0*	
5/5/18		2			*0*	
6/5/18		3			*0*	
7/5/18		4			*0*	
8/5/18		5	27.7	78	*1-2*	On day 5, sheep behaviour changed: "Most sheep in the morning were fast panting with mouths closed" "in afternoon … 1-2 in every other pen … open mouth panting with head elevated" "… disruption of the ventilation supply … for 15-16 minutes…" "This disruption was really noted in the sheep on deck 7."
9/5/18		6			*1-2*	"From day 5-12 just before arrival the pens become (sic) moist"
10/5/18		7			*1-2*	"Other post-mortems revealed case of … heat stress…"
11/5/18		8			*1-2*	
12/5/18		9			*1-2*	
13/5/18		10			*1-2*	**Twins** born. Euthanised "based on the high temperatures expected in the feedlot post-discharge"
14/5/18		11			*1-2*	
15/5/18		12			*1-2*	
16/5/18		13			*1*	
17/5/18	Oman	14			*1*	"humidity disappeared … sheep appeared to get rid of some of the heat load"
18/5/18	Oman	15			*1*	"temperatures during discharge were high around 36° but humidity was low"

Table 5. Voyage 7 with Independent Observer (IO): MV Al Shuwaikh to Middle East in **May 2018** where 609 of 69,117 sheep (0.88% overall, but 0.98% of Adelaide consignment) died (Source FOI LEX-755 pages 480-498). The adjusted HST for a 55 kg adult Merino sheep sourced from Zone 2 is 28.98°C WBT.

Date	Day	Ship location	Day ex-Freo	Bridge WBT (°C)	Relative Humidity (%)	*Approx Pant Score*	Sheep deaths	Comments on voyage in general and sheep in particular by IO in final report (with redactions by DoA)
10/5/18	0	Adelaide		NIL	NIL			"some pens … without water overnight on numerous occasions"
11/5/18	1							"closed holds (Decks 4-1) consistently had higher temperatures and humidity than open holds"
12/5/18	2							
13/5/18	3							
14/5/18	4							
15/5/18	5	Fremantle	0					IO boarded ship
16/5/18	6		1					
17/5/18	7		2					
18/5/18	8		3					
19/5/18	9		4					
20/5/18	10		5				spike	Equatorial spike in mortality
21/5/18	11		6				spike	
22/5/18	12		7				spike	
23/5/18	13		8				spike	
24/5/18	14		9					
25/5/18	15		10					
26/5/18	16		11					
27/5/18	17		12					
28/5/18	18		13				spike	
29/5/18	19		14				spike	Persian Gulf spike in mortality
30/5/18	20		15				spike	
31/5/18	21		16				spike	
1/6/18	22		17				spike	
2/6/18	23	Kuwait	18					"livestock were without fodder for two sequential feedings…sheep vocalising loudly" "towards end of voayage (from day 18) … higher number of water troughs contained fouled water" "manure was falling from upper tiers into waters below"
3/6/18	24	Kuwait	19					
4/6/18	25	Qatar	20				spike	Qatar spike in mortality
5/6/18	26	Qatar	21				spike	
6/6/18	27	Qatar	22				spike	
7/6/18	28	UAE	23				spike	UAE spike in mortality
8/6/18	29	UAE	24					

Table 6. Voyage 8 with Independent Observer (IO): MV Maysora to Turkey in **May/June 2018** where 155 of 68,039 sheep (0.23%) died. Highest mortality was in 53 kg Merino adult sheep (Source FOI LEX-755 pages 499-530). The adjusted HST for a 53 kg adult Merino sheep sourced from Zone 3 is 28.96°C WBT. Note deck WBT will be 2-4°C higher than bridge WBT.

Date	Ship location	Day ex-Freo	Sea temp (°C)	Bridge WBT (°C)	Relative humidity (%)	*Approx Pant Score*	Comments on voyage in general and sheep in particular by IO in final report (with redactions by DoA)
31/5/18	Fremantle	0	21	13.7	62	*0*	Allometric space allocation *k*=0.033 for this voyage
1/6/18		1				*0-1*	"6 lambs born" over entire voyage
2/6/18		2				*0-1*	
3/6/18		3				*0-1*	
4/6/18		4				*0-1*	"temperatures of sea, decks and bridge rose gradually to Day 5"
5/6/18		5	27	23.7	70	*0-1*	"sheep ... panting scores of 0-1 ... about 50% PS1 by Day 5"
6/6/18		6				*1*	
7/6/18		7				*1*	
8/6/18		8	30	25.5	~ 70%	*1*	
9/6/18	Equator	9			rain	*1*	
10/6/18		10			rain	*1*	
11/6/18		11			rain	*1*	
12/6/18	Gulf of Aden	12			gale	*1*	"steered the vessel in a zig zag pattern"; 95% sheep PS1, 5% PS2, "occasional ... mouth open breathing"
13/6/18		13			gale	*1*	
14/6/18		14				*1*	
15/6/18		15		29.8	79	*1-2*	"maximum panting score reached by sheep was 2 ... on Day 15 and 16" HST for 53 kg sheep 28.96°C
16/6/18		16				*1-2*	"higher tendency for animals to remain standing"
17/6/18	(Jedda)	17		28.8	79	*0-1*	"Panting scores of ... sheep ... dropped to 0 by Day 17" "75% of pen would be lying down"
18/6/18		18				*0*	
19/6/18		19				*0*	
20/6/18	Turkey	20				*0*	
21/6/18	Turkey	21		21.8	76	*0*	

Table 7. Voyage 9 with Independent Observer (IO): MV Al Messilah to Middle East in **June 2018** where 306 of 57,428 sheep (0.53%) died (Source FOI LEX-755 pages 698-793). The adjusted HST for a 55 kg adult Merino sheep sourced from Zone 3 is 28.88°C WBT. Note deck WBT will be 2-4°C higher than bridge WBT.

Date	Ship location	Day ex-Freo	Bridge WBT (°C)	Relative humidity (%)	Sheep deaths	*Approx Pant Score*	Comments on voyage in general and sheep in particular by IO in final report (with redactions by DoA)
5/6/18	Fremantle					*0*	
6/6/18	Fremantle	0				*0*	IO boarded ship
7/6/18		1			8		"Each deck has just one thermometer… unlikely to be representative of the worst environmental conditions on the … deck"
8/6/18		2			17		"relationship between ambient temp … and signs of increased respiratory effort/stress did not emerge as clear cut to me"
9/6/18		3			30		
10/6/18		4			29		
11/6/18		5			43		Mortality curve pattern "associated with probable enterotoxaemia"
12/6/18		6			43		
13/6/18		7			25		
14/6/18		8			14		Morbidity: KCS in second week," 20% in some pens"
15/6/18		9			13		
16/6/18		10	27	78	9	*2*	"wet bulb … around 29-30°C a greater percentage of the sheep showed the slightly open mouth breathing and lip licking …"
17/6/18		11			12	*1-2*	"Sheep distribuated themselves within the … pen … around the available vents… when warmer more humid"
18/6/18		12			8	*1-2*	
19/6/18	Entered Persian Gulf	13		60-70	14	*1-3*	"…humidity across water extremely variable to high but … much better than it can be." "open mouth breathing and panting … most commonly seen on the day the voyage entered the Persian Gulf"
20/6/18	Kuwait	14		40	6		
21/6/18		15		60-70	9		"Toward the end of the voyage I came across several thermometers where the wet bulb temperature was as high as and in one case higher the the dry bulb reading…"
22/6/18		16		60-70	7		
23/6/18		17		60-70	8		
24/6/18	Qatar	18		60-70	7		
25/6/18	UAE	19		60-70			
26/6/18	UAE	20		60-70			

Table 8. Voyage 10 with Independent Observer (IO): MV Bahijah to Middle East in **June 2018** where 17 of 9,227 sheep (0.18%) died (Source FOI LEX-755 pages 794-818). The adjusted HST for a 55 kg adult Merino sheep sourced from Zone 3 is 28.88°C WBT. The figures in purple correspond to x-axes in Figures **8b&d**. Pant Scores were derived from **Figure 8d**.

Date	Ship location	Day ex-Freo	Day on charts in IO Report Summary	Bridge WBT (°C)	Relative humidity (%)	*Approx Pant Score*	Comments on voyage in general and sheep in particular by IO in final report (with redactions by DoA)
9/6/18	Fremantle						"temperatures recorded every 4 hours by the crew with a handheld device…" "… no maximum temperature recorded"
10/6/18	Fremantle	0				*0*	"My data for measured respiratory rates of sheep on board consistently measured differently (much higher) that what was submitted by the (redacted) in his daily report."
11/6/18		1				*0*	"The sheep visibly struggled with the heat on board"
12/6/18		2				*0*	
13/6/18		3				*0*	
14/6/18		4				*0*	
15/6/18		5	1			*1*	First noticed panting
16/6/18		6	2			*1*	
17/6/18		7	3			*2*	"A degree of heat stress existed … from the equator until the passage of the Suez Canal. There was a low level of discomfort and elevated respiratory rate of almost all sheep during this time. There was only one afternoon where this was observed to progress to open mouth panting and higher levels of heat stress existed across the ship."
18/6/18	Equator	8	4			*2-2.5*	"… marked increase in respiratory discomfort at the equator…"
19/6/18	(Maldives)	9	5			*2-2.5*	"… humidity levels were generally highest in the morning…"
20/6/18		10	6			*1-2*	
21/6/18		11	7			*1-2*	
22/6/18		12	8			*1-2*	
23/6/18		13	9			*1-2*	
24/6/18		14	10			*1-2*	
25/6/18	Gulf of Aden	15	11			*2-2.5*	"… discomfort markedly increased again in the Gulf of Aden…"
26/6/18		**16**	12			*2.5-3*	"… hottest afternoon…sheep would stop and start open mouth panting…"
27/6/18	Red Sea	17	13			*2*	
28/6/18		18	14			*2*	
29/6/18	Suez Canal	19	15			*1*	
30/6/18	Haifa, Israel	20	16			*1*	

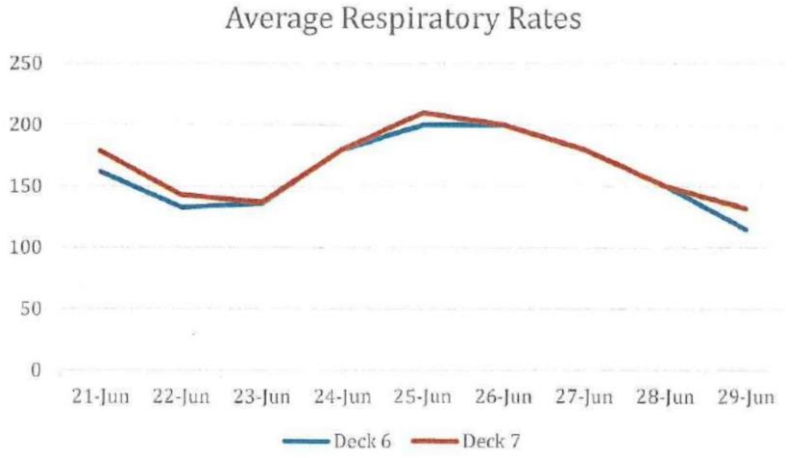


Figure 8a. Average respiratory rates for sheep travelling to Israel in June 2018. At least 30-40 sheep from each deck were counted.

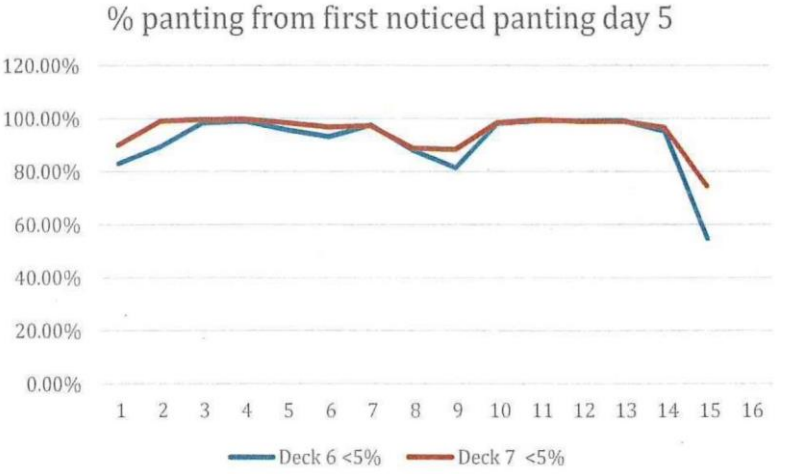


Figure 8b. Percentage of sheep panting for sheep travelling to Israel in June 2018. At least 10 pens per deck were observed at the hottest part of the day. Numbers on *x*-axis correspond to purple figures in Table 8.

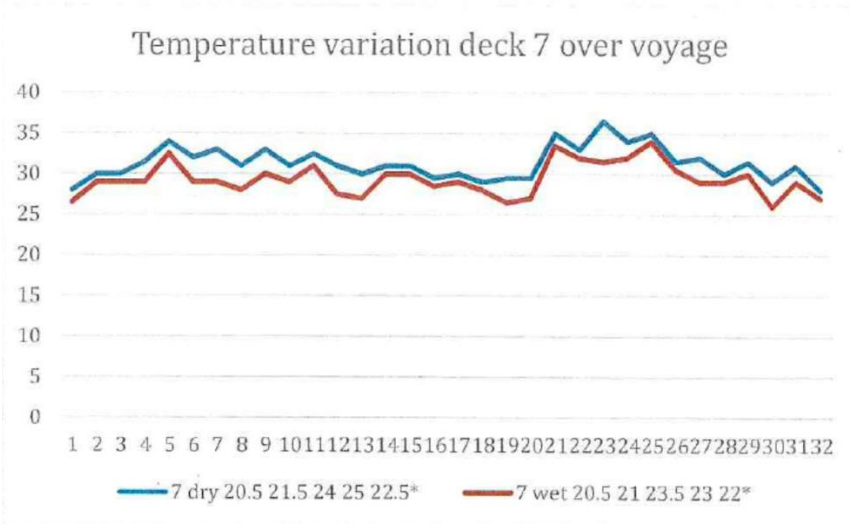


Figure 8c. Temperature variation on Deck 7 during voyage to Israel in June 2018. (Source: Final IO Report for MV Bahijah voyage June 2018, FOI LEX-755 pages 806-809).

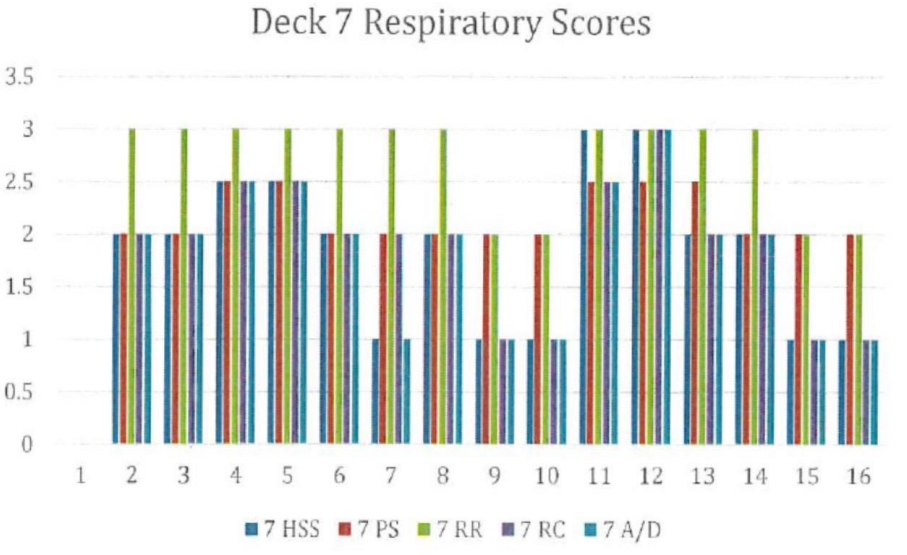


Figure 8d. Average respiratory rates for sheep travelling to Israel in June 2018. Numbers on x-axis correspond to purple figures in Table 8.

Table 9. Summary of 2019 IO Report Summaries (source: http://www.agriculture.gov.au/export/controlled-goods/live-animals/livestock/regulatory-framework/compliance-investigations/independent-observations-livestock-export-sea). Months: November - December 2018; January, February and May 2019.

IO #	Date of departure (1-2 days loading prior)	Ship (MV)	Port/s of departure	Port/s of discharge	Days ex-Fremantle	Sheep total	Sheep died	% died	Space allocation (ASEL 2.3 2011)	IO Summary Report comments by DoA *pertaining to sheep only (cattle data not included)*
31	9/11/18	Yangtze Harmony	Fremantle	Oman	16 days	14788	36	0.24	**+17.5%**	"Temperature readings were taken daily from each deck around 10.00am. The observer noted that there was little variation over the day and there was no major inconsistency between the temperature readings on the daily report and in situ thermometers."
36	13/11/18	Al Shuwaikh	Fremantle	Kuwait, Qatar,	25 days	58886	153	0.26	**+17.5%**	"Temperatures on the hottest time was around **31/32 degrees C dry bulb and 86% humidity**." "Overall, the environmental conditions were relatively benign."
47	5/12/18	Al Messilah	Fremantle	Kuwait, Qatar, UAE	22 days	65,602	130	0.20	**+17.5%**	"maximum temperatures were recorded on days 7, 8 and 9 and were around **32°C and 86% humidity**" when "maximum panting score was assessed as between normal with elevated respiratory rates to mild panting" and "the respiratory rate increased for most animals however no open mouth panting was observed" "The wet bulb temperature decreased from Day 10 and pant scores reverted to normal" and "respiratory character appeared normal."
57	23/12/18	Al Shuwaikh	Fremantle	Kuwait, Qatar, UAE	23 days	69917	211	0.30	**+17.5%**	"The crew recorded temperature and humidity measurements every 4 hours on each deck. The highest temperature recorded on the decks was **32°C dry bulb with an 86% humidity**." "The sheep in the enclosed lower decks experienced higher temperatures and humidity compared to the upper decks. Respiratory rates increased as the ship approached the equator and remained elevated in the lower decks for longer than the open decks. Some panting was observed. For the warmest part of the voyage the average heat stress score was between 1 and
67	18/1/19	Al Messilah	Fremantle	Kuwait, Qatar	20 days	64548	140	0.22	**+17.5%**	"some sheep had wool length longer than 2.5 cm and should have been drafted out" "No animal showed any evidence of heat stress as a cause of death" "Panting score 1 was evident after day 1 but the percentage of animals with pant score 1 dropped once the equator was crossed. There was no significant evidence of sheep with heat stress score 3 (open mouth)"
74	5/2/19	Al Shuwaikh	Fremantle	Kuwait, Qatar, UAE	24 days	71160	329	0.46	**+17.5%**	"**33°C with humidity at 86%** and a wet bulb temperature of 31°C for approximately 4 days around the equator" "During the warmest period of the journey respiratory rates were elevated but at no time were there any signs of open mouth breathing observed."
76	8/2/19	Brahman Express	Fremantle	Israel	21 days	5004	30	0.60	**+17.5%**	"From the first day of loading in Fremantle with an ambient temperature of 33°C, the sheep exhibited an increased respiratory rate. The increased rate remained throughout the voyage. Temperature and humidity increased on entry into the Red Sea and respiratory rates also increased. However, no sheep were observed with open mouth panting." "Temperatures were consistently measured at around **30 – 32°C and humidity of 80 - 86%**. On entry into Eilat port, the temperature recorded was down to 25°C and 75% humidity."

Table 9. Summary of 2019 IO Report Summaries (source: http://www.agriculture.gov.au/export/controlled-goods/live-animals/livestock/regulatory-framework/compliance-investigations/independent-observations-livestock-export-sea). (*Table continued from previous page*).

IO #	Date of departure (1-2 days loading prior)	Ship (MV)	Port/s of departure	Port/s of discharge	Days ex-Fremantle	Sheep total	Sheep died	% died	Space allocation (ASEL 2.3 2011)	IO Summary Report comments by DoA *pertaining to sheep only (cattle data not included)*
86	23/2/19	Al Messilah	Fremantle	Kuwait, Qatar, UAE	21 days	66165	209	0.32	**+17.5%**	"The animals did not exhibit any significant signs of heat stress on the voyage. As the voyage neared the equator, where average temperatures were higher, some animals were observed with elevated respiratory rates and a few animals with longer wool were heat affected and seen to open mouth pant. As the vessel approached the Gulf of Oman, respiratory rates returned to normal."
123	8/5/19	Al Messilah	Fremantle	Kuwait, UAE	21 days	58568	99	0.17	Special conditions k=0.033	"Mortalities for this voyage were the lowest in the vessel's 166 voyage history" "Temperatures for the voyage below decks reached a maximum of 34°C dry bulb, and **wet bulb of 31.7°C**. The average heat stress score was 2, with open mouth breathing observed in several sheep per deck during the hottest part of the voyage (heat stress score 3). No animals were observed with a heat stress score of 4 (open mouth, tongue out). Lambs travelled well in the higher wet bulb temperatures with the least mortality rate encountered."
127	19/5/19	Maysora	Fremantle	Israel, Jordan	29 days	48610	118	0.24	Special conditions k=0.033	"nature of the open decks (Decks 7-11) meant that individual areas of the open decks were subjected to varying air flow so '**hotspots**' tended to be unpredictable and were not observed to persist. The ship made **regular minor course changes** as required to improve airflow across the open decks. In the enclosed decks temperature and humidity readings were less variable. During periods of increased humidity, open mouth panting was rarely observed (<1% of animals observed)." "Extra fans were placed in the lower decks near bulkheads to improve air flow in these slightly restricted spaces." "Sawdust was applied to pens that had wet areas to firm up pad condition. This did not always absorb sufficient moisture to improve the pad condition, however, no adverse animal welfare issues were noted." "extreme conditions were observed from Day 24 until completion of discharge with temperatures reaching 37.2 degrees Celsius dry bulb, 25.8 degrees Celsius wet bulb and relative humidity around 40%. During this period, the heat stress score for sheep generally ranged from one to two. However for a period of between 5-10 hours each day during the afternoon and early evening, there were isolated examples (<1% of sheep) of heat stress scores rising to three on the open decks before then dropping again later in the night." "Open mouth panting was rarely (<1%) observed in either sheep or cattle even on the days with the highest wet bulb temperatures (32°C)."

Table 9. Summary of 2019 IO Report Summaries (source: http://www.agriculture.gov.au/export/controlled-goods/live-animals/livestock/regulatory-framework/compliance-investigations/independent-observations-livestock-export-sea). (*Table continued from previous page*).

IO #	Date of departure (1-2 days loading prior)	Ship (MV)	Port/s of departure	Port/s of discharge	Days ex-Fremantle	Sheep total	Sheep died	% died	Space allocation (ASEL 2.3 2011)	IO Summary Report comments by DoA *pertaining to sheep only (cattle data not included)*
133	26/5/19	Ocean Drover	Fremantle	Kuwait, UAE	18 days	56,915	65	0.11	Special conditions k=0.033	"from day 5 when the wet bulb temperatures reached 28°C there was a mild increase in heat stress scores (between 1 and 2) and it was common that 5 – 10% of sheep per pen would show a heat stress score of 3. This pattern maintained while the wet bulb temperature gradually increased to a daily max of 30 to 31°C on about day 10 when the vessel was passing Jebel Ali for the first time in the Persian Gulf." "The wet bulb temperatures dropped very quickly on days 11 and 12 towards arrival in Kuwait. Although the dry bulb temperatures on decks increased in the day or so before arriving in Kuwait (commonly 41°C), this was accompanied by a sharp reduction in relative humidity (commonly 14%) and wet bulb temperature (commonly 22°C). During this period of high dry bulb temperatures and low relative humidity the numbers of sheep showing a heat stress score of 3 was generally less than 5%." "After departing Kuwait and returning toward Jebel Ali, the humidity and wet bulb temperatures on decks increased rapidly from day 14 to day 15 (commonly a daily maximum around 31°C and 85%). The heat stress scores increased during this period of rapid wet bulb increase, particularly in the pens identified as potential hot spots on decks 7 and 9 where 30 – 50% of sheep per pen showed heat stress scores of 3 on day 15. However this increase in the heat stress scores was transient as the sheep adapted to the rapid increase in wet bulb temperatures. Adverse animal welfare outcomes were not observed at any of the potential hot spot locations during the voyage."

Lack of diurnal and day-to-day variation in WBT

It is important to remember that where bridge/ambient wet bulb temperatures are used in any of the above tables:

- The deck wet bulb temperatures (experienced by the sheep) are generally 2-4°C higher than those of the bridge/ambient.

- There is little diurnal variation during any 24-hour period, so sheep are unable to shed heat load during cooler periods. This is very different to sheep in a paddock on a hot day that are able to seek shade, have unrestricted access to a water trough, and shed their heat load at night when the sun sets. There is also very little day-to-day variation in WBT from around latitude 5°S, particularly between May and October, but in other months as well. This has been described by Catherine Stockman in her doctoral experiments on heat stress in sheep to mimic conditions during live sheep export:

  > "*Dry bulb temperature and moisture content … were changed over a period of 14 days to mimic a typical long haul ship voyage from Western Australia to the Middle-East … The wet bulb temperature was held relatively constant over the 24 hour period, to mimic the lack of diurnal variation in environmental temperatures experienced by animals transported in equatorial regions*" (Stockman 2006).

  This lack of diurnal and day-to-day variation is also illustrated in **Figure 9** where temperature data loggers recorded bridge/ambient WBTs.

Where the climate is adverse such that the WBT is greater than the sheep's heat stress threshold, the implications are that sheep's core body temperatures remain elevated 24 hours a day, as do their respiratory rates in an attempt to thermoregulate, and this can extend for days and even weeks without respite (Stockman 2006, Beatty, Barnes et al. 2008) (AVA 2018, AVA 2018).

For this reason and based on the supporting data given above, it is important that Policy Option 2, if adopted, is modified to ensure that granting of export permits ceases on a date in May such that sheep are not on the water for any days in June.

The AVA also supports the requirement for exporters to place automated data (WBT) logging equipment on board vessels and report that data to the department, at least for the months May to October (inclusive), and in all months on any voyages crossing the equatorial zone. WBTs should be recorded in a range of locations across the decks to ensure data from the hottest locations is also captured. This data, as well as past accumulated data, should be used to further validate the HSRA model.

Voyage 1 wet bulb temperatures calculated from automatically logged data and the manually collected data for the same locations are plotted in Figure 0.5. The dry bulb temperatures and relative humidities are plotted in the same way in Figure 0.6 and Figure 0.7. The figures show clearly that, although the dry bulb temperature and relative humidity may oscillate considerably, the wet bulb temperature changes more slowly with time. In particular, during the hottest weather (day 17) there may be no overnight respite from the oppressive conditions. Some respite is seen (during daylight hours) on days 18 and 19.

A general summary of the response of Voyage 1 sheep to hot conditions is presented in Figure 0.1. Apart from the cross-bred lambs (Deck 8, pens 1 & 5) and to a lesser extent the Merino lambs (Deck 5, pens 1 & 2), below a wet bulb temperature of 25^{0}C the observed sheep maintained a steady body temperature of approximately 39.5 to 40.0^{0}C. The body temperature of some lines rose as the wet bulb temperature rose above 24^{0}C. The point at which the rise started, and the rate of rise, varied with different classes of animals. All animals had elevated body temperatures for wet bulbs above 30^{0}C. On the basis of Figure 0.1, the heat stress threshold (HST) for adult sheep was estimated to lie between 28 and 30°C wet bulb.

A similar assessment was possible from Voyage 2, using the data presented in Figure 0.2. At wet bulb temperatures below approximately 26°C, the rectal temperature of observation animals fell within the range of 39.25 and 40.5°C. A rise in rectal temperature (compared to the 'normal' range of 39.25 to 40.25°C) was first seen at a wet bulb temperature of 26°C, and occurred consistently (always above 40.25°C) once the ambient wet bulb temperature exceeded 30°C. These data are in general agreement with earlier findings, but suggest that the HST may range between a low of 26°C and the same upper limit of 30°C seen from Voyage 1. These data provide no information about the HST distribution between these points.

The onset of stress based on observations of the breathing rate taken across the whole pen was generally consistent with the onset of stress as seen by rectal temperature rise.

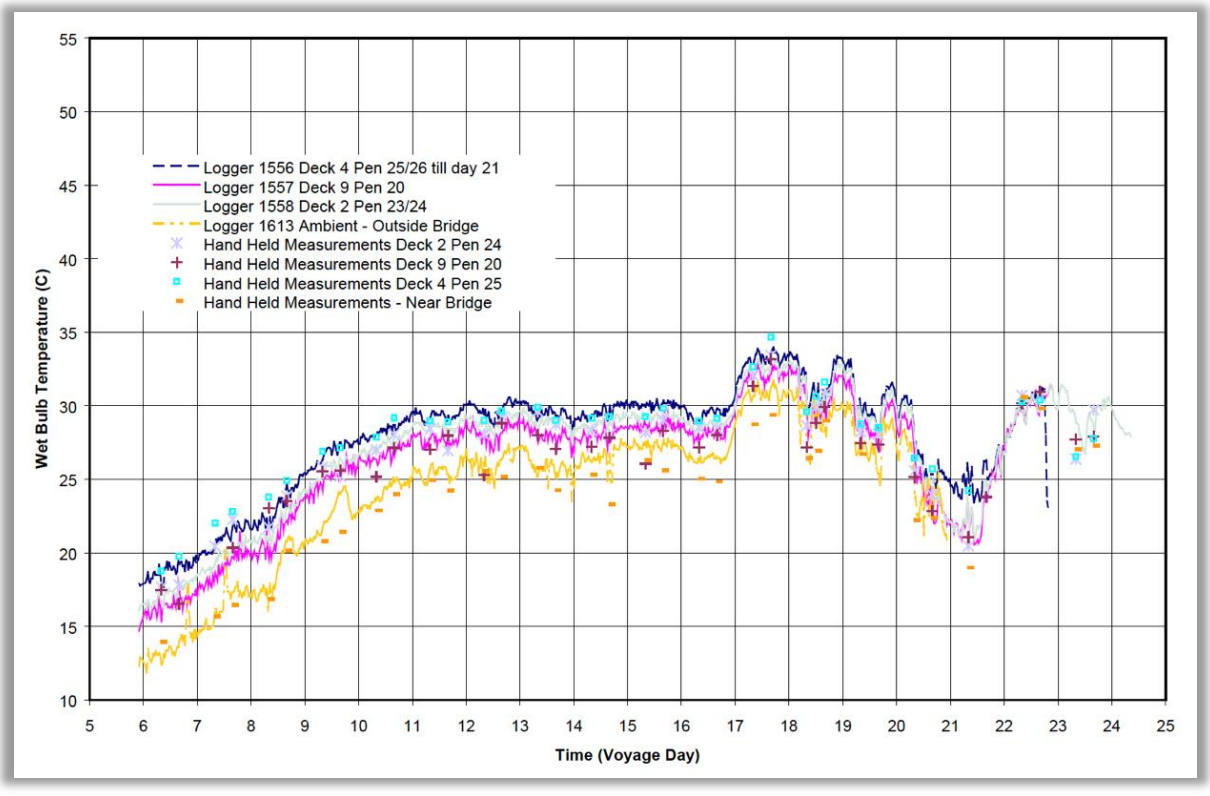


Figure 9. Excerpt of text and "Figure 0.5 Voyage 1" from Maunsell-Australia (2004) demonstrating (a) the long-available ability to log temperature and humidity on live export ships, (b) how deck wet bulb temperature (WBT) is 2-4°C hotter than bridge/ambient WBT, (c) the lack of diurnal and day-to-day variation in WBT on livestock decks during a voyage on a ship with fully enclosed decks in **June/July**, and (d) how "the onset of stress based on observations of the breathing rate taken across the whole pen was generally consistent with the onset of stress as seen by rectal temperature". The ship crossed the Equator on day 11, and entered the Persian Gulf on day 17.

Policy option 3

Policy option 3 proposes that a revised HSRA model would be adopted where risk settings were based on heat stress thresholds (HSTs) or an approach based on agreed animal welfare indicators.

The AVA supports the paradigm shift recommended by McCarthy for a move away from risk assessment based on mortality, to a risk assessment based on animal welfare. The AVA also supports a change in the way the Heat Stress Risk Assessment (HotStuff) model is implemented, so that it is used to calculate the risk of WBTs exceeding the heat stress threshold for the particular sheep on any proposed voyage, rather than only being used to calculate stocking density for the proposed voyage.

The AVA strongly supports the recommendation of the HSRA Review, for a risk assessment based on 2% probability that deck temperatures could exceed a sheep's HST.

For that reason, the AVA supports Option 3, provided risk settings are based on heat stress thresholds (HSTs), and provided that Option 3 is implemented in combination with the modified version of Option 2 we have recommended.

Implementation of the HSRA (HotStuff) Model to determine the heat stress threshold in October to May (inclusive) is appropriate for every voyage that crosses the Equator carrying any livestock, regardless of estimated duration (short haul, long haul or extra-long haul).

This recommendation is in line with the recommendations made by the AVA in submissions to the ASEL Stage 2 Issues Paper[23] and the HSRA (HotStuff) Review[24].

Research was undertaken more than 15 years ago to measure and mathematically model data from (a) many voyages carrying sheep and cattle from Australia, and (b) experiments performed in controlled climate rooms, to define heat stress thresholds and mortality limits for various classes of sheep and cattle (Maunsell-Australia 2003, Barnes, Beatty et al. 2004, Maunsell-Australia 2004, McCarthy 2005, Stockman 2006, Beatty, Barnes et al. 2008). The end product, HotStuff, has been refined since (Figure 10) (Stacey 2011, Ferguson and Lea 2013, Stacey 2017, Stacey 2017) and historically has been used, where required by legislation (EAN 2012-08[25] and EAN 2018-06[26]), to predict risk of mortality due to heat stress on selected voyages from Australia.

Nevertheless, HotStuff can be also used to predict the heat stress threshold for different lines of stock and should be applied in all months of the year where live animal export vessels cross the Equator. The equatorial waters (latitudes 5°S to 5°N) of the Indian Ocean, have a relatively uniform WBT around 25-26°C with a slight peak from April to June when trade winds are weaker (Maunsell-Australia 2003). South of latitude 5°S there are periods between March and May when the mean WBT is close to 26°C with occurrences in April and other months of the year when 28°C WBT is reached (Maunsell-Australia 2003).

23 Source: https://www.ava.com.au/siteassets/advocacy/ava_comment_on_asel_stage-2-issues-paper.pdf
24 Source: https://www.ava.com.au/siteassets/advocacy/ava-hotstuff-submission.pdf
25 Source: http://www.agriculture.gov.au/export/controlled-goods/live-animals/advisory-notices/2012/2012-08
26 Source: http://www.agriculture.gov.au/export/controlled-goods/live-animals/advisory-notices/2018/2018-06

Base Parameter	Bos taurus		Bos indicus			Merino		Awassi	
	beef	dairy	beef	25%	50%	adult	lamb	adult	lamb
Weight (kg)	300	300	300	300	300	40	40	40	40
Core Temperature (degrees C)	40	40	40	40	40	40	40	40	40
Condition (Fat Score)	3	3	3	3	3	3	3	3	3
Coat	mid	mid	N/A	N/A	N/A	shorn	shorn	hairy	hairy
Acclimatisation WB Temp	15	15	15	15	16	15	15	15	15
Base HST (degrees C)	30	28.2	32.5	31.25	31.875	30.6	26.7	31.9	28.6
Base ML (degrees C)	33.2	32.9	36.0	34.60	35.30	35.5	35.20	36.1	35.90
Beta distribution lower limit (degrees C)	30.31	29.88	34.30	32.30	32.30	33.58	33.17	34.52	34.15
Beta distribution upper limit (degrees C)	34.74	34.51	36.90	35.82	35.82	36.52	36.29	37.03	36.83

Figure 10. Heat stress thresholds and mortality limit values for "standard animals" of different classes of sheep and cattle defined in the heat stress risk assessment model, HotStuff V4 (Stacey 2017).

The HST generated by HotStuff is defined as:

> *"the maximum ambient wet bulb temperature at which heat balance of the deep body temperature can be controlled using available mechanisms of heat loss'. That is; when the local air wet bulb temperature reaches any animal's HST, the animal is on the verge of becoming stressed. As implied above, incipient stress in this sense means the first uncontrolled rise in core body temperature. We take this as being 0.5^{o}C above what the core temperature would otherwise have been"* (Maunsell-Australia 2003).

The HST generated by HotStuff is the same value designated "HST 2" by Catherine Stockman in her research into heat stress in sheep (Table 10) (Stockman 2006).

Table 10. Heat stress threshold definitions (Stockman 2006).

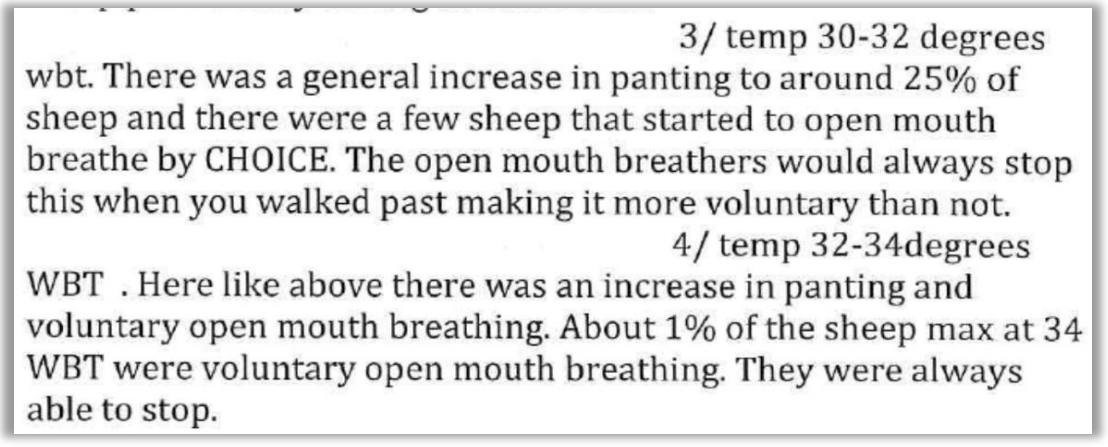
	HST definition
HST 1	The daily mean wet bulb temperature on the day that the daily mean core body temperature first significantly increases over pre-heat values
HST 2	The daily mean wet bulb temperature on the day that the daily mean core body temperature first significantly increases 0.5°C above pre-heat values
HST 3	The daily mean wet bulb temperature on the day that the daily mean core body temperature first significantly increases 1°C above pre-heat values

Defining panting scores

Attempts have been made to ascribe a Panting Score to respiratory rates and/or respiratory character that correspond with the loss in ability to regulate core body temperature (HST 1, 2 & 3).

It has been noted that "*the onset of stress based on observations of the breathing rate taken across the whole pen was generally consistent with the onset of stress as seen by rectal temperature*" (Maunsell-Australia 2004) but because of physiological differences amongst sheep, it is difficult to consistently link specific respiratory rate and/or respiratory character with a specific increase in core body temperature; hence variation appears in all tables that attempt to assign a panting score to a specific range of respiratory rates or core body temperature range (Stockman 2006, McCarthy 2018, AVA 2019, Barnes, Phillips et al. 2019, Lees, Sullivan et al. 2019).

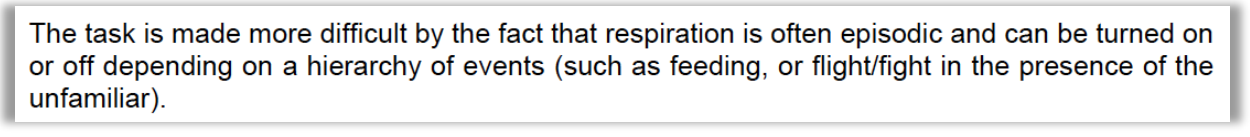
This can lead to varying interpretation and misunderstanding, as illustrated below:
Figure 11 is an excerpt from an IO report describing episodic open-mouthed panting by sheep attempting to thermoregulate as "voluntary" on a voyage from Australia to the Middle East in May 2018. Though this observer concluded the open mouth panting was "voluntary", it is more likely that the open mouth panting was an essential cooling mechanism employed by the sheep, but which ceased when the sheep was disturbed by the IO. Open-mouth breathing is undertaken by sheep in an attempt to maintain their core body temperature and physiological functions so they do not die, but may cease if overridden by other stressors such as hunger, thirst or the flight/fight response to the presence of an observer in or near their pen. This is articulated by McCarthy (2005) in **Figure 12**.



3/ temp 30-32 degrees wbt. There was a general increase in panting to around 25% of sheep and there were a few sheep that started to open mouth breathe by CHOICE. The open mouth breathers would always stop this when you walked past making it more voluntary than not.

4/ temp 32-34degrees WBT . Here like above there was an increase in panting and voluntary open mouth breathing. About 1% of the sheep max at 34 WBT were voluntary open mouth breathing. They were always able to stop.

Figure 11. Excerpt from IO report 3 on MV Bader III in May 2018 (FOI LEX-755 page 154) describing open-mouth breathing as "voluntary".



The task is made more difficult by the fact that respiration is often episodic and can be turned on or off depending on a hierarchy of events (such as feeding, or flight/fight in the presence of the unfamiliar).

Figure 12. Excerpt from McCarthy (2005) describing the difficulties of accurate measurement of respiratory rate.

Nevertheless, the ***onset of phase 1 panting is a good indicator of the onset of thermal stress*** and the ***onset of phase 2 panting indicates severe heat load and risk of respiratory alkalosis*** (Figure 13) (AVA 2018).

Option 3 on its own, (without an accompanying defined period of prohibition as set out in Option 2), poses risks, due to the potential for varying interpretation and implementation of the HSRA model. There are varying opinions on what is an acceptable duration of open-mouth panting. The AVA believes that sheep should not be exposed to HST 3 (open mouth panting) even for short periods on voyages to or through the Middle East. This is because they will have already suffered moderate heat stress up until reaching HST 3, and are unlikely to be able to easily return to thermoneutrality, due to lack of respite in temperatures overnight and lack of day to day variation in WBT. This is very different to sheep open-mouth panting on land, when they will be able to shed their heat load at night.

On sea voyages to the Middle East, once sheep reach HST 3 (open-mouth panting and severe heat stress), they are on the tipping point of irreversible heat stress. If conditions should change for the worse or there is a sudden spike in temperatures, these animals are at high risk of suffering extreme heat stress and dying. Given the Department's aim is now to reduce poor animal welfare outcomes (not just reduce mortality), months where any duration of open-mouth panting has been recorded should be seen as high risk months for subsequent voyages.

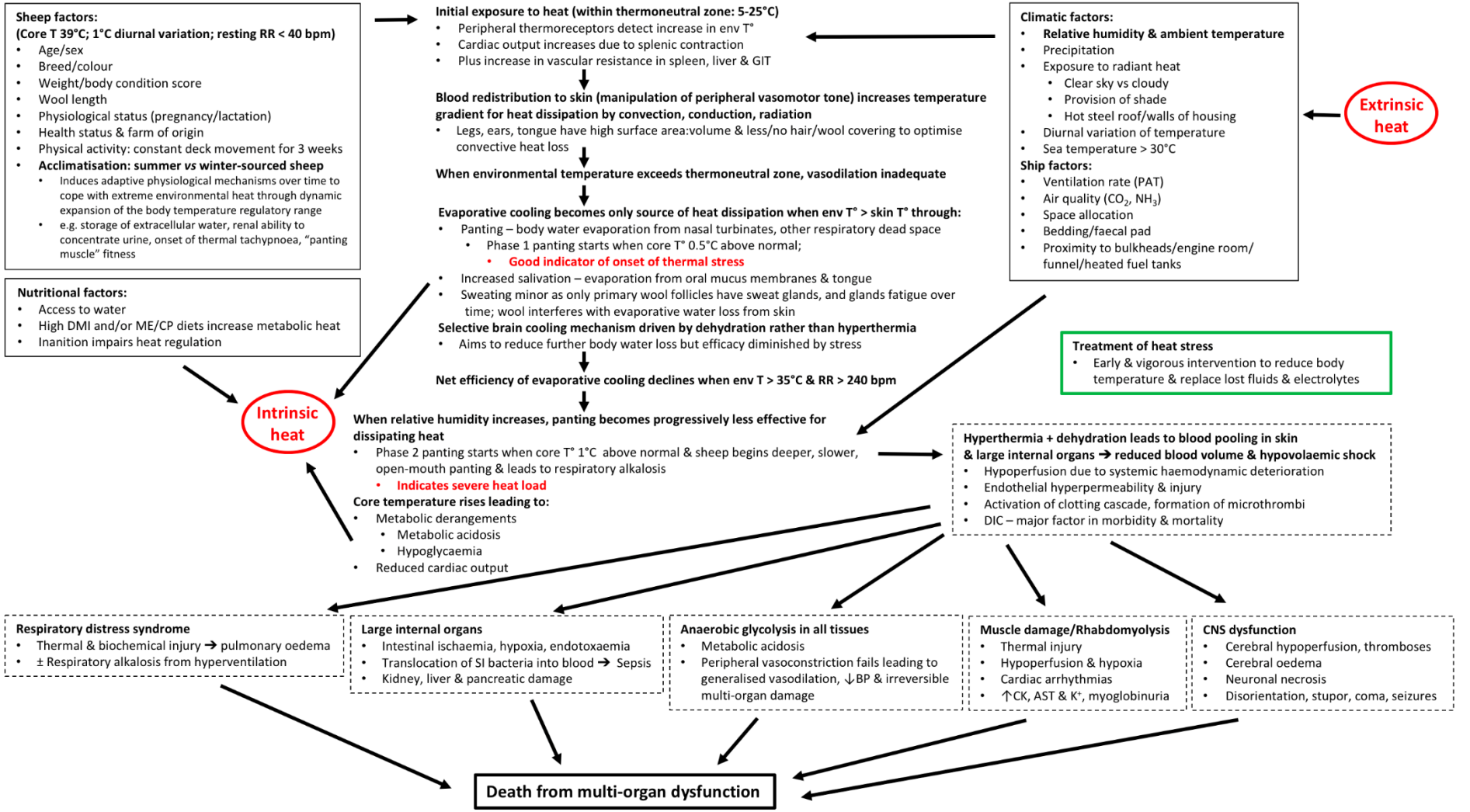


Figure 13. Pathogenesis of heat stress in sheep (appears as Figure 2 in (AVA 2018).

The AVA has presented many graphs illustrating how the adjusted Heat Stress Threshold in HotStuff predicts the likelihood of heat stress in sheep (Figures 14-18 in that same document) (AVA 2018) and made recommendations in that submission including:

> *"It is inappropriate for sheep or any other animals to be exposed to long periods of heat stress, due to the impact of cumulative heat load on normal physiological processes. Sheep should never be exposed to HST 3, even for short periods. Sheep should not be exposed to HST 2 for more than 3 consecutive days where there is no diurnal variation in temperature. Diurnal variation allows sheep to return to their thermoneutral zone and for respiratory rates to return to resting range at night. Otherwise, sheep can start dying within 3 days of being exposed to hot, humid weather, as heat load is cumulative. This duration of permissible exposure should be further reduced in the presence of other welfare imposts and/or co-morbidities as these will further reduce the animal's ability to cope. This is consistent with the 5 Domains approach to assessing welfare which looks at severity and duration of welfare compromise, as well as the anticipated integrated impact of the combined welfare impacts on the animal's mental state."*

> *"Death of sheep secondary to heat stress during live shipping is not just of concern during "heat wave conditions" but a major cause of mortality during all shipments of sheep across the Equator. It is apparent that even on low mortality shipments, there are extended periods where sheep are suffering significant and prolonged heat stress, which is not acceptable. Further, this can occur at any time of the year when shipments cross the equator, and for that reason the HotStuff Model should be applied to all voyages to the Northern Hemisphere, in all months of the year. Even summer-acclimatised sheep travelling in the cooler months of the Northern Hemisphere are at risk of heat stress crossing the Equator."*

Table 11 and
Figure 14 (below) correlate comments made by the IO in daily reports (FOI LEX-755 pages 148-418) and adjusted HSTs for sheep that could have been on a voyage from Australia to the Middle East in May 2018. This voyage falls into a category that has historically been regarded as a low mortality shipment (0.27%); however it can be seen that sheep experienced prolonged and consistent exposure to WBTs above their heat stress thresholds over periods of many days.

Other shipments in April and May 2018 (space allocation ASEL + 17.5%; **Table 1-Table 5**) and 2019 (space allocation *k*-value 0.033; **Table 9**) also provide examples of heat stress occurring in sheep in these months.

Sheep are exceedingly stoic, and although fewer animals may have died in these examples, this does not negate the fact that the surviving animals would have suffered prolonged effects of heat stress throughout these journeys. The Australian Veterinary Association, in submissions into the ASEL and HotStuff reviews, has described this prolonged exposure of sheep to heat stress without respite as unacceptable.[27] [28]

The AVA therefore supports adoption of Option 3, provided that:

1. Risk settings are based on heat stress thresholds (HSTs), and
2. The risk assessment is based on 2% probability that deck temperatures could exceed a sheep's HST, and
3. Option 3 is implemented in combination with the modified version of Option 2 AVA has recommended.

27 Source: https://www.ava.com.au/siteassets/advocacy/ava-hotstuff-submission.pdf
28 Source: https://www.ava.com.au/siteassets/advocacy/improving-animal-welfare/ava-response-to-hsra-technical-panel-review-1-03-19.pdf

Table 11. Adjusted heat stress threshold (HST) wet bulb temperature (WBT, °C) for an example of sheep that could have travelled from from Adelaide and Fremantle to Israel and Jordan in May 2018. Data was derived from Independent Observer Daily Reports (Source FOI LEX-755 pages 148-418). (F = factor applied in HotStuff model calculations, std = standard).

Age of Merino sheep, month & destination	Weight (kg)	F wt	Core temp (°C)	Fat score	F fat	Fleece length	F coat	Zone	Zone temp (°C)	F zone	Base HST (°C)	Tcore-HST (°C)	Adjusted HST WBT (°C)
Standard adult Merino	40	1.00	40	3	1	shorn	1	std	15	1.00	30.6	9.40	30.60
Adult sheep to Israel, May	55	1.07	40	3	1	shorn	1	3	12.3	1.07	30.6	10.69	29.31
Adult rams to Israel, May	70	1.12	40	3	1	shorn	1	2	11	1.1	30.6	11.56	28.44

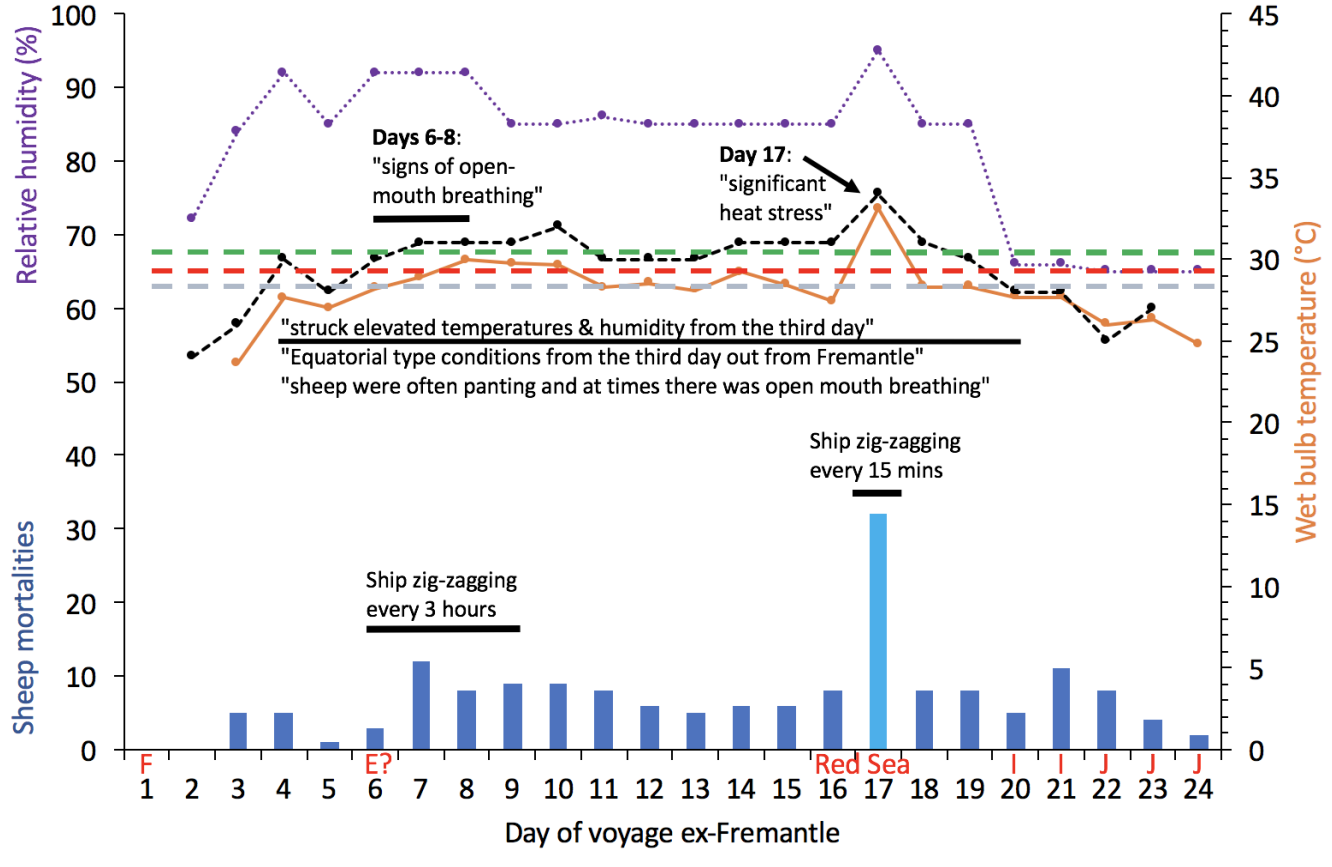


Figure 14. Mean mid-morning wet bulb temperature (WBT, °C) of all decks (solid orange line), maximum WBT measured by Independent Observer (dashed black line), mean deck relative humidity (dotted purple line) and daily sheep mortalities (blue columns; pale blue column: deaths not reported on day 17, so figure was calculated as the difference between total and sum of other daily deaths) by day for a voyage on the Bader III (sheep loaded on double-tiered open decks) undertaken in **May 2018** from Fremantle (F) to Israel (I) and Jordan (J) where 169 (0.27%) of 62,668 sheep died, showing heat stress threshold (HST 30.6°C, dashed green line) for a "standard" sheep (Stacey 2017b), and the heat stress threshold for 55 kg mature Merino sheep from Zone 3 (29.3°C; dashed red line) and 70 kg Merino rams from Zone 2 (28.4°C; dashed grey line) according to assumptions described in **Table 11**. The ship crossed the Equator (E) around day 6. The horizontal black lines and comments were obtained from the IO Shipboard Daily Reports of the voyage (Source: FOI LEX-755 148-418).

Policy option 4

This option proposes that there is no prohibition, and that the existing HSRA model would continue to be used only to determine stocking densities for voyages. This represents a return to conditions before 2018 and is not supported, as it represents an unacceptably high risk to sheep welfare.

Conclusion

The AVA has provided comment and supporting material on the 4 options proposed by the Department, and proposes alternate recommendations which should be able to achieve acceptable animal welfare outcomes, based on the science of heat stress in sheep. These are in line with AVA's previous key recommendations in the body of work we have submitted to date.

The AVA has relied upon limited resources to provide recommendations, including:

- Legislated 6-monthly summaries of live animal export29
- Department of Agriculture Mortality Investigation Reports30
- Limited peer-reviewed scientific papers
- Non-peer reviewed, Live Export Industry-funded project reports with data omissions [e.g.(MAMIC 2001)]
- Heavily redacted AAV Daily Shipboard Reports attained under FOI
- IO Report Summaries heavily abridged by the Department
- Heavily redacted IO Final Reports and Daily Reports attained under FOI.

The AVA strongly recommends that all research data on heat stress in sheep which has been collected over several decades by industry, be made available, so that scientists can evaluate thermoregulation and heat stress in livestock crossing the equator and beyond at all times of the year, without the need for further research. This would allow for immediate improvements, and prevent a delay in data-gathering, which will put livestock welfare at risk unnecessarily.

The data available from Mortality Investigation Reports, Independent Observer Report Summaries and FOI documents clearly show that heat stress occurs in sheep as they cross the equator at all times of the year, and in the Middle East during the months of May to October[31]. Unpublished data, [such as that cited in McCarthy (2005) and Norman (2014, 2015, 2016) and Independent Observer, climatic and sheep physiological data collected during 2018 and 2019 voyages] supports the limited published data.

As such, the AVA supports a modified version of Option 2, in combination with Option 3, as outlined in our discussion and executive summary.

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29 Source: http://www.agriculture.gov.au/export/controlled-goods/live-animals/live-animal-export-statistics/reports-to-parliament
30 Source: http://www.agriculture.gov.au/export/controlled-goods/live-animals/livestock/regulatory-framework/compliance-investigations/investigations-mortalities#2017
31 Source: https://www.ava.com.au/siteassets/advocacy/ava-hotstuff-submission.pdf

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