

Investigation into the reportable sheep mortality level on a sea voyage from Portland, Victoria to Bahrain, Kuwait and the United Arab Emirates, June 2010.

1. Purpose

To report on the investigation into the cause of mortalities in sheep exported by sea to Bahrain, Kuwait and the United Arab Emirates (UAE), and to make recommendations with the objective of reducing the likelihood of a recurrence.

2. Summary

There were two consignments of sheep on this voyage. In one consignment of 36,518 sheep loaded at Portland on 3 June 2010, there were 913 mortalities recorded which equates to a mortality of 2.50%. In the second consignment of 34,208 sheep loaded in Fremantle on 8 June 2010, there were 211 mortalities recorded which equates to a mortality of 0.62%. This investigation only reports on the consignment of sheep loaded in Portland which exceeded the reportable mortality limit of 2%. The main cause of mortality was enteritis, though mortalities due to heat stress were also recorded. High temperatures and humidity experienced in the Persian Gulf contributed to the mortality rate exceeding the reportable level.

3. Background

The investigation into the mortality was completed by reviewing the following information:

1. Report from the exporter
2. End of Voyage and daily reports from the AQIS accredited veterinarian (AAV) who accompanied the consignment on board the vessel.
3. Records from the AAV who prepared the consignment.
4. Report from the master of the vessel.
5. Correspondence from the Australian Maritime Safety Authority (AMSA).
6. Report from the AQIS regional certifying officer.
7. Records from the registered premises.

Table 1 Chronology of events showing cumulative mortality (count and percentage) by day

Date	Day	Event	Cumulative voyage mortality count	Cumulative Mortality %
03/06/2010	1	36,518 Sheep loaded in Portland. No mortalities	0	0.00%
04/06/2010	2	5 Mortalities	5	0.01%
05/06/2010	3	13 Mortalities	18	0.05%
06/06/2010	4	14 Mortalities	32	0.09%
07/06/2010	5	41 Mortalities	73	0.20%
08/06/2010	6	67 Mortalities. Loading in Fremantle	140	0.38%
09/06/2010	7	82 Mortalities	222	0.61%
10/06/2010	8	46 Mortalities	268	0.73%
11/06/2010	9	29 Mortalities	297	0.81%
12/06/2010	10	22 Mortalities	319	0.87%
13/06/2010	11	43 Mortalities	362	0.99%
14/06/2010	12	26 Mortalities	388	1.06%
15/06/2010	13	23 Mortalities	411	1.13%
16/06/2010	14	23 Mortalities	434	1.19%
17/06/2010	15	20 Mortalities	454	1.24%
18/06/2010	16	31 Mortalities	485	1.33%

Date	Day	Event	Cumulative voyage mortality count	Cumulative Mortality %
19/06/2010	17	24 Mortalities	509	1.39%
20/06/2010	18	23 Mortalities	532	1.46%
21/06/2010	19	39 Mortalities	571	1.56%
22/06/2010	20	99 Mortalities Vessel arrived in Bahrain and commenced unloading sheep.	670	1.84%
23/06/2010	21	48 Mortalities Vessel completed unloading sheep and departed Bahrain for Kuwait.	718	1.97%
24/06/2010	22	25 Mortalities Vessel arrived in Kuwait and commenced unloading sheep.	743	2.04%
25/06/2010	23	10 Mortalities Vessel unloading sheep in Kuwait.	753	2.06%
26/06/2010	24	36 Mortalities Vessel completed unloading sheep in Kuwait and departed for the UAE.	789	2.16%
27/06/2010	25	21 Mortalities	810	2.22%
28/06/2010	26	8 Mortalities Vessel arrived in the UAE and completed unloading sheep.	818	2.24%
		95 Mortalities for which detailed information is not available.	913	2.50%

The reportable mortality trigger for sheep is 2.0% (or 3 animals whichever is greater). The reportable mortality level was triggered on day 22 of the voyage (24 June 2010) as the vessel arrived in Kuwait. There were 95 mortalities for which no detailed information (including location on vessel, date of mortality and cause of death) is available. The analysis of the mortality in this report includes only the 818 mortalities for which detailed information is available.

4. Findings

4.1 Preparation in the Registered Premises

The 36,518 sheep exported from Portland were assembled at a registered premises near Portland, Victoria. Between 21 May and 28 May 2010, 38,345 sheep were received at the registered premises. There were 28 mortalities recorded in the registered premises during the assembly period which equates to a mortality of 0.07%.

Records obtained from the registered premises indicate that rain occurred on 7 of the 13 days of the assembly period, as well as the day that the sheep were loaded onto the vessel. The exporter, AQIS veterinary officer and the AQIS accredited veterinarian did not report that these adverse weather conditions had a negative effect on the health and welfare of the sheep.

The AQIS veterinary officer and AQIS accredited veterinarian inspected the sheep on 2 June 2010. Both the AQIS veterinary officer and AQIS accredited veterinarian were satisfied with the general health status and condition of the sheep though some scouring individuals were noted.

4.2 Loading onto the Vessel

The loading records indicate the stocking density and the amount of fodder loaded was in accordance with the ASEL. Sheep from this consignment were loaded onto decks 6 – 11 of the vessel.

During loading, 699 sheep were rejected from the consignment by the AQIS accredited veterinarian. Half of those sheep that were rejected were found to be scouring or inappetant. Other reasons for rejection included eye problems, lameness or injuries.

4.3 Conditions during the Journey

Figure 1 shows the wet bulb temperature for each deck and each day as well as the heat stress threshold (HST) and mortality limit (ML) for adult merino sheep. Heat stress threshold is the maximum ambient wet bulb temperature at which heat balance of the deep body temperature can be controlled using available mechanisms of heat loss. Mortality Limit is the wet bulb temperature at which the animal will die. For adult merino sheep the heat stress threshold is 30.6°C and the mortality limit is 35.5°C¹.

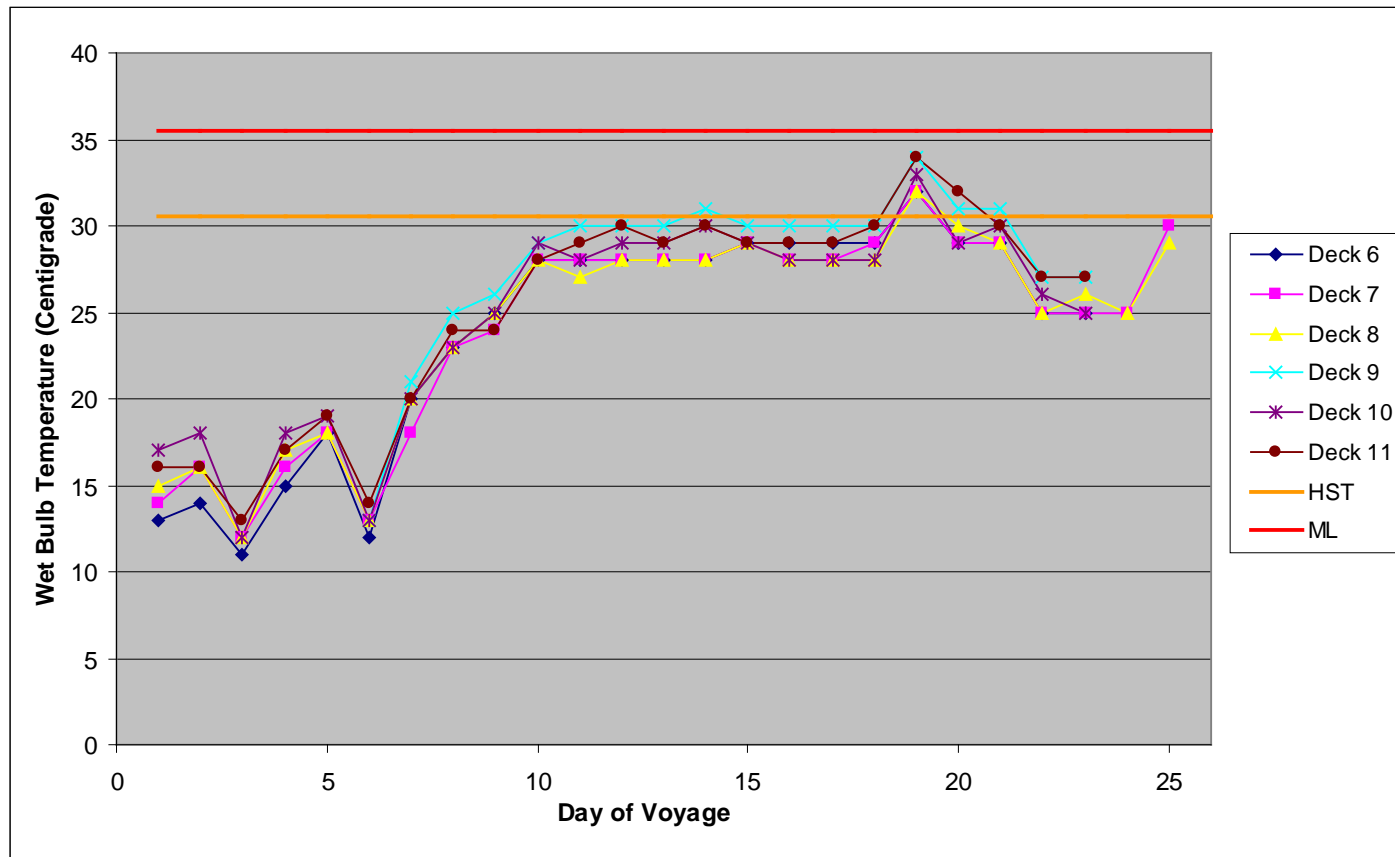


Figure 1 Wet bulb temperatures by deck and day, heat stress threshold (HST) and mortality limit (ML).

The available information indicates that the sheep were exposed to temperatures above the heat stress threshold on days 19 – 21 of the voyage. During days 19 – 21 of the voyage the vessel was in the Persian Gulf and discharging sheep in Bahrain. The sheep on deck 9 also experienced temperatures above the heat stress threshold on day 14 of the voyage as the vessel was passing through an area north of the equator. Figure 1 shows that the recorded wet bulb temperatures did not exceed the mortality limit at any stage during the voyage. However the onboard AQIS accredited veterinarian’s reports recorded mortalities on deck 8 due to heat stress on day 20, before arrival in Bahrain. The veterinarian indicated that initial heat stress mortalities occurred in sheep that were affected by other health conditions, though later heat stress mortalities occurred in healthy sheep.

4.4 Mortality by Cause

The causes of mortality were reported on the veterinarian’s daily reports and end of voyage report but were not recorded for each individual deck. Post mortems were performed each day, up to and including day 17 of the voyage. From day 18 onward, the vessel was approaching, entering or within the Persian Gulf and post mortems could no longer be performed.

According to the veterinarian’s daily reports, 65 post mortem examinations were undertaken during the voyage and a diagnosis was reached in 60 of these. The veterinarian post mortemed a subset of mortalities each day to monitor the causes of mortality and ensure that any new clinical problems were quickly identified. Based on his findings, the veterinarian concluded that 85% of the mortalities during the voyage were due to enteritis and 12% were due to heat stress. The remaining 3% were mortalities due to other causes such as inanition and bloat.

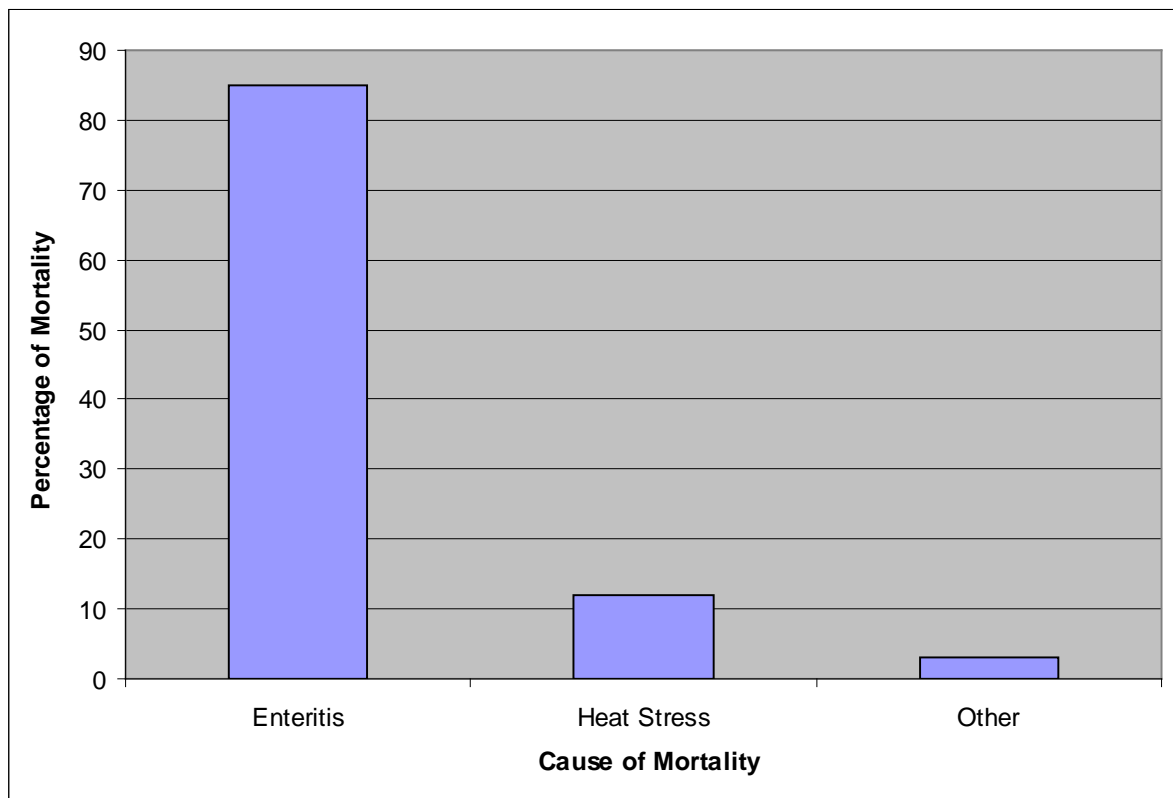


Figure 2 - Percentage of mortality assigned to each cause

4.5 Mortality by Day

Figure 3 shows the percentage of sheep that died each day (this is not a cumulative mortality) and the average wet bulb mortality across all decks of the vessel. The available information suggests that the initial significant increase in mortality was caused by enteritis. The second significant increase in mortality appears to be due to heat stress and heat stress related mortalities though enteritis was still an important factor. The veterinarian's reports indicate that enteritis was the dominant cause of mortality throughout the voyage.

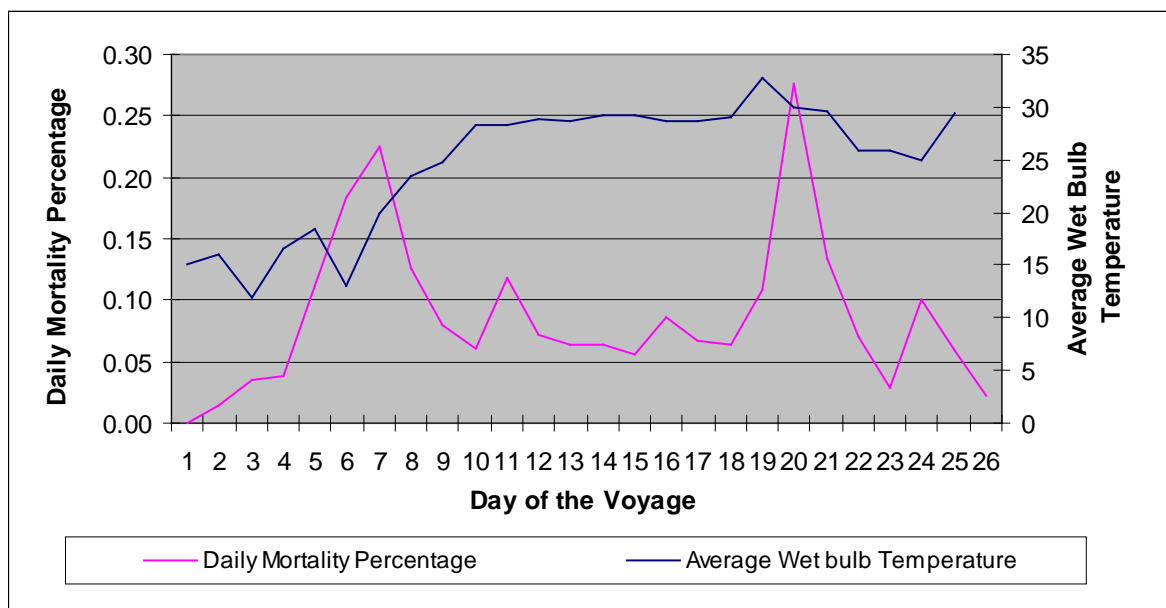


Figure 3 - Daily percent mortality and temperature

The pink lines indicate the percentage of sheep that died each day (not cumulative)

The blue line indicates the average wet bulb temperature across all decks

4.6 Mortality by Class

Figure 4 shows the mortality percentage for each class of sheep. Class of sheep refers to the age and sex of sheep, i.e. lamb, ewe or ram as well as the commercial class of sheep, i.e. an A class wether is larger than a B class wether which is larger than a C class wether.

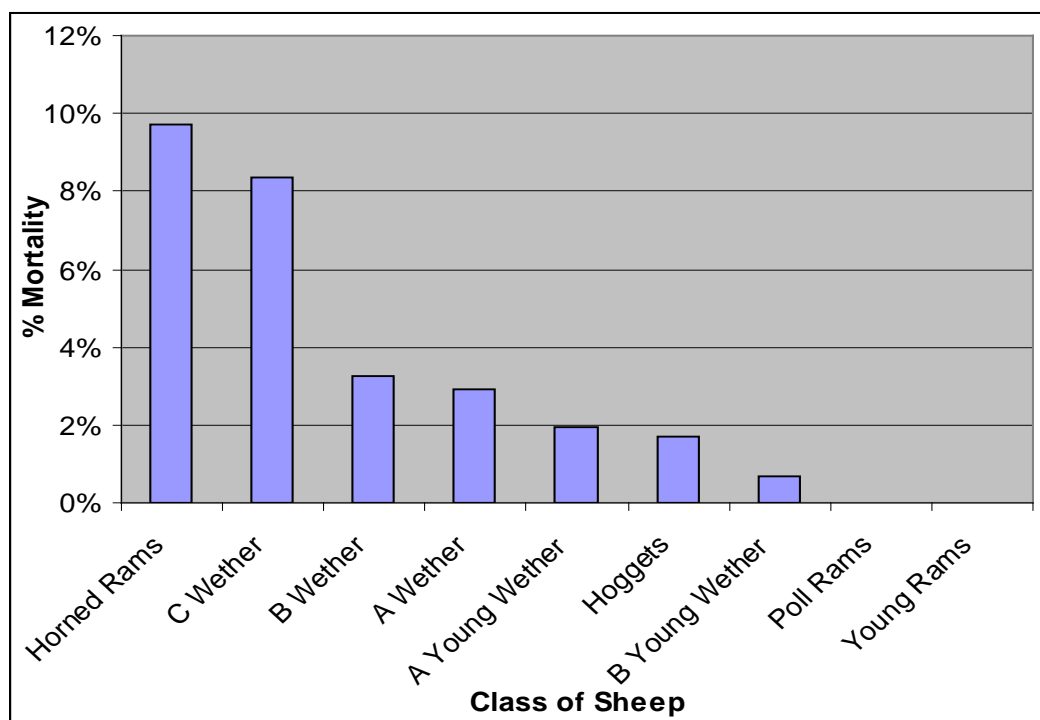


Figure 4 - Mortality percentages for each class of sheep arranged in order of decreasing mortality rate.

The sheep classes with the highest mortality percentages were the horned rams and C class wethers. In addition to this, the mortality in the A and B class wethers exceeded 2%. The veterinarian's daily voyage reports indicated that the B and C class wethers were most severely affected by enteritis. Available information indicates that one group of sheep within the B class wethers, and identified by ear tag as originating from one property, experienced a higher percentage mortality than other groups of sheep from different properties.

Table 2 showing the percentage contribution to the total loaded, the percentage mortality and the percentage of the total voyage mortality of each class of sheep.

Class of sheep	% of loaded sheep	% Mortality	% of total mortality
B Wethers	35.2%	3.23%	50.7%
B Young Wethers	27.0%	0.70%	8.4%
A Young Wethers	24.1%	1.93%	20.8%
Hoggets	6.1%	1.70%	4.6%
A Wethers	4.6%	2.92%	6.0%
C Wethers	2.2%	8.35%	8.1%
Horned Rams	0.3%	9.73%	1.3%
Poll Rams	0.3%	0.00%	0.0%
Young Rams	0.3%	0.00%	0.0%

Table 2 shows the percentage each class of sheep represented of the total number loaded, the percentage mortality that each class experienced and the contribution these mortalities made to the total voyage mortality. It can be seen that the B class wethers, C class wethers and horned rams experienced the highest percentage mortality. B class wethers represented only 35.2% of the sheep loaded but contributed to 50.7% of the total voyage mortality. Likewise, the C class wethers represented only 2.2% of the sheep loaded and contributed to 8.1% of the total voyage mortality. B class young wethers however represented 27.0% of the sheep loaded, experienced a mortality of 0.7% and contributed to only 8.4% of the total voyage mortality. From the available information, classes of sheep which displayed clinical signs of enteritis subsequently experienced a higher percentage mortality than those which did not and contributed to a greater percentage of the total voyage mortality.

4.7 Mortality by Deck

Table 3 shows mortality by deck. The stock loaded on decks 9 and 11 experienced the lowest percentage mortality. The stock loaded on decks 6, 7 and 10 experienced the highest percentage mortality. The B class wethers and C class wethers were loaded on decks 6, 7 and 10 and the veterinarian reported that these classes of sheep were severely affected by enteritis. The veterinarian reported that heat stress mortalities were experienced by the sheep on deck 8 though this deck experienced a lower percentage mortality than most other decks. Post mortem results were not recorded by location and it is difficult to determine if the variation in mortality rates was due to deck or sheep factors.

Table 3 Mortality by Deck

Deck	Number Loaded	Mortality Count	Mortality %
11	9,844	69	0.70%
10	9,388	337	3.59%
9	3,457	12	0.35%
8	8,807	171	1.94%
7	1,992	129	6.48%
6	3,030	100	3.30%
Total	36,518	818	2.24%

4.8 Management of the livestock during the voyage

From the veterinarian's report and correspondence between the vessel and the exporter presented to AQIS, the following actions were instituted by the veterinarian, stockman, officers and crew of the vessel:

1. Measure to reduce the spread of infectious disease:

- Mortalities and sick sheep were promptly removed from pens
- Groups of sick sheep affected by enteritis were isolated from those unaffected by alleyways as well as fences
- Water and fodder troughs were cleaned regularly

2. Measures to treat the sick sheep:

- Sick individual sheep were promptly treated and moved to hospital pens
- Groups of sheep affected by the increased incidence of enteritis were provided with a chaff ration to promote fodder and water consumption.

On arrival in Fremantle, additional chaff and medication was loaded by the exporter at the request of the Master, AAV and Stockman. The stocking density was reduced after unloading was

completed at Bahrain, and again after Kuwait, to take advantage of the extra space that became available. The available information indicates that the onboard management of the livestock was compliant with Standard 5 of the ASEL.

5. AMSA evaluation of the vessel upon return to Australia

The pre-loading inspection of the vessel by AMSA on 15 July 2010 at Port Adelaide did not find any apparent deficiencies in the livestock services.

6. Conclusion

The main cause of mortalities was identified to be enteritis, but mortalities due to heat stress were also recorded. These results are consistent with existing knowledge on the causes of mortality in sheep exported live by sea^{2,3}. Inclement weather was experienced by the sheep in the registered premises on a number of days of the assembly and preparation period, and may have contributed to the final outcome. The B class wethers experienced an outbreak of enteritis, and mortalities within that class of sheep contributed to more than half of the total voyage mortality. High temperatures and humidity in the Persian Gulf also contributed to the mortality exceeding the reportable level.

7. Recommendations

- a. Industry to urgently advise AQIS when the revised heat stress risk assessment software is available to better manage the risk of heat stress for the 2011 northern hemisphere summer.
- b. Seek the advice of the Livestock Export Standards Advisory Group if future research and development can be undertaken to investigate management strategies to reduce stress in the registered premises, particularly during inclement weather, and provide a response to AQIS.
- c. Industry to routinely collect post mortem samples during each voyage for return to Australia in the event of a reportable incident so as to provide definitive diagnostic information for analysis.

8. Actions

AQIS placed the following conditions on a subsequent consignment of sheep exported from Portland to the Persian Gulf by this exporter on a different vessel in August 2010. These conditions were applied to ensure that high risk groups of sheep were not prepared for the subsequent consignment:

- The exporter must not prepare pastoral and station sheep for export for this consignment.
- During the last three clear days in the registered premises, the sheep must be fed *ab libitum*, but only on pelletised feed equivalent to that normally used during the export journey.

Note that *ab libitum* is intended to mean that the sheep have unrestricted access to feed.

9. Results

The result for the consignment of sheep with these conditions applied was 427 mortalities reported out of 40,895 sheep loaded which equates to an acceptable mortality rate of 1.04%.

The exporter has regularly shipped similar consignments of sheep to the Persian Gulf. Since January 2005, this exporter has exported over 1.8 million sheep to the Persian Gulf on 46 voyages with an average mortality of 0.85%.

10. References:

1. Maunsell Australia Pty Ltd. 2003. LIVE.116 Development of a heat stress risk management model. Meat and Livestock Australia.
2. Richards, R., R. Norris, et al. (1989). "Causes of death in sheep exported live by sea." Australian Veterinary Journal 66(2): 33-38.
3. Kelly, A. P. (1996). Mortalities in sheep transported by sea. Faculty of Veterinary Science. Melbourne, University of Melbourne. PhD.