



## **Investigation into reportable sheep mortality level for a voyage Fremantle Muscat Jebel Ali Manama Kuwait Muscat May 2007**

### **1. Purpose**

To report on the investigation into the cause of the mortalities in sheep and to make recommendations with the objective of reducing the likelihood of a recurrence.

### **2. Summary**

For the consignment of 14,954 sheep exported, 622 sheep died which corresponds to a mortality rate of 4.16%. The vessel was loaded with 109,035 sheep and had an overall mortality rate of 1.88%.

The likely contributing causes were heat stress, a prolonged voyage and presence of a severe storm in close proximity to the vessel.

### **3. Background**

The investigation into the mortality was carried out by reviewing the following information:

1. AQIS accredited veterinarian's (AAV) end of voyage report.
2. AAV Daily Reports
3. Report from the exporter.
4. Records from the registered premises.
5. Report by the master of the vessel.
6. Report from the AQIS certifying veterinarian.
7. Record of surface water temperature from the TRMM polar orbiting satellite and advice from weather consultant

**Table 1: Summary of chronology of events**

| <b>Action</b>            | <b>Date</b> |
|--------------------------|-------------|
| Sheep loaded Fremantle   | 15 May 2007 |
| Sheep unloaded Muscat    | 27 May 2007 |
| Sheep unloaded Jebel Ali | 29 May 2007 |
| Sheep unloaded Manama    | 31 May 2007 |
| Sheep unloaded Kuwait    | 2 June 2007 |
| Sheep unloaded Muscat    | 8 June 2007 |

**Table 2: Chronology of Events**

| <b>Dates</b>  | <b>Day of Voyage</b> | <b>Action</b>      | <b>Cumulative Voyage Death Total</b> | <b>Cumulative % Deaths</b> |
|---------------|----------------------|--------------------|--------------------------------------|----------------------------|
| 17 April 2007 | N/A                  | NOI/CRMP submitted |                                      |                            |

|               |     |                                    |             |             |
|---------------|-----|------------------------------------|-------------|-------------|
| 20 April 2007 | N/A | NOI/CRMP approved                  |             |             |
| 15 May 2007   | 1   | Sheep loaded Fremantle, 2 deaths   | 2           | 0.01        |
| 16 May 2007   | 2   | 4 deaths                           | 6           | 0.04        |
| 17 May 2007   | 3   | 3 deaths                           | 9           | 0.06        |
| 18 May 2007   | 4   | 4 deaths                           | 13          | 0.09        |
| 19 May 2007   | 5   | 3 deaths                           | 16          | 0.11        |
| 20 May 2007   | 6   | 6 deaths                           | 22          | 0.15        |
| 21 May 2007   | 7   | 5 deaths                           | 27          | 0.18        |
| 22 May 2007   | 8   | 4 deaths                           | 31          | 0.21        |
| 23 May 2007   | 9   | 8 deaths                           | 39          | 0.27        |
| 24 May 2007   | 10  | 6 deaths                           | 45          | 0.31        |
| 25 May 2007   | 11  | 4 deaths                           | 49          | 0.33        |
| 26 May 2007   | 12  | 6 deaths                           | 55          | 0.38        |
| 27 May 2007   | 13  | 7 deaths                           | 62          | 0.42        |
| 28 May 2007   | 14  | 0 sheep unloaded Muscat 154 deaths | 216         | 1.47        |
| 29 May 2007   | 15  | 48 deaths                          | 264         | 1.80        |
| 30 May 2007   | 16  | 7 deaths                           | 271         | 1.85        |
| 31 May 2007   | 17  | 9 deaths                           | 280         | 1.91        |
| 1 June 2007   | 18  | 287 deaths                         | 567         | 3.87        |
| 2 June 2007   | 19  | 15 deaths                          | 582         | 3.97        |
| 3 June 2007   | 20  | 5 deaths                           | 587         | 4.01        |
| 4 June 2007   | 21  | 8 deaths                           | 595         | 4.06        |
| 5 June 2007   | 22  | 12 deaths                          | 607         | 4.14        |
| 6 June 2007   | 23  | 4 deaths                           | 611         | 4.17        |
| 7 June 2007   | 24  | 8 deaths                           | 619         | 4.22        |
| 8 June 2007   | 25  | 2 deaths                           | 621         | 4.24        |
| 9 June 2007   | 26  | Sheep unloaded Muscat 19 deaths    | <b>640</b>  | <b>4.37</b> |
| <b>TOTALS</b> |     | <b>631</b>                         | <b>4.3%</b> |             |

**Table 3: Mortality by deck**

| DECK DAY | 10 Upper | 10 Lower | 8 Lower | 7 | 6 | 4 | 3 | 1 |
|----------|----------|----------|---------|---|---|---|---|---|
| 1        |          | 2        |         |   |   |   |   |   |
| 2        | 1        | 3        |         |   |   |   |   |   |
| 3        | 2        | 1        |         |   |   |   |   |   |
| 4        | 2        | 2        |         |   |   |   |   |   |
| 5        | 4        | 2        |         |   |   |   |   |   |
| 6        | 2        | 2        | 1       |   |   |   |   |   |
| 7        | 3        | 1        |         |   |   |   |   |   |
| 8        | 1        | 6        | 1       |   |   |   |   |   |
| 9        | 2        | 4        |         |   |   |   |   |   |
| 10       |          | 4        |         |   |   |   |   |   |
| 11       | 3        | 3        |         |   |   |   |   |   |
| 12       | 3        | 3        |         |   |   |   |   |   |
| 13       | 2        | 4        | 1       |   |   |   |   |   |
| 14       | 61       | 90       | 3       |   |   |   |   |   |
| 15       | 15       | 27       | 6       |   |   |   |   |   |
| 16       | 1        | 4        | 2       |   |   |   |   |   |
| 17       | 3        | 5        | 1       |   |   |   |   |   |
| 18       | 15       | 270      | 2       |   |   |   |   |   |
| 19       | 1        | 8        | 1       | 1 |   |   | 3 | 1 |
| 20       |          | 1        | 1       |   |   |   | 2 | 1 |

|               |             |              |            |            |             |             |             |             |
|---------------|-------------|--------------|------------|------------|-------------|-------------|-------------|-------------|
| 21            | 1           | 1            | 3          |            |             |             | 2           | 1           |
| 22            | 1           | 3            | 1          |            |             |             | 2           | 5           |
| 23            |             | 1            | 1          | 1          |             |             | 1           |             |
| 24            |             | 1            |            | 4          |             |             | 1           | 2           |
| 25            | 1           |              |            | 1          |             |             |             |             |
| 26            |             | 2            | 3          | 4          | 5           | 3           | 2           |             |
| <b>TOTALS</b> | <b>124</b>  | <b>450</b>   | <b>27</b>  | <b>11</b>  | <b>5</b>    | <b>3</b>    | <b>13</b>   | <b>10</b>   |
| <b>%</b>      | <b>19.3</b> | <b>69.98</b> | <b>3.7</b> | <b>1.7</b> | <b>0.78</b> | <b>0.47</b> | <b>2.02</b> | <b>1.56</b> |

The consignment was originally loaded on to decks 8 and 10. On day 19, the stockman spread the sheep out onto other decks (1, 3, 4, 6 and 7) in order to increase the space per sheep available and therefore reduce the heat stress being experienced by the sheep.

**Table 4: Mortality by deck – All consignments**

| DECK        | 11 U | 11 L | 10 U | 10 L | 9 U | 9 L | 8 U | 8 L | 7 | 6 | 5 | 4 | 3 | 2 | 1 |  |
|-------------|------|------|------|------|-----|-----|-----|-----|---|---|---|---|---|---|---|--|
| <b>DATE</b> |      |      |      |      |     |     |     |     |   |   |   |   |   |   |   |  |
| 9-May       |      |      |      |      |     |     |     |     |   |   |   |   |   |   |   |  |
| 10-May      |      |      |      |      | 1   |     |     |     |   |   | 1 |   |   |   |   |  |
| 11-May      |      |      |      |      | 1   |     |     |     |   |   | 1 |   |   |   |   |  |
| 12-May      |      | 1    |      |      | 9   |     | 3   |     |   |   |   |   |   | 1 | 2 |  |
| 13-May      |      |      |      |      | 1   | 1   | 1   |     |   |   |   |   | 1 | 1 | 2 |  |
| 14-May      |      | 1    |      |      | 1   | 1   | 1   |     |   |   | 2 |   |   |   | 1 |  |
| 15-May      |      | 1    |      | 2    | 1   |     |     |     | 1 |   |   |   | 2 | 1 | 3 |  |
| 16-May      | 1    |      | 1    | 3    | 2   | 2   | 1   |     | 4 |   |   |   |   |   | 2 |  |
| 17-May      | 1    | 1    | 4    | 1    | 1   | 2   |     | 2   | 2 | 2 |   |   |   |   | 1 |  |
| 18-May      | 2    | 1    | 3    | 2    | 2   | 2   | 4   |     |   | 1 |   |   |   |   | 4 |  |
| 19-May      | 1    | 1    | 5    | 2    | 3   | 3   | 2   | 2   | 3 |   | 1 | 2 | 2 | 1 | 2 |  |
| 20-May      | 4    | 2    | 4    | 2    | 8   | 3   | 2   | 2   | 5 | 2 | 1 | 4 | 1 |   |   |  |
| 21-May      | 2    | 2    | 5    | 1    | 11  | 3   | 2   | 1   | 3 | 3 | 2 | 1 | 1 |   |   |  |
| 22-May      | 5    | 7    | 3    | 6    | 8   | 4   |     | 3   | 7 | 1 | 3 |   | 1 | 1 | 4 |  |
| 23-May      | 4    | 2    | 4    | 4    | 5   |     |     |     | 3 | 1 | 2 | 1 |   |   |   |  |
| 24-May      | 2    | 4    | 4    | 4    | 2   | 9   | 2   | 5   |   |   | 4 | 1 | 4 | 2 | 4 |  |
| 25-May      | 3    | 3    | 3    | 3    | 6   | 3   | 5   | 3   |   |   | 1 | 1 | 1 |   | 1 |  |
| 26-May      | 2    | 6    | 5    | 3    | 3   |     | 5   | 3   | 2 | 2 | 1 | 1 |   |   | 2 |  |
| 27-May      | 4    | 7    | 3    | 4    | 4   | 4   | 2   | 14  | 3 | 2 | 6 | 1 | 1 | 2 | 3 |  |
| 28-May      | 139  | 123  | 103  | 90   | 76  | 29  | 39  | 43  | 9 | 6 | 4 | 3 | 2 | 3 | 4 |  |

|                             |     |     |     |             |     |     |     |     |     |     |     |     |     |     |     |      |
|-----------------------------|-----|-----|-----|-------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|------|
| 29-May                      | 5   | 6   | 18  | 27          | 11  | 6   | 10  | 14  | 1   | 2   | 3   | 2   |     | 2   | 3   |      |
| 30-May                      | 1   | 7   | 4   | 4           | 12  | 6   | 11  | 38  | 7   | 5   | 9   | 4   | 6   | 2   | 7   |      |
| 31-May                      |     |     | 3   | 5           |     |     |     | 1   |     |     |     |     |     |     |     |      |
| 1-Jun                       | 3   | 3   | 15  | 270         |     | 3   | 64  | 3   | 6   | 19  | 7   | 17  | 6   | 13  |     |      |
| 2-Jun                       |     |     | 2   | 8           | 6   | 2   | 6   | 1   | 4   |     | 5   | 2   | 3   | 1   | 1   |      |
| 3-Jun                       |     |     | 1   | 1           | 1   |     |     | 1   | 2   | 3   | 2   | 1   | 2   |     | 1   |      |
| 4-Jun                       |     |     | 3   | 1           | 2   | 2   | 2   | 3   | 3   | 7   | 2   | 3   | 2   |     | 1   |      |
| 5-Jun                       |     |     | 1   | 3           |     | 1   |     | 1   |     |     |     |     | 2   |     | 5   |      |
| 6-Jun                       |     |     |     | 1           |     | 6   |     | 1   | 1   | 2   |     |     | 1   |     |     |      |
| 7-Jun                       |     |     |     | 1           |     | 1   |     |     | 4   |     |     |     | 1   |     | 2   |      |
| 8-Jun                       |     |     | 1   |             |     | 1   |     |     | 1   |     |     |     |     |     |     |      |
| 9-Jun                       |     |     |     | 2           |     |     |     | 3   | 4   | 5   |     | 3   | 2   |     |     |      |
| <b>TOTALS</b>               | 179 | 178 | 195 | <b>450</b>  | 177 | 94  | 162 | 144 | 75  | 63  | 57  | 47  | 41  | 30  | 55  | 1947 |
| <b>% of total mortality</b> | 9.2 | 9.1 | 10  | <b>23.1</b> | 9.1 | 4.8 | 8.3 | 7.4 | 3.9 | 3.2 | 2.9 | 2.4 | 2.1 | 1.5 | 2.8 | 100  |

**Table 5: Comparison of mortality on open (8-11) VS closed (1-7) decks.**

|                               | <b>OPEN DECKS</b>   | <b>CLOSED DECKS</b> |
|-------------------------------|---------------------|---------------------|
| <b>Total loaded</b>           | <b>~71228 (68%)</b> | ~33608 (32%)        |
| <b>Total mortalities</b>      | <b>1579</b>         | 368                 |
| <b>% of overall mortality</b> | <b>81.1</b>         | 18.9                |

## 4. Findings

### 4.1 Deaths in Registered Premises

The sheep exported from Fremantle were present at the registered premises from 8 May 2007. The records of the registered premises indicated low mortalities over the preparation period.

The record of rejects indicated the main reasons for rejection at the wharf were lameness, scabby mouth and eye problems.

### Loading

The sheep were loaded in accordance with ASEL and the heat stress risk assessment.

For open decks, the HSRA includes a requirement for a crosswind. The crosswind required is approximate 5m/s according to the HSRA.

**Table 6: Loading details**

| <b>Deck</b> | <b>Number of sheep</b> | <b>Type of sheep</b> |
|-------------|------------------------|----------------------|
| 8           | 970                    | Rams                 |
| 10          | 13984                  | A & B wethers        |

### 4.2 Journey

The climatic condition for the sheep decks were as follows

**Table 7: Climatic conditions**

| <b>Day of voyage</b> | <b>Dry bulb (°C)</b> | <b>Wet bulb (°C)</b> | <b>Humidity (%)</b> | <b>Deaths</b> | <b>Daily water consumption (L)</b> | <b>Daily weather conditions from daily reports</b>  |
|----------------------|----------------------|----------------------|---------------------|---------------|------------------------------------|---|
| 1                    | 21                   | 21/21                | 78                  | 2             | 3                                  | Travelling well. Normal heat stress   |
| 2                    | 26.5                 | 23/25                | 80                  | 4             | 3.5                                | Travelling well. Normal heat stress. PM: 2 x inanition, others autolysed                        |
| 3                    | 28                   | 24/27                | 78                  | 3             | 4                                  | Travelling well. Normal heat stress. PM: 1 x urinary calculi, others autolysed                  |
| 4                    | 29                   | 26/27                | 80                  | 4             | 4                                  | Travelling well. Normal heat stress. PM: 2 x inanition, others autolysed                        |
| 5                    | 31.5                 | 26/26                | 83                  | 3             | 4                                  | Travelling well. Normal/mild heat stress. PM: 1 x inanition, others autolysed                   |
| 6                    | 31                   | 26/26                | 79                  | 6             | 4                                  | Deck Temps rising due equator soon Normal/mild heat stress. PM: 1 x inanition, others autolysed |
| 7                    | 31.5                 | 29/28                | 83                  | 5             | 4                                  | Deck Temps rising due equator soon. Mild heat stress. PM: 1 x inanition, others                 |

|    |      |       |    |     |     |  |
|----|------|-------|----|-----|-----|--|
|    |      |       |    |     |     | autolysed  |
| 8  | 32.5 | 28/31 | 80 | 4   | 4   | Deck Temps rising. Mild heat stress. PM: 1 x inanition, others autolysed   |
| 9  | 31.5 | 29/28 | 86 | 8   | 4.5 | Humid and hot conditions, Mild heat stress.  |
| 10 | 32   | 29/29 | 79 | 6   | 4.5 | Humid and hot conditions. Mild heat stress.  |
| 11 | 32   | 30/30 | 86 | 4   | 4.5 | Humid and hot conditions. Mild heat stress.  |
| 12 | 31   | 29/28 | 82 | 6   | 4.5 | Humid and hot conditions. Mild heat stress.  |
| 13 | 32   | 31/32 | 83 | 7   | 4.5 | Humid and hot conditions. Mild heat stress.  |
| 14 | 35   | 31/30 | 71 | 154 | 5.3 | Ceased discharge Muscat at 0900/28 <sup>th</sup> . Sailed 1200/28 <sup>th</sup> due to severe heat stress and rising mortalities. Exporter notified.                             |
| 15 | 33   | 32/31 | 90 | 48  | 4.3 | Conditions improved on way to Jebel Ali. Livestock settling and travelling OK. Heat stress mild-severe.  |
| 16 | 33   | 32/31 | 90 | 7   | 4.3 | Livestock settling and travelling OK. Heat stress mild-severe.   |
| 17 | 34   | 30/30 | 74 | 9   | 4.3 | Mild – severe heat stress- Port stay Bahrain.  |
| 18 | 34   | 30/30 | 74 | 287 | 4.3 | Continuing hot, humid conditions. No breeze. Severe heat stress.   |
| 19 | 36.5 | 29/29 | 50 | 15  | 4.3 | Hot and dry conditions. Sheep and deck conditions improved. Heat stress mild-severe.   |
| 20 | 34   | 25/25 | 49 | 5   | 4.3 | Hot and dry conditions. Sheep and deck conditions improved.  |
| 21 | 31.5 | 27/28 | 70 | 8   | 4.3 | Hot and dry conditions. Sheep and deck conditions improved.  |
| 22 | 30.5 | 28/28 | 83 | 12  | 4.3 | Hot condition, good breeze, sheep spread over the ship.  |
| 23 | 31   | 28/27 | 79 | 4   | 4   | Outside Muscat – Port closed due to cyclone damage.  |
| 24 | 27   | 24/24 | 77 | 8   | 4   | Outside Muscat Port waiting to open, possibly 8 <sup>th</sup> June Awaiting advice from exporter if port doesn't open. Mild heat stress. PM: All mortalities due to heat stress. |
| 25 | 28   | 28/28 | 85 | 2   | 4   | Outside Muscat port possibly berthing early PM today. Mild-severe heat stress. PM: All mortalities due to heat stress  |
| 26 | 31.5 | 29/30 | 86 | 19  | 4   | Final report. Discharge completed Muscat 1800/9 <sup>th</sup> June 07. Mild-severe heat stress. PM: All mortalities due to heat stress.  |

The figures reported are averages across the two decks.

The mortalities occurred in two spikes. The first was around unloading at Muscat. The second was around unloading in Bahrain. The spikes correspond to unfavorable environmental conditions. The weather consultant advised that the sea surface temperature was approximately 3.5°C higher than expected at that time of year around Muscat.

The effect of a higher than normal sea surface temperature is to raise the wet bulb temperature. The sea surface temperature around Bahrain was approximately 7°C higher than expected for that time of year. Higher sea surface temperatures can be associated with light winds (enabling the sea surface temp to rise).

The reportable mortality trigger for a long haul sheep voyage is 2 per cent. The reportable mortality level was triggered some time between 30 May and 2 June, most likely on 2 June.

Most deaths were associated with inanition/enteritis syndrome initially and then severe heat stress and trampling later in the voyage. The veterinarian's report states that weather conditions in Muscat

port can deteriorate quickly due to the rocky topography of the surrounding hills blocking any breeze into the port.

## **5. AMSA evaluation of the vessel on return to Australia**

The vessel was given permission to load livestock by AMSA on return to Australia.

## **6. Conclusion**

The factors contributing to the sheep mortalities was heat stress and the salmonella inanition complex and prolonged voyage due to climatic conditions and the presence of a storm near Muscat. The number of mortalities up until day 13 was consistent with other voyages which did not have a reportable mortality level. Most post mortem results for the sheep which died up until that point indicated the salmonella inanition complex. However the cause of mortalities from day 13 onwards was due to heat stress.

Heat stress is a known risk for exporting livestock from Southern Australian winter conditions to Middle Eastern summer conditions. The Livestock export industry formulated a HSRA for the export of livestock to the Middle East a number of years ago following the significant cattle mortality event.

The HSRA requires inputs for sheep including, vessel used, departure and arrival time, ports of departure and port of arrival, wool length, type (ram/wether/ewe), weight, position on vessel, originating area in Australia and number on particular deck of vessel. The computer program then makes a risk assessment based on the known environmental conditions during the voyage and at discharge.

On closed decks the ventilation is controlled and known for each vessel and deck. For closed decks the output is a risk assessment of a chance of a 5% mortality rate. The acceptable risk for HSRA in the ASEL is a 2% chance of a 5% mortality rate. In other words, the risk of one in 50 voyages having a heat stress incident resulting in a 5% mortality rate.

For open decks the risk assessment also considers the cross wind required to manage the risk of heat stress for the specific load configuration. Heat stress can arise if the wet bulb temperature rises above expected levels or if the cross wind ventilation expected does not eventuate. The absence (or diminished) cross wind can occur if there is no (or little) wind or if the direction of the wind is not favorable. For example a tail wind is not an effective cross wind or in port the cross wind may be from the wrong direction to benefit the livestock.

The transport of livestock on open decks reliant on cross wind in Northern Hemisphere has higher risk than closed decks unless the mechanical pen area turnover is sufficient. The weather consultant confirmed the abnormal climatic conditions at the time of transit and unloading of the vessel in the two ports.

## **7 Recommendations:**

Sheep exported to the Middle East on open decks during May to October are either loaded at a lower stocking rate suggested at:

- . Mechanical Pen area turnover in the HSRA
- . ASEL plus 10% additional space.

All sheep exported to the ME during Northern Hemisphere summer are clean shorn.



AQIS request International Division and Biosecurity Australia negotiate the dispensation for Oman Government as the first port of call for the period of May to October each year because of the risk of heat stress.

**Actions**

The next consignment had an additional condition as follows:

If any sheep are loaded on the open decks they must be provided with 10 per cent additional space over and above the requirements of the Australian Standards for the Export of Livestock and the Heat Stress Risk Assessment.