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National livestock export industry shipboard performance report 2011

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Executive summary

The objective of this project was to summarise the performance of the livestock export industry in terms of mortality levels of sheep, cattle and goats exported by sea from Australia during 2011.

Industry stakeholders, government, animal welfare groups and the general public have a keen interest in monitoring performance in different sectors of the livestock export trade. This summary report provides the only comprehensive breakdown by ship, species, time of year, load ports and major destinations over the calendar year.

The overall mortality rate for sheep during sea transport to all destinations during 2011 was 0.76% out of approximately 2.42 million sheep exported. This was lower than the 0.88% mortality rate observed in 2010, and second only to the record low of 0.75% in 2004. The main port of loading was Fremantle (1.7 million sheep exported with mortality rate of 0.68%), followed by Adelaide (0.3 million sheep exported with mortality rate of 0.75%) and Portland (0.5 million sheep exported with mortality rate of 1.05%).

The overall mortality rate among the 0.68 million cattle exported from Australia in 2011 was 0.12%. This was lower than the 0.15% mortality rate observed in 2010. The overall mortality rate on voyages to the Middle East/North Africa was a record low 0.16% in 2011, falling from 0.40% in 2010. The overall mortality rate on voyages to South-East Asia was 0.04%, continuing the record low rate observed in 2010 for the region. The highest overall mortality rate on a regional basis was 0.49% for exports to Miscellaneous destinations (86,039 cattle exported), including Mauritius, Russia and Turkey, while the lowest overall mortality rate was 0.04% for exports to South-East Asia (446,708 cattle exported).

The overall mortality rate among the 610 goats exported by sea from Australia in 2011 was 0.16%. This was significantly less than the 0.69% seen in 2010, and a record low figure. All goats exported by sea during 2011 went to South-East Asia. Air transport of goats was again examined in 2011, after being introduced for the first time in the 2010 report.

Contents

1 Background

The live export of sheep and cattle makes a significant contribution to the Australian economy and provides employment in services that support this industry. The livestock export trade provides important support for the sheep and cattle industries of Australia and is the only market outlet for producers in some areas of the country.

This report summarises information about mortalities in sheep, cattle and goats during sea transport from Australia. It allows industry, government and others to monitor mortality trends in these sectors. The report also lists relevant published studies.

The Australian Government Department of Agriculture, Fisheries and Forestry (DAFF) also presents mortality data, though in a different format, at their website: www.daff.gov.au/animal-plant-health/welfare/export-trade/mortalities. The DAFF data refers to reports received during the calendar year, in contrast to the current report which refers to voyages which departed during the calendar year.

2 Project objectives

The project objectives were to:

a) Produce a report which summarises the mortality of sheep, cattle and goats for the 2011 calendar year and provide an informed analysis of mortality trends in the livestock export industry
b) Maintain data and expertise to provide analysis and informed comment

3 Methodology

The information in this report was obtained from ship Master's Reports which record livestock mortalities and other information about each voyage, and also from "Yellow Books". "Yellow Books" record more detailed information about numbers of livestock mortalities (daily mortality by type-age-sex category and port of loading over the loading, voyage and discharge phases) than is available from the Masters' Report.

The shipboard part of the export process is divided into three phases: loading (load); voyage to the first port of unloading (voyage); and discharge. The discharge phase includes all mortalities after arrival at the first port. Consequently if a ship called at more than one discharge port, all the mortalities after arrival at the first port were included in the discharge phase.

The 2011 report is for voyages which departed Australia during 2011 and for which records were to hand on 27 April 2012. Information on the number of sheep exported to various destination countries from ports in Australia was sourced from the Australian Bureau of Statistics.

Readers should be aware that additional mortality information (Masters' reports or "Yellow Books") for a particular year may be received after publication of that year's summary report. These records are added to the database and used in subsequent analyses. Therefore, statistics for a particular year may vary slightly in subsequent reports from those originally published.

In order to maintain confidentiality, individual ships are identified by codes.

Summary information was produced using Statistix 7.0 (Analytical software 2000 Tallahassee, Florida USA).

One shipment that returned to an Australian port after 10 days at sea is not included in the 2011 report. The mortality rate for the 67,000 sheep involved over that period was 0.45%.

4 Results and discussion

4.1 Sheep

4.1.1 Performance trend

Figures 1 and 2 show the number of sheep exported and the number of mortalities during sea transport from all ports in Australia to all destinations since 1985 as well as the trend line (linear regression) across the years. The 2.42 million sheep exported in 2011 is the lowest recorded since 1985. The number of sheep exported annually has varied between 2.49 and 6.65 million, and the annual mortality has varied between 0.75 and 2.98%. The trend for numbers of sheep exported and annual mortality has been downward.

Figure 1 Number of sheep exported by sea from Australia to all destinations since 1985

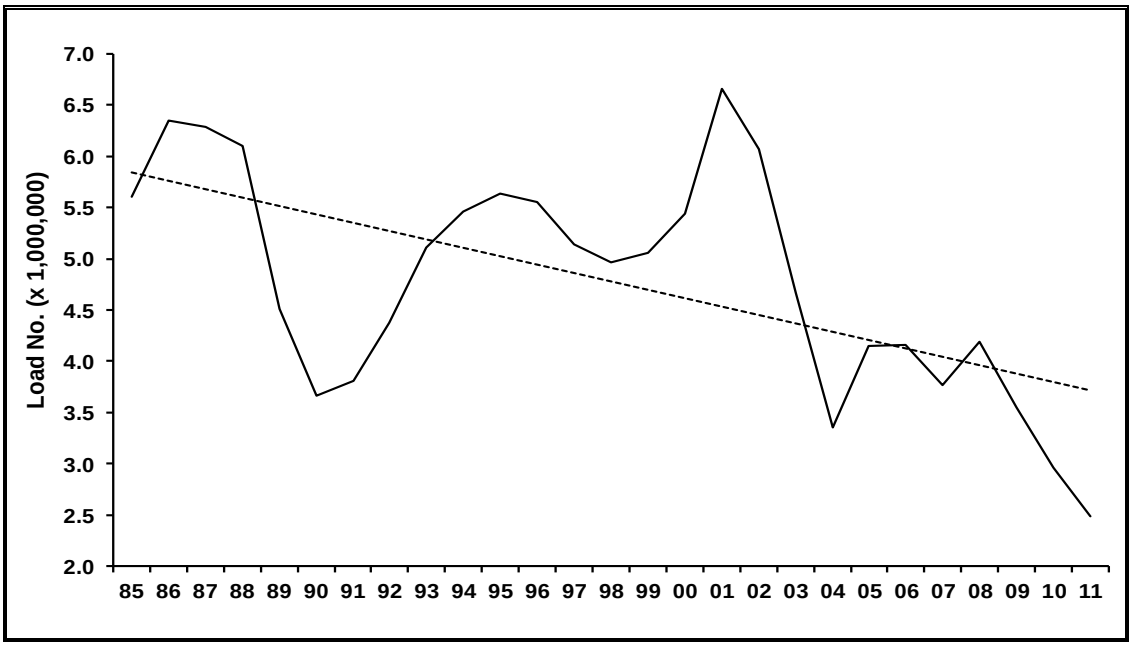
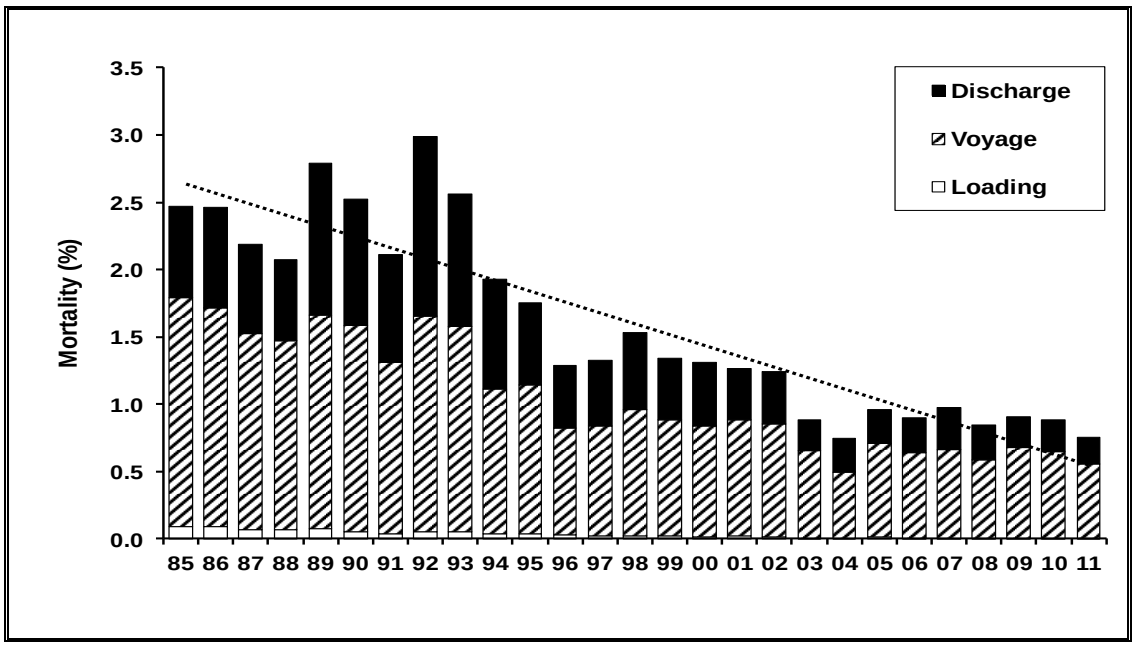


Figure 2 Annual mortality of sheep exported by sea from Australia to all destinations since 1985



4.1.2 Overview

All sheep exported live by sea from Australia in 2011 were loaded either at Fremantle (68.9%), Portland (19.9%), Adelaide (11.0%) and Broome (0.1%). Average voyage and discharge length regardless of loading and destination ports were 18.3 and 5.5 days respectively.

Most sheep were sent to the Middle East/North Africa (85.4%) and the average voyage length for exports to this region was 17.0 days with 5.8 days for discharge (most voyages had multiple discharge ports). The overall mortality for these sheep was 0.75%.

Over 350,000 sheep were exported to miscellaneous destinations, including ports in Turkey and Mauritius. The overall mortality rate for these sheep was 0.85% with an average voyage length (voyage to first discharge port) of 23.8 days with an additional 4.6 days for discharge (most voyages had multiple discharge ports).

There were 2,929 sheep exported to South-East Asia which experienced a mortality rate of 0.41%. There was one voyage to the region; which lasted 7.6 days with 1.1 days for discharge.

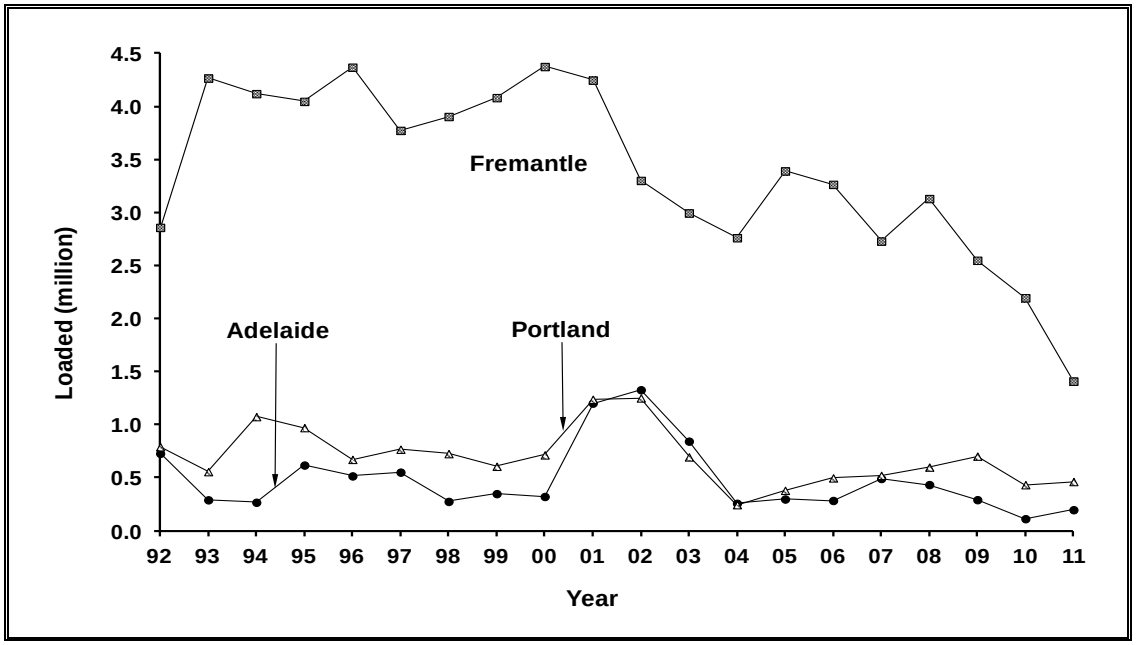
One shipment that returned to an Australian port after 10 days at sea (0.45% mortality out of 67,000 sheep) is not included in the 2011 analysis.

Except where indicated, the comments below refer to voyages of sheep to the Middle East/North Africa.

4.1.3 Port of loading

Most sheep exported by sea from Australia to the Middle East/North Africa during 2011 were loaded at Fremantle (68.1% of all sheep, Figure 3) with smaller numbers loaded at Portland (22.4%) and Adelaide (9.5%).

Figure 3 Number of sheep exported by sea to the Middle East/North Africa from Fremantle (Western Australia), Portland (Victoria) and Adelaide (South Australia) since 1992



The number and classes of sheep exported by sea to the Middle East/North Africa from Fremantle, Adelaide and Portland during 2011 are shown in Table 1. Overall numbers exported in 2011 fell by over 24% compared to 2010, with exports from Fremantle falling by 36%, while exports from Adelaide and Portland rose by 75% and 7% respectively. Exports to the region were the lowest since recording began in 1985.

The main changes in 2011 compared to 2010 were a 46% decrease in exports of wether adults from Fremantle and a 30% decrease in wether lambs, also from Fremantle. Overall, exports of ewe adults, hoggets and lambs fell by 50%, 100% and 62% respectively. The only class to experience an increase in exports was wether hoggets which rose by 77%.

Table 1 The numbers and classes of sheep exported by sea to the Middle East/North Africa from Fremantle, Adelaide and Portland during 2011

Livestock		Fremantle	Adelaide	Portland	Total
Wethers	adults	547,893	97,841	412,280	1,058,014
	hoggets	148,018	65,364	38,547	251,929
	lambs	386,868	32,596	2,024	421,488
Rams	adults	31,140	507	4,103	35,850
	hoggets	43,048		2,158	45,206
	lambs	141,862	629	551	143,042
Ewes	adults	62,637		3,025	65,662
	hoggets				
	lambs	47,307			47,307
Total	sheep	1,408,873	196,937	462,688	2,068,498

4.1.4 Destination

The countries that imported Australian sheep in 2011 are shown in Table 2. The main importing countries were Kuwait, up from 36% in 2010 to 39% of all Australian sheep exports in 2011, followed by Qatar (16%) and Bahrain (14%).

Exports to Turkey rose by more than 50% to increase its market share to 14%. Conversely, exports to Saudi Arabia fell by 91%, down to 1% of the market.

Table 2 Destination country for sheep exported from Australia during 2011

Country	Fremantle	Adelaide	Portland	Other	Total
Bahrain	212,242	7,500	134,708		354,450
Israel	53,251	3,349			56,600
Jordan	173,592	43,475			217,067
Kuwait	680,712	59,190	216,740		956,642
Oman	35,025		6,000		41,025
Qatar	210,185	83,423	95,649	6,495	395,752
Saudi Arabia	24,000				24,000
Turkey	263,141	71,211	18,000		352,352
UAE	28,194		9,191		37,385
S.E. Asia				22,562	22,562
Other	70			43	113
Total	1,680,412	268,148	480,288	29,100	2,457,948

SOURCE – Australian Bureau of Statistics (amended), April 2012

Note: As ABS figures include exports by air; figures in Table 2 may not reflect those in Table 1.

4.1.5 Mortality rates

There were 16 voyages to the Middle East/North Africa in 2011 for which sheep were loaded at more than one port in Australia (split-load voyages). Wherever possible, mortalities for split-load voyages are attributed to the port of loading, and this was done for all voyages in 2011. Where analysis involving split-load voyages has been performed, the consignments of sheep from each load port have been considered as separate “voyages”.

Using the above definition of voyage, there were 45 "voyages" of sheep to the Middle East/North Africa during 2011. This involved 28 ship journeys, one of which was loaded at three ports.

The shipboard part of the export process is divided into three phases: loading (load); voyage to the first port of unloading (voyage); and discharge. The discharge phase includes all mortalities after arrival at the first port. Consequently if a ship called at more than one discharge port, all the mortalities after arrival at the first port were included in the discharge phase.

The total mortality rate for all sheep exported to all destination regions during 2011 was 0.75% (Table 3), a decrease from 0.88% observed in 2010. The mortality rate of 0.65% for sheep exported from Fremantle was the lowest ever recorded, while the overall mortality rate of 0.75% equalled the record low set in 2004.

There were 12 shipments to Miscellaneous destinations (involving Turkey and Mauritius) for which the mortality rate was 0.85% for the 351,992 sheep loaded.

For shipments to the Middle East/North Africa, the main changes compared to 2010 were falls in mortalities for each loading port and for each phase of the voyage. The major reduction was for Adelaide which had a record low total mortality of 0.74% (Table 3 and Figure 4).

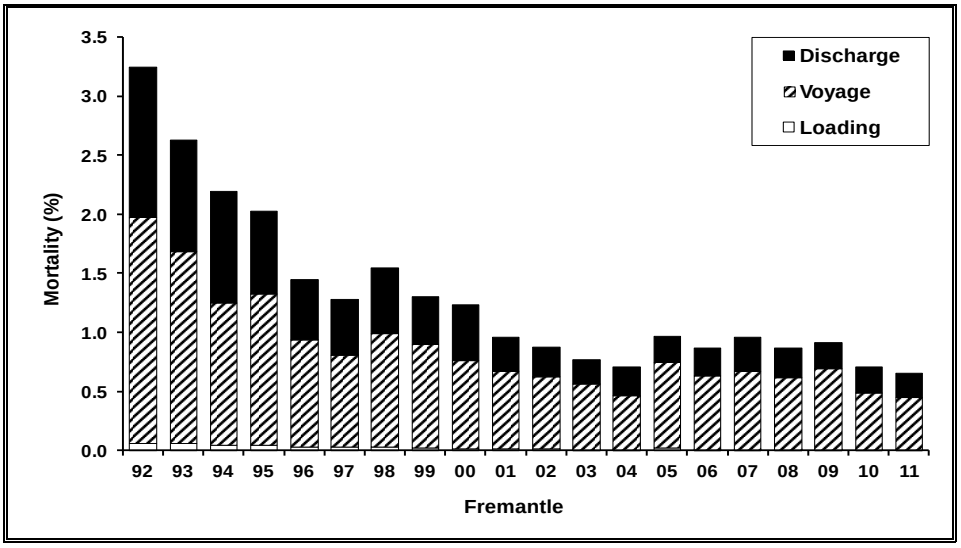
Table 3 Annual shipboard mortality rates for sheep exported from Fremantle, Adelaide and Portland to the Middle East/North Africa, and Total mortality rate for all sheep exported to all destinations

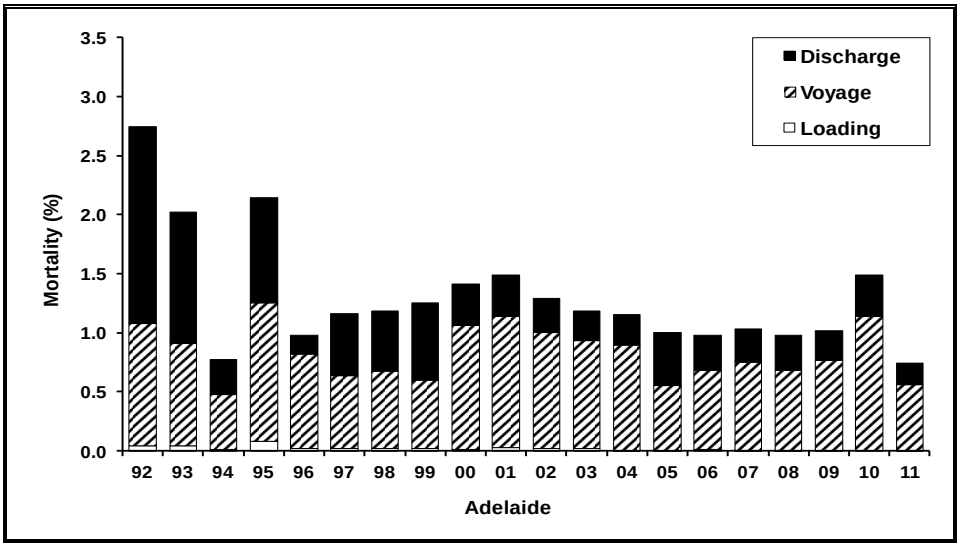
		Mortality rate (%)			
	Year	Load	Voyage	Discharge	Total
Fremantle*	2007	0.00	0.66	0.29	0.96
	2008	0.01	0.61	0.25	0.87
	2009	0.00	0.68	0.22	0.91
	2010	0.00	0.48	0.22	0.71
	2011	0.00	0.44	0.20	0.65
Adelaide*	2007	0.00	0.74	0.28	1.03
	2008	0.00	0.67	0.30	0.97
	2009	0.00	0.76	0.25	1.01
	2010	0.00	1.14	0.35	1.48
	2011	0.00	0.55	0.18	0.74
Portland*	2007	0.00	0.60	0.40	0.99
	2008	0.00	0.36	0.27	0.64
	2009	0.00	0.61	0.24	0.86
	2010	0.00	1.17	0.32	1.49
	2011	0.00	0.83	0.21	1.05
Total**	2007	0.00	0.66	0.31	0.97
	2008	0.00	0.58	0.26	0.84
	2009	0.00	0.68	0.23	0.91
	2010	0.00	0.64	0.24	0.88
	2011	0.00	0.55	0.20	0.75

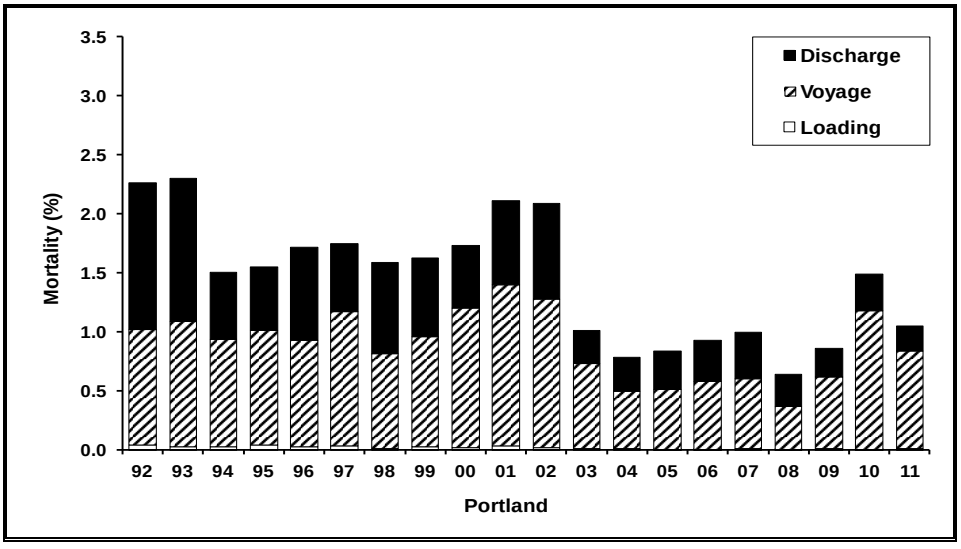
* Middle East/North Africa only

** Total includes all sheep exported by sea from Australia to all destinations

Figure 4 Annual mortality for sheep exported from Fremantle, Adelaide and Portland to the Middle East/North Africa since 1992







4.1.6 Class of sheep

The mortality rates of various classes of sheep exported from Australia to the Middle East/North Africa are shown in Table 4 and Figure 5. The highest overall mortality rates for 2011 were in adult and hogget rams (1.2% in both) (refer to Table 1 for numbers loaded).

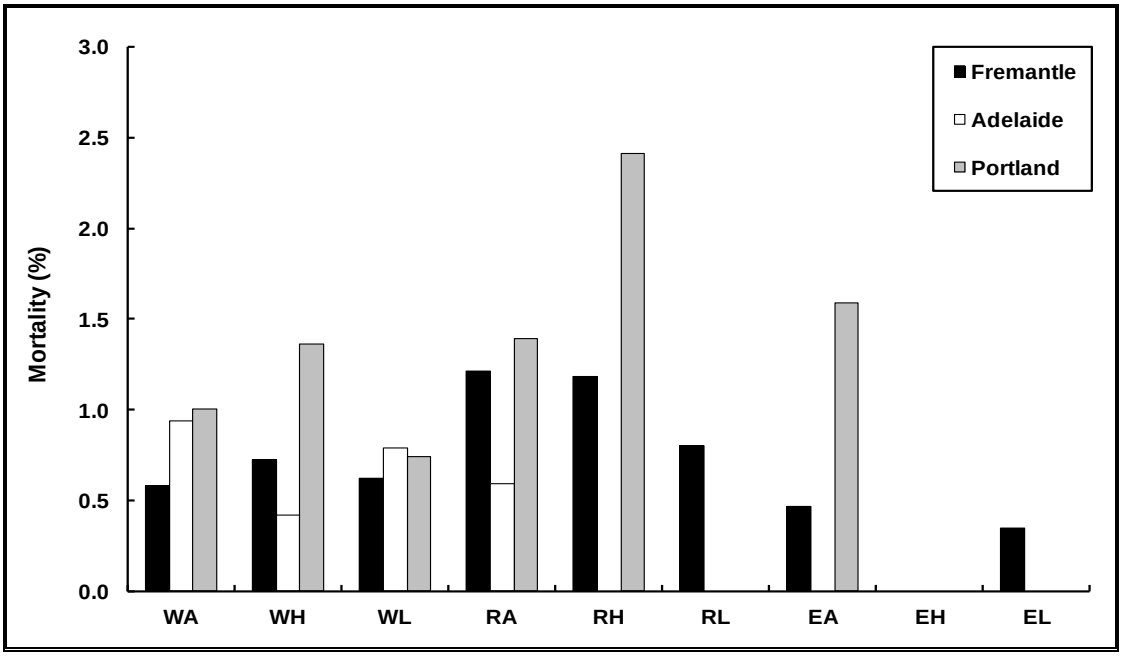
Table 4 Overall mortality (%) for classes of sheep exported from Fremantle, Adelaide and Portland to the Middle East/North Africa in 2011

Class of sheep		Fremantle	Adelaide	Portland	Total
Wethers	adult	0.58	0.94	1.01	0.78
	hogget	0.72	0.42	1.36	0.74
	lamb	0.62	0.79	0.74	0.63
Rams	adult	1.21	0.59	1.39	1.22
	hogget	1.18	n/a	2.41	1.24
	lamb	0.80	n/a	n/a	0.80
Ewes	adult	0.47	n/a	1.59	0.52
	hogget	n/a	n/a	n/a	n/a
	lamb	0.35	n/a	n/a	0.35

n/a - not applicable (no sheep of this class were loaded)

Figure 5 Overall mortality (%) for classes of sheep exported from Fremantle, Adelaide and Portland to the Middle East/North Africa in 2011

WA = wether adults WH = wether hoggets WL = wether lambs
RA = ram adults RH = ram hoggets RL = ram lambs
EA = ewe adults EH = ewe hoggets EL = ewe lambs

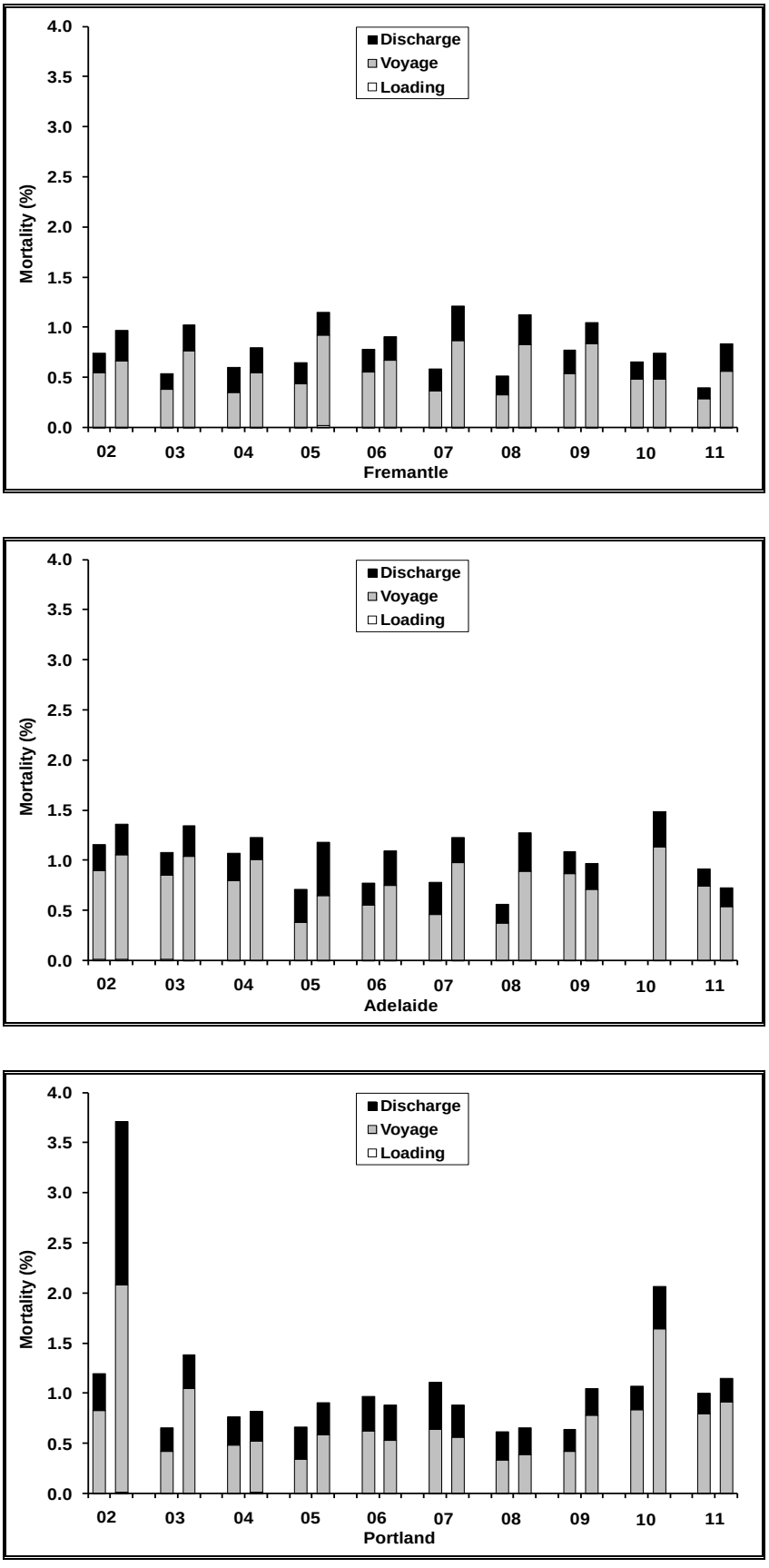


4.1.7 Time of year

Mortality rates were lower ($P < 0.05$) in the first half of 2011 compared with the second half in sheep exported from Fremantle (0.40% and 0.83%) and Portland (1.00% and 1.15%). The effect was reversed for Adelaide (0.91% and 0.73%), but it should be noted that all sheep exported from Adelaide in the first half of the year (12,000) were carried on one voyage.

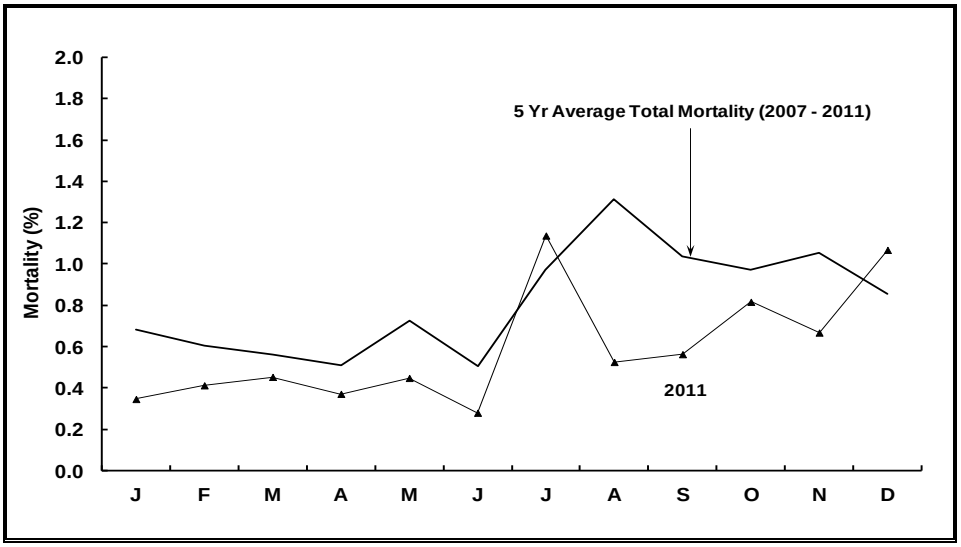
Research by Higgs *et al* (1991) indicates that seasonal metabolic cycles are the likely reason behind the finding of lower mortality rates in the first half of the year compared to the second.

Figure 6 Mortality (%) for sheep exported by sea from Fremantle, Adelaide and Portland to the Middle East/North Africa for the first and second half of each year from 2002 to 2011



In 2011, monthly mortality rates (total mortality as a proportion of total loaded for each month) in sheep exported from Fremantle were lower than the 5-year monthly mortality rates, particularly over the months August to November (Figure 7). This indicates that the seasonal increase in mortality rates in the second half of the year were less pronounced during the spring months than in previous years.

Figure 7 Monthly mortality rates for shipments from Fremantle to the Middle East/North Africa in 2011 and the 5-year monthly averages for the period 2007 to 2011



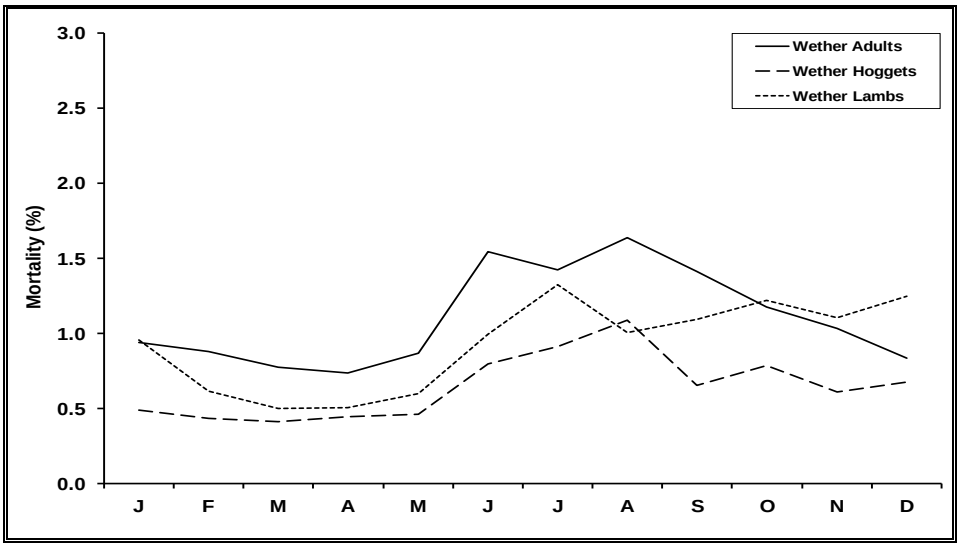
4.1.8 Time of year and age of sheep

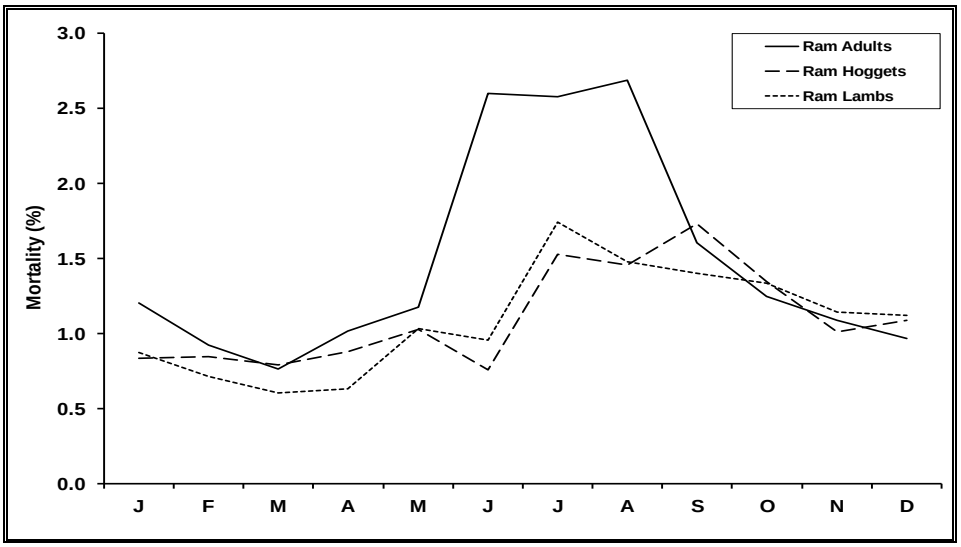
Figure 8 shows the monthly mortality rates (total mortality as a proportion of total loaded for each month) in wether and ram adults, hoggets and lambs, and ewe adults and lambs exported from Australia to the Middle East/North Africa from 2000 to 2011. Results for ewe hoggets are not presented because of the paucity of data.

Figure 9 shows the mortality rates in the first and second half of the year for the wether classes over the same period. There were significantly more deaths ($P < 0.05$) in the second half of the year than in the first half for each year and each age category of wethers except for adult and hogget wethers in 2006, and adult wethers in 2011.

Higgs et al (1991) identified a seasonal difference in mortality for adult wethers but not for wether hoggets and lambs. However, their data for this analysis was limited to 1989 only. The results as shown in Figures 8 and 9 indicate that seasonal differences in mortality exist for wether hoggets and lambs as well as adults. In general, similar findings were observed for ram classes and for ewe adults and lambs (half-year results for these classes are not presented here). For ewe hoggets, the paucity of data in most years made conclusions unreliable.

Figure 8 Monthly mortality (%) for wether and ram adults, hoggets and lambs, and ewe adults and lambs exported by sea from Australia to the Middle East/North Africa from 2000 to 2011.





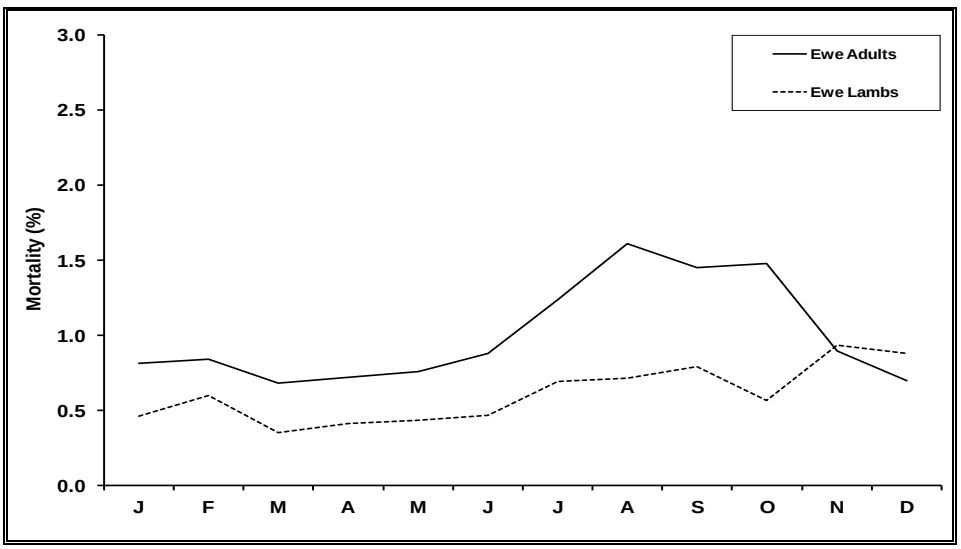
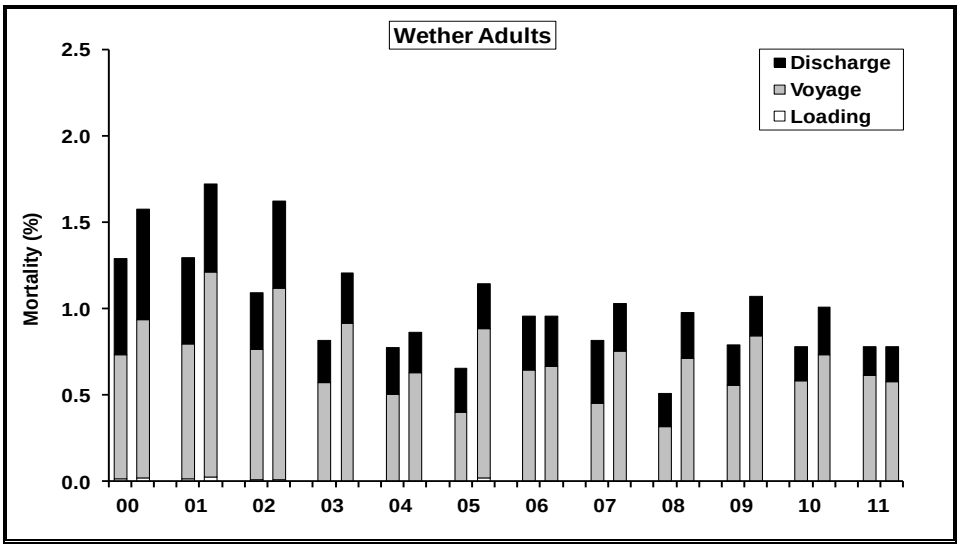
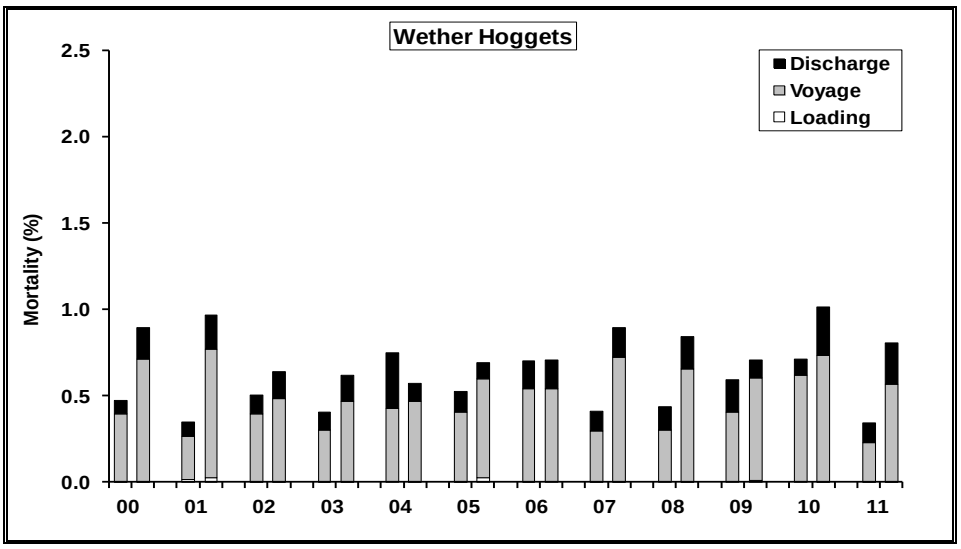
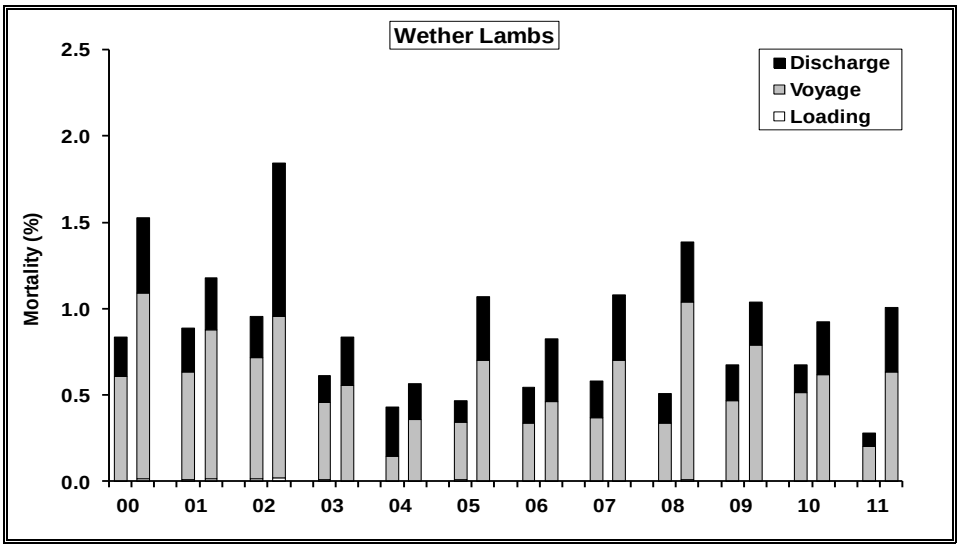


Figure 9 Mortality (%) for wether adults, hoggets and lambs exported by sea from Australia to the Middle East/North Africa for the first and second half of each year from 2000 to 2011.







4.1.9 Ship

The voyages of each ship were classified into low (mortality rate up to 1.0%), medium (mortality rate from 1.0 to 2.0%) and high (mortality rate greater than 2.0%) mortality categories for sheep exported to the Middle East/North Africa from Fremantle (Table 5a), Adelaide (Table 5b) and Portland (Table 5c).

There was only one voyage in the "high" category in 2011. Approximately 81% of voyages from Fremantle, 80% from Adelaide and 69% from Portland were in the "low" category.

The number of voyages to the region fell by approximately 9% in 2011, down from 49 in 2010 to 45 in 2011.

Table 5a Number of voyages in low, medium and high mortality categories for ships loaded at Fremantle in 2011

	Mortality rate			
Ship (code)	Low <1.0%	Medium 1.0–2.0%	High >2.0%	Total
2	6	0	0	6
32	6	0	0	6
33	3	0	0	3
34	5	2	0	7
35	1	0	0	1
42	1	2	0	3
44	0	1	0	1
Total	22	5	0	27

Table 5b Number of voyages in low, medium and high mortality categories for ships loaded at Adelaide in 2011

	Mortality rate			
Ship (code)	Low <1.0%	Medium 1.0–2.0%	High >2.0%	Total
32	2	0	0	2
33	1	0	0	1
34	1	1	0	2
Total	4	1	0	5

Table 5c Number of voyages in low, medium and high mortality categories for ships loaded at Portland in 2011

	Mortality rate			
Ship (code)	Low <1.0%	Medium 1.0–2.0%	High >2.0%	Total
2	4	1	0	5
32	2	1	1	4
34	3	1	0	4
Total	9	3	1	13

4.2 Cattle

4.2.1 Performance trend

The number of cattle shipped from all ports in Australia to all destinations since 1995 as well as the trend line (linear regression) across those years is shown in Figure 10. Figure 11 shows the number of cattle mortalities during sea transport since 1995. The number of cattle exported annually has varied from approximately 450,000 to 960,000, and the annual mortality has varied between 0.10 and 0.42%. The overall trend for numbers of cattle exported has been slightly upwards whereas the trend for annual mortality has been downward.

Figure 10 Number of cattle exported by sea from Australia to all destinations since 1995

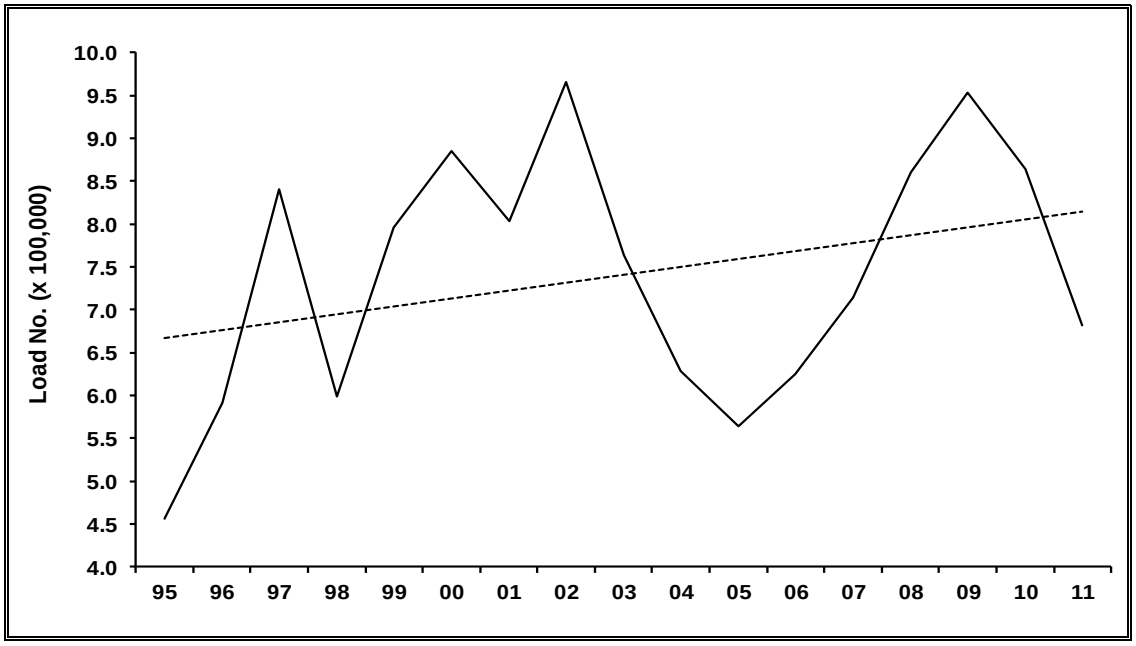
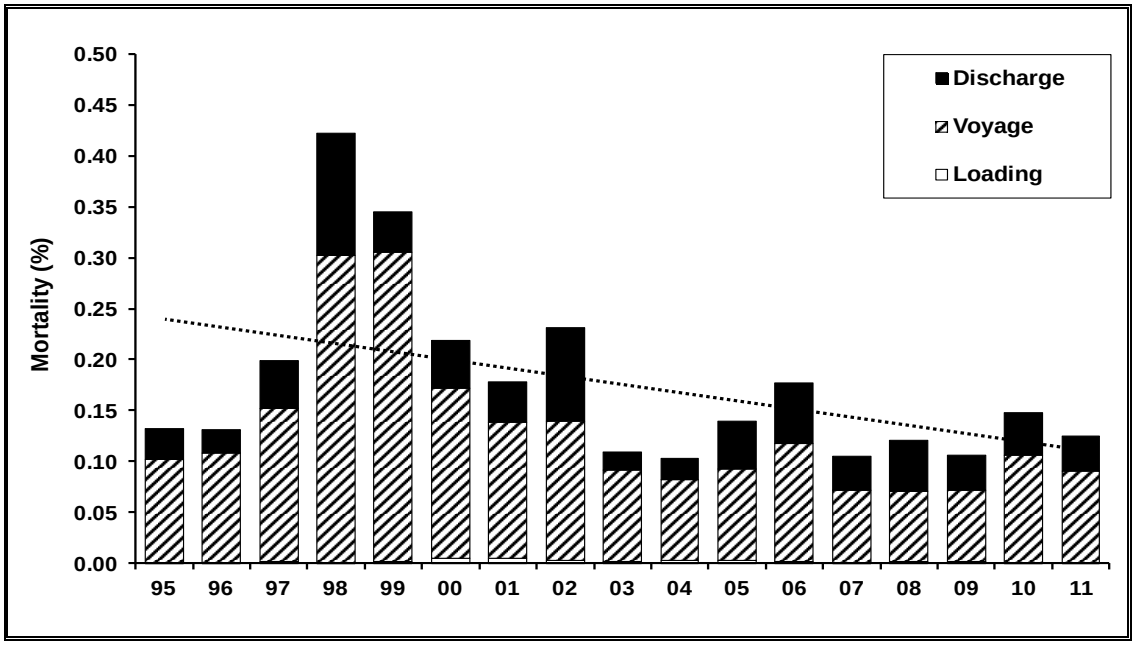


Figure 11 Annual mortality of cattle exported by sea from Australia to all destinations since 1995



4.2.2 Overview

The live cattle trade from Australia in 2011 was characterised by the large number of ports of loading in Australia and the regions to which the animals were shipped. This is in contrast to the live sheep trade where there were only three main ports of loading, and the majority of sheep were shipped to the Middle East/North Africa.

There were 20 voyages in 2011 for which cattle were loaded at more than one port in Australia. Mortalities for split-load voyages were attributed to the port of loading where possible. Where analysis involving split-load voyages has been performed, the consignments of cattle from each load port have been considered as separate “voyages”.

Using the above definition of voyage, there were 189 "voyages" of cattle during 2011. This involved 169 ship journeys, which was 38% fewer than in 2010. The overall number of cattle exported fell by 21% in 2011 compared to 2010.

The overall mortality rate among the 0.68 million cattle exported from Australia in 2011 was 0.12% (Table 6). This was lower than the 0.15% observed in 2010. The highest overall mortality rate on a regional basis was for exports to Miscellaneous destinations, which included Mauritius, Russia and Turkey. The lowest overall mortality rate was for exports to South-East Asia.

The number of cattle exported to the Middle East/North Africa in 2011 fell by half compared to 2010, while the number of voyages fell by 24%. The mortality rate to the region fell by 60%.

In previous years, exports to South-East Asia involved small consignments on short voyages, but more recently, larger ships have been introduced which load and discharge at more than one port. In 2011, these larger vessels accounted for half of the trade and 25% of the voyages to the region.

The number of voyages to South-East Asia fell by 44% in 2011 compared to 2010 (113 and 202 respectively), while the number of cattle exported to the region fell by 19%.

Exports to North-East Asia mainly comprised steers sent to Japan and dairy cattle sent to China. The number of voyage and cattle exported to the region in 2011 were similar to 2010.

No deaths were recorded on 38% of all cattle voyages during 2011.

Table 6 Mortality rates, number of voyages, voyage and discharge days, and number of cattle exported for voyages to major destination regions during 2011

Parameter	ME/N Africa	SE Asia	NE Asia	Misc	Total
Voyages (No.)	28	113	31	17	189
Cattle (No.)	80,180	446,708	68,779	86,039	681,700
Mortality rate overall (%)	0.16	0.04	0.15	0.49	0.12
Mortality rate range (%)	0.0 – 0.7	0.0 – 0.8	0.0 – 0.5	0.0 – 1.4	0.0 – 1.4
Voyage days (Ave.)	17.91	6.95	18.08	25.28	12.05
Discharge days (Ave.)	3.14	1.72	0.87	4.49	2.08
Voyages with nil mortalities (No.)	10	55	5	2	72

4.2.3 Middle East/North Africa

The live cattle trade to the Middle East/North Africa during 2011 fell by 51% compared to 2010 (Table 7). Overall mortality rates have remained below 0.5% since 1998 except for 2002 and 2006. In 2011 the mortality rate of 0.16% was the lowest since recording began in 1995.

Table 7 Mortality rates, number of voyages, average voyage and discharge length, and number of cattle exported to the Middle East/North Africa from 1995 to 2011

Year	Voyages (No.)	Cattle (No.)	Mortality rate overall (%)	Mortality rate range (%)	Voyage days	Discharge days	Nil mortality voyages (No.)
1995	11	14,557	0.67	0.0 – 2.1	14.64	6.91	2
1996	36	65,066	0.65	0.0 – 5.0	16.33	5.36	14
1997	62	137,869	0.67	0.0 – 4.2	18.85	3.76	15
1998	122	266,286	0.69	0.0 – 41.5*	20.02	3.05	23
1999	112	314,981	0.35	0.0 – 3.3	18.42	2.79	25
2000	96	274,159	0.42	0.0 – 8.0	17.91	2.92	22
2001	101	287,242	0.32	0.0 – 5.0	17.01	3.00	27
2002	102	265,005	0.61	0.0 – 35.0*	17.01	3.60	33
2003	52	106,080	0.45	0.0 – 2.0	16.31	5.65	18
2004	31	61,679	0.43	0.0 - 1.3	16.10	5.55	9
2005	38	90,808	0.34	0.0 – 1.0	15.60	5.17	12
2006	43	119,297	0.52	0.0 – 4.3	16.05	4.42	13
2007	41	74,256	0.19	0.0 – 0.5	16.43	4.23	16
2008	46	120,122	0.29	0.0 – 0.8	17.09	5.02	19
2009	41	98,183	0.32	0.0 – 1.8	15.37	4.62	13
2010	37	163,869	0.40	0.0 – 1.6	17.57	3.75	14
2011	28	80,180	0.16	0.0 – 0.7	17.91	3.14	10

* exceptional voyages involving presumed heat stroke in 1998 and heat stroke in 2002

4.2.3.1 Port of loading

There were 5 ports of loading for voyages to the Middle East/North Africa in 2011, with most cattle exported from Fremantle, followed by Broome and Darwin (Table 8). Mortality rates in 2011 were highest from Broome, followed by Adelaide and Portland. Two voyages which loaded at Broome subsequently loaded at Fremantle thereby adding to the average voyage length from Broome.

The voyages from each port were classified into various mortality categories as shown in Table 9. There were four voyages in the medium or high categories, two loaded at Fremantle and one at each of Portland and Broome. No mortalities occurred on 60% and 39% of the voyages from Portland and Fremantle respectively.

Table 8 Mortality rates, number of voyages, average voyage and discharge length, and number of cattle exported from various ports to the Middle East/North Africa for 2011

Port	Voyages (No.)	Cattle (No.)	Mortality rate overall (%)	Mortality rate range (%)	Voyage days	Discharge days
Fremantle	18	58,070	0.13	0.0 – 0.6	16.55	3.53
Broome	3	12,950	0.31	0.3 – 0.7	20.72	0.87
Darwin	1	5,363	0.15	n/a	17.70	0.72
Portland	5	3,373	0.18	0.0 – 0.7	20.07	3.11
Adelaide	1	424	0.24	n/a	23.33	5.57

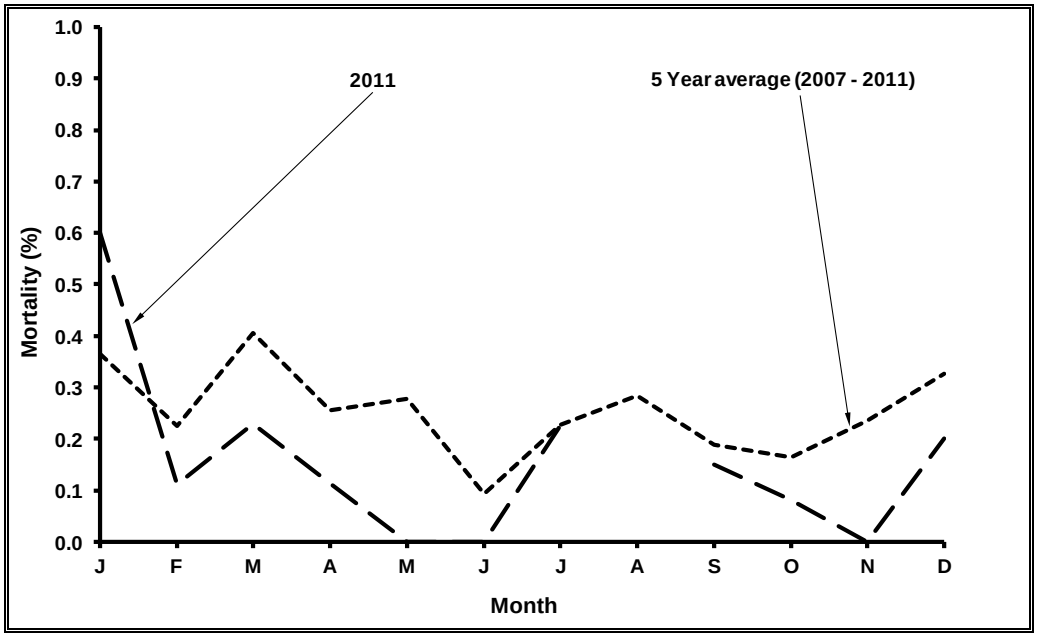
Table 9 Number of voyages in nil, low, medium and high mortality categories for shipments from various ports to the Middle East/North Africa for 2011

Port	Mortality rate				Total
	Nil 0.0%	Low >0.0–0.5%	Medium >0.5–1.0%	High >1.0%	
Fremantle	7	9	2	0	18
Broome	0	2	1	0	3
Darwin	0	1	0	0	1
Portland	3	1	1	0	5
Adelaide	0	1	0	0	1
Total	10	14	4	0	28

4.2.3.2 Time of year

In 2011, monthly mortality rates (total mortality as a proportion of total loaded for each month) in cattle exported from all ports to the Middle East/North Africa remained below 0.60% throughout the year (Figure 12).

Figure 12 Monthly mortality rates of cattle on voyages from all ports to the Middle East/North Africa for 2011 and the 5-year monthly rates for the period 2007 to 2011



Note – one 2010 high mortality voyage excluded; if included, Feb' percentages 0.6% for the 5 year average profile

4.2.3.3 Ship

The voyages of each ship from Australia to the Middle East/North Africa were classified into the following mortality categories: nil (no mortalities reported); low (mortality rate up to 0.5%); medium (mortality rate from 0.5 to 1.0%); and high (mortality rate greater than 1.0%). Note that for this comparison, “voyage” equates to consignment from a port. Consequently, if a ship loaded at two ports, then two “voyages” are shown for that ship, one for each port.

Table 11 shows the number of voyages in the various mortality categories for each ship. Most voyages (81%) were in the nil or low categories. There were four voyages in the medium category involving ships 32, 34 and 44.

Table 11 Number of voyages in nil, low, medium and high mortality categories for shipments to the Middle East/North Africa for 2011

	Mortality rate				
Ship (code)	Nil 0.0%	Low >0.0–0.5%	Medium >0.5–1.0%	High >1.0%	Total
32	2	1	1	0	4
33	0	4	0	0	4
34	5	0	2	0	7
35	0	2	0	0	2
42	0	4	0	0	4
44	1	0	1	0	2
45	0	1	0	0	1
103	0	1	0	0	1
120	0	1	0	0	1
121	2	0	0	0	2
Total	10	14	4	0	28

4.2.3.4 Class of cattle

In 2011, the highest mortality rates occurred in beef heifers (0.35%) followed by dairy heifers (0.26%), and adult steers (0.24%; Table 12). Bull classes made up 66% of all cattle shipped to the region.

Since 2009, young cattle have been referred to as “weaners” instead of "calves" in these reports.

Table 12 Mortality rates, number of voyages and number of cattle in various classes exported to the Middle East/North Africa in 2011

Class	Voyages (No.)	Cattle (No.)	Mortality rate (%)	Mortality rate range (%)
Bull adult*	22	32,999	0.12	0.0 – 2.6
Bull weaner	6	20,298	0.13	0.0 – 0.2
Steer adult*	15	19,045	0.24	0.0 – 0.5
Heifer dairy	9	5,476	0.26	0.0 – 0.9
Heifer beef	4	1,450	0.35	0.0 – 0.8
Steer weaner	3	629	0.00	n/a
Cow dairy	2	283	0.00	n/a

* may include young as well as mature animals (ie animals not separately classified as "weaner")

4.2.4 South-East Asia

Approximately 0.45 million cattle were exported to South-East Asia in 2011 (Table 13). The mortality rate for voyages to the region remained at the record low 0.04% while the number of voyages fell to a record low of 113. No mortalities were reported on half of the voyages to the region. The mortality rate has remained below 0.1% since 2001.

Table 13 Mortality rates, number of voyages, average voyage and discharge length, and number of cattle exported to South-East Asia from 1995 to 2011

Year	Voyages (No.)	Cattle (No.)	Mortality rate overall (%)	Mortality rate range (%)	Voyage days	Discharge days	Nil mortality voyages (No.)
1995	365	430,653	0.11	0.0 – 8.5	–	–	206
1996	415	505,777	0.05	0.0 – 1.2	–	–	280
1997	507	678,585	0.09	0.0 – 1.7	6.42	0.83	277
1998	229	296,823	0.17	0.0 – 8.8	7.19	0.76	127
1999	326	462,540	0.34	0.0 – 74.7*	7.17	0.67	162
2000	385	587,049	0.11	0.0 – 5.3	6.75	0.76	168
2001	312	472,363	0.08	0.0 – 5.0	6.69	0.76	139
2002	365	656,767	0.07	0.0 – 8.5	6.57	0.91	191
2003	306	587,716	0.05	0.0 – 2.2	6.46	0.87	190
2004	217	465,498	0.05	0.0 – 1.8	6.17	0.92	118
2005	169	403,819	0.09	0.0 – 0.8	6.06	0.97	73
2006	166	452,516	0.09	0.0 – 1.0	6.24	1.38	66
2007	205	573,729	0.09	0.0 – 4.0	6.47	1.10	92
2008	219	682,265	0.09	0.0 – 1.9	6.33	1.14	93
2009	288	795,465	0.08	0.0 – 0.9	6.27	0.99	130
2010	202	551,761	0.04	0.0 – 0.4	6.47	0.86	105
2011	113	446,708	0.04	0.0 – 0.8	6.95	0.87	55

* exceptional voyage involving heat stroke caused by ventilation failure due to contaminated fuel

4.2.4.1 Port of loading

Most cattle exported to South-East Asia in 2011 were loaded at Darwin (58%) followed by Broome (18%) and Wyndham (9%, Table 14). The mortality rate was highest for cattle exported from Mourilyan (0.13%).

The voyages from each port were classified into various mortality categories as shown in Table 15. All except one voyage was in the nil or low categories. No voyages were in the high category in 2011.

Table 14 Mortality rates, number of voyages, average voyage and discharge length, and number of cattle exported from various ports to South-East Asia in 2011

Port	Voyages (No.)	Cattle (No.)	Mortality rate overall (%)	Mortality rate range (%)	Voyage days	Discharge days
Darwin	66	261,312	0.05	0.0 – 0.8	6.58	1.68
Broome	20	79,052	0.05	0.0 – 0.4	6.39	2.06
Wyndham	10	41,219	0.01	0.0 – 0.0	5.73	1.01
Townsville	7	33,240	0.05	0.0 – 0.1	9.57	2.95
Fremantle	3	21,769	0.03	0.0 – 0.0	8.66	1.93
Karumba	4	6,638	0.06	0.0 – 0.3	9.77	0.75
Mourilyan	2	2,363	0.13	0.1 – 0.2	12.98	0.89
Geraldton	1	1,085	0.00	n/a	8.44	0.25

Table 15 Number of voyages in nil, low, medium and high mortality categories for shipments from various ports to South-East Asia for 2011

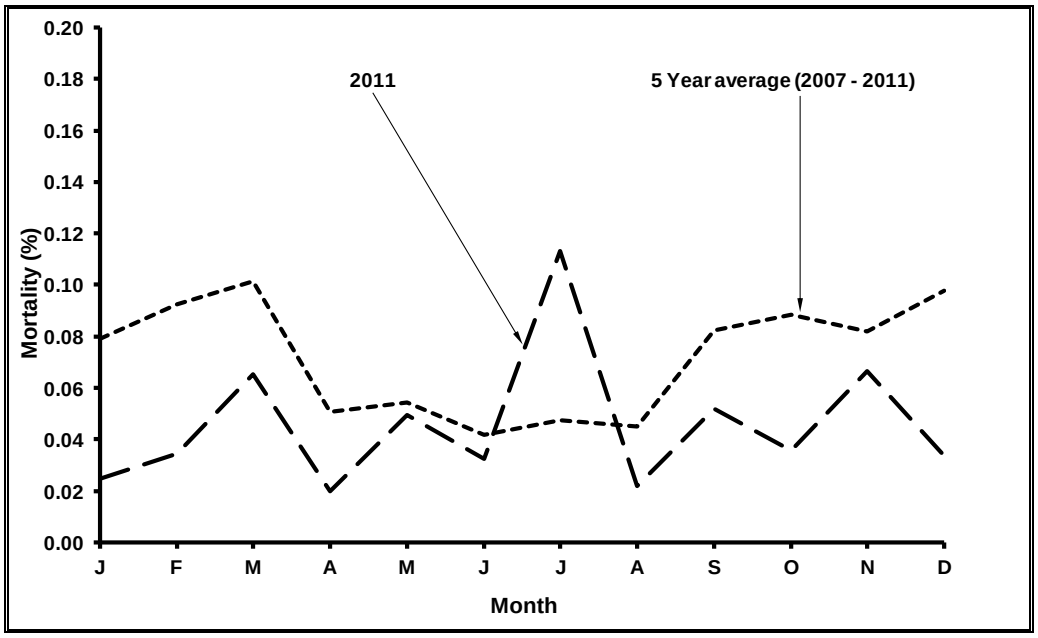
Port	Mortality rate				Total
	Nil 0.0%	Low >0.0–0.5%	Medium >0.5–1.0%	High >1.0%	
Darwin	28	37	1	0	66
Broome	13	7	0	0	20
Wyndham	8	2	0	0	10
Townsville	2	5	0	0	7
Fremantle	1	2	0	0	3
Karumba	2	2	0	0	4
Mourilyan	0	2	0	0	2
Geraldton	1	0	0	0	1
Total	55	57	1	0	113

4.2.4.2 Time of year

Monthly mortality rates (total mortality as a proportion of total loaded for each month) for voyages to South-East Asia in 2011 were below 0.07% throughout the year except for the month of July (Figure 13).

The monthly mortality rate in 2011 remained below the 5-year average except for the month of July.

Figure 13 Monthly mortality rates of cattle on voyages from all ports to South-East Asia for 2011 and the 5-year monthly rates for the period 2007 to 2011



4.2.4.3 Ship

The voyages of each ship from Australia to South-East Asia were classified into various mortality categories as shown in Table 16. All voyages except one were in the nil or low mortality categories.

The number of voyages to the region decreased by 44% in 2011 compared to 2010.

Table 16 Number of voyages in nil, low, medium and high mortality categories for shipments to South-East Asia for 2011

	Mortality rate				
Ship (code)	Nil 0.0%	Low >0.0–0.5%	Medium >0.5–1.0%	High >1.0%	Total
33	1	0	0	0	1
42	0	8	0	0	8
43	0	2	0	0	2
44	5	7	0	0	12
45	3	0	0	0	3
46	1	1	0	0	2
47	1	1	0	0	2
59	1	2	0	0	3
88	4	7	0	0	11
103	2	3	0	0	5
109	6	4	0	0	10
114	6	6	0	0	12
115	1	0	0	0	1
117	10	9	0	0	19
119	2	0	0	0	2
120	6	6	0	0	12
121	1	0	0	0	1
124	4	1	1	0	6
125	1	0	0	0	1
Total	55	57	1	0	113

4.2.4.4 Class of cattle

Nearly all cattle (95%) exported to South-East Asia in 2011 could be identified by class. Of those, the highest mortality rates occurred in beef cows (0.31%) followed by dairy cows (0.26%), though it should be noted that the dairy cow mortality involved only one voyage (Table 17).

The 5% of cattle not identified to class provided 5% of all mortalities, with an overall mortality rate of 0.04%.

Table 17 Mortality rates, number of voyages and number of cattle in various classes exported to the South-East Asia in 2011

Class	Voyages (No.)	Cattle (No.)	Mortality rate (%)	Mortality rate range (%)
Steer adult*	94	233,521	0.03	0.0 – 0.5
Heifer beef	88	144,873	0.03	0.0 – 0.5
Bull adult*	47	25,314	0.08	0.0 – 1.5
Cow beef	9	10,228	0.31	0.0 – 1.3
Steer weaner	5	5,024	0.04	0.0 – 0.1
Heifer dairy	1	3,725	0.00	n/a
Bull weaner	6	1,927	0.05	0.0 – 1.4
Cow dairy	1	757	0.26	n/a

* may include young as well as mature animals (ie animals not separately classified as "weaner")

4.2.5 North-East Asia

The number of cattle exported and number of voyages to North-East Asia in 2011 remained at similar levels to 2010 (Table 18). The mortality rate of 0.15% in 2011 was the highest since 1999, almost doubling the 0.08% of 2010.

Table 18 Mortality rates, number of voyages, average voyage and discharge length, and number of cattle exported to North-East Asia from 1995 to 2011

Year	Voyages (No.)	Cattle (No.)	Mortality rate overall (%)	Mortality rate range (%)	Voyage days	Discharge days	Nil mortality voyages (No.)
1995	7	7,311	0.29	0.1 - 0.5	–	–	0
1996	9	12,587	0.40	0.1 - 1.2	–	–	0
1997	11	15,960	0.29	0.0 - 2.6	16.82	2.91	4
1998	10	14,734	0.17	0.0 - 0.4	16.00	2.10	2
1999	8	10,772	0.22	0.0 - 0.4	16.75	0.63	1
2000	10	13,830	0.14	0.0 - 0.4	17.00	0.30	4
2001	14	18,190	0.11	0.0 - 0.9	16.86	1.93	5
2002	17	22,483	0.12	0.0 - 0.7	18.24	1.12	7
2003	36	66,861	0.12	0.0 - 1.1	16.58	2.03	10
2004	50	95,534	0.10	0.0 - 0.8	16.00	1.26	12
2005	37	52,565	0.09	0.0 – 0.4	16.47	1.74	14
2006	26	37,963	0.12	0.0 – 1.3	17.09	1.28	11
2007	21	34,837	0.06	0.0 – 0.2	16.60	1.71	10
2008	19	29,873	0.06	0.0 – 0.4	17.51	1.04	10
2009	23	48,116	0.07	0.0 – 0.2	16.91	0.70	5
2010	34	69,638	0.08	0.0 – 0.3	17.69	0.62	10
2011	31	68,773	0.15	0.0 – 0.5	18.08	0.87	5

4.2.5.1 Port of loading

Cattle were exported to North-East Asia mainly from Portland, Geelong and Brisbane (Table 19). All cattle loaded at Brisbane were exported to Japan while those loaded at Geelong and Fremantle were exported to China. One shipment from Portland went to North-Eastern Russia, but the rest of Portland cattle went to China.

The voyages from each port were classified into various mortality categories as shown in Table 20. All voyages were in the nil or low categories.

Table19 Mortality rates, number of voyages, average voyage and discharge length, and number of cattle exported from various ports to North-East Asia for 2011

Port	Voyages (No.)	Cattle (No.)	Mortality rate overall (%)	Mortality rate range (%)	Voyage days	Discharge days
Portland	14	39,830	0.14	0.0 – 0.5	18.75	1.00
Geelong	5	13,520	0.24	0.1 – 0.4	16.21	1.80
Brisbane	7	13,498	0.11	0.0 – 0.3	13.59	1.43
Fremantle	5	1,925	0.05	0.0 – 0.3	24.34	0.77

Table 20 Number of voyages in nil, low, medium and high mortality categories for shipments from various ports to North-East Asia for 2011

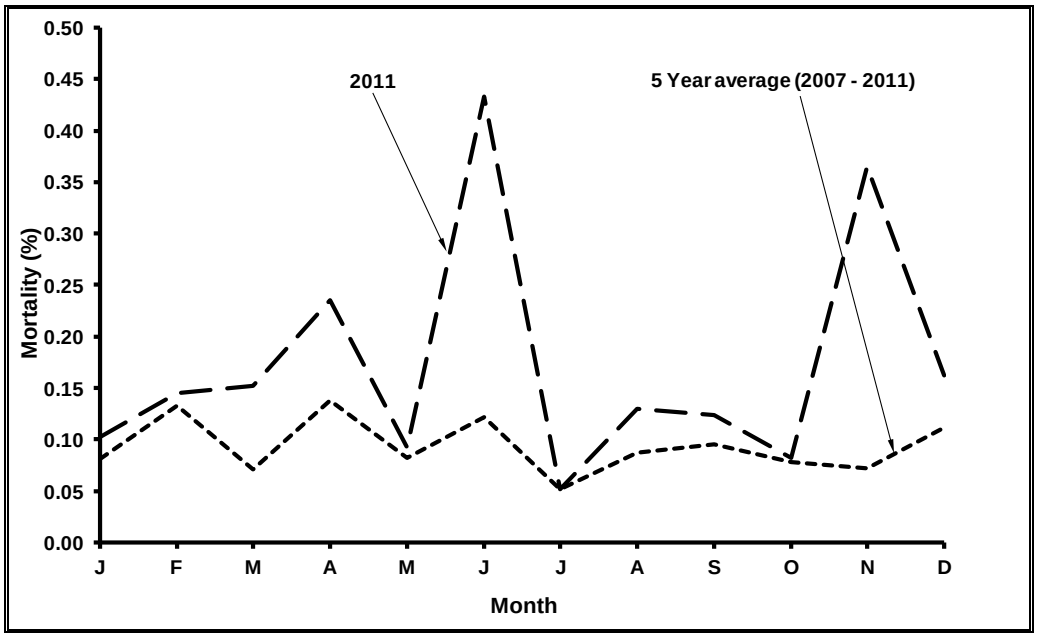
Port	Mortality rate				Total
	Nil 0.0%	Low >0.0–0.5%	Medium >0.5–1.0%	High >1.0%	
Portland	0	14	0	0	14
Geelong	0	5	0	0	5
Brisbane	1	6	0	0	7
Fremantle	4	1	0	0	5
Total	5	26	0	0	31

4.2.5.2 Time of year

Monthly mortality rates (total mortality as a proportion of total loaded for each month) for voyages to North-East Asia in 2011 were below 0.24% throughout the year except for the months of June and November (Figure 14).

The monthly mortality rate in 2011 widely stayed above the five year average throughout the year.

Figure 14 Monthly mortality rates of cattle on voyages from all ports to North-East Asia for 2011 and the 5-year monthly rates for the period 2007 to 2011



4.2.5.3 Ship

The voyages of each ship taking cattle from Australia to North-East Asia were classified into various mortality categories as shown in Table 21. All voyages were in the nil or low categories.

Table 21 Number of voyages in nil, low, medium and high mortality categories for shipments to North-East Asia for 2011

	Mortality rate				
Ship (code)	Nil 0.0%	Low >0.0–0.5%	Medium >0.5–1.0%	High >1.0%	Total
44	1	2	0	0	3
45	0	1	0	0	1
59	0	7	0	0	7
77	1	1	0	0	2
103	0	1	0	0	1
114	0	1	0	0	1
117	0	2	0	0	2
119	1	2	0	0	3
120	1	1	0	0	2
121	1	1	0	0	2
123	0	7	0	0	7
Total	5	26	0	0	31

4.2.5.4 Class of cattle

Mortality rates for each class of cattle exported to North-East Asia during 2011 are presented in Table 22. The North-East Asian cattle trade comprised mainly steers exported to Japan and dairy heifers exported to China.

No detailed class breakdowns were received for the 13,498 cattle shipped to Japan. These made up 19.6% of all cattle shipped to the region, and incurred a mortality rate of 0.11%. For the remainder, the highest mortality rates occurred in beef heifers (0.83%) followed by dairy heifers (0.17%).

Table 22 Mortality rate, number of voyages and number of cattle in the classes exported to North-East Asia in 2011

Class	Voyages (No.)	Cattle (No.)	Mortality rate (%)	Mortality rate range (%)
Heifer dairy	23	49,275	0.17	0.0 – 0.5
Cow dairy	1	2,656	0.04	n/a
Steer adult*	1	2,422	0.00	n/a
Heifer beef	2	847	0.83	0.2 – 1.6
Bull adult*	1	57	0.00	n/a

* may include young as well as mature animals (ie animals not separately classified as "weaner")

4.2.6 Miscellaneous destinations

In previous years the Miscellaneous category has comprised relatively few voyages to widely differing destinations. However in 2011, most voyages in the Miscellaneous category were to Turkey and the Black Sea.

The number of cattle exported to Miscellaneous destinations again rose in 2011 (Table 23), and was the only region to experience an increase in trade. This was mainly due to an increase in shipments to the Black Sea.

Table 23 Mortality rates, number of voyages, average voyage and discharge length, and number of cattle exported to Miscellaneous destinations from 1995 to 2011

Year	Voyages (No.)	Cattle (No.)	Mortality rate overall (%)	Mortality rate range (%)	Voyage days	Discharge days	Nil mortality voyages (No.)
1995	3	3,840	0.70	0.1 – 1.4	–	–	0
1996	4	3,493	0.40	0.0 – 0.9	–	–	1
1997	1	769	0.00	n/a	4.00	0.00	1
1998	0	0	n/a	n/a	n/a	n/a	n/a
1999	0	0	n/a	n/a	n/a	n/a	n/a
2000	1	828	0.00	n/a	12.00	1.00	1
2001	6	5,694	0.05	0.0 – 0.2	13.67	1.00	4
2002	4	4,184	0.05	0.0 – 0.1	11.25	0.25	2
2003	2	1,001	0.00	n/a	8.00	0.50	2
2004	2	573	0.52	0.0 – 0.5	11.00	0.50	1
2005	0	0	n/a	n/a	n/a	n/a	n/a
2006	1	3,382	0.09	n/a	19.18	1.98	0
2007	8	8,506	0.26	0.0 – 1.0	23.80	0.98	1
2008	12	20,109	0.11	0.0 – 0.2	23.30	1.08	4
2009	1	3,483	0.37	n/a	41.60	0.69	0
2010	12	79,473	0.44	0.0 – 0.8	24.06	4.64	2
2011	17	86,039	0.49	0.0 – 1.4	25.28	4.49	2

4.2.6.1 Port of loading

Cattle exported to Miscellaneous destinations were all from the southern ports of Fremantle, Adelaide and Portland (Table 24).

The voyages from each port were classified into various mortality categories as shown in Table 25. There was 1 voyage in the high category for the port of Portland. Most voyages (76%) were in the nil or low categories.

Table 24 Mortality rates, number of voyages, average voyage and discharge length, and number of cattle exported from various ports to Miscellaneous destinations for 2011

Port	Voyages (No.)	Cattle (No.)	Mortality rate overall (%)	Mortality rate range (%)	Voyage days	Discharge days
Fremantle	10	42,292	0.43	0.0 – 0.9	22.28	4.54
Portland	5	35,242	0.56	0.3 – 1.4	30.18	4.39
Adelaide	2	8,505	0.52	0.2 – 0.5	28.04	4.50

Table 25 Number of voyages in nil, low, medium and high mortality categories for shipments from various ports to Miscellaneous destinations for 2011

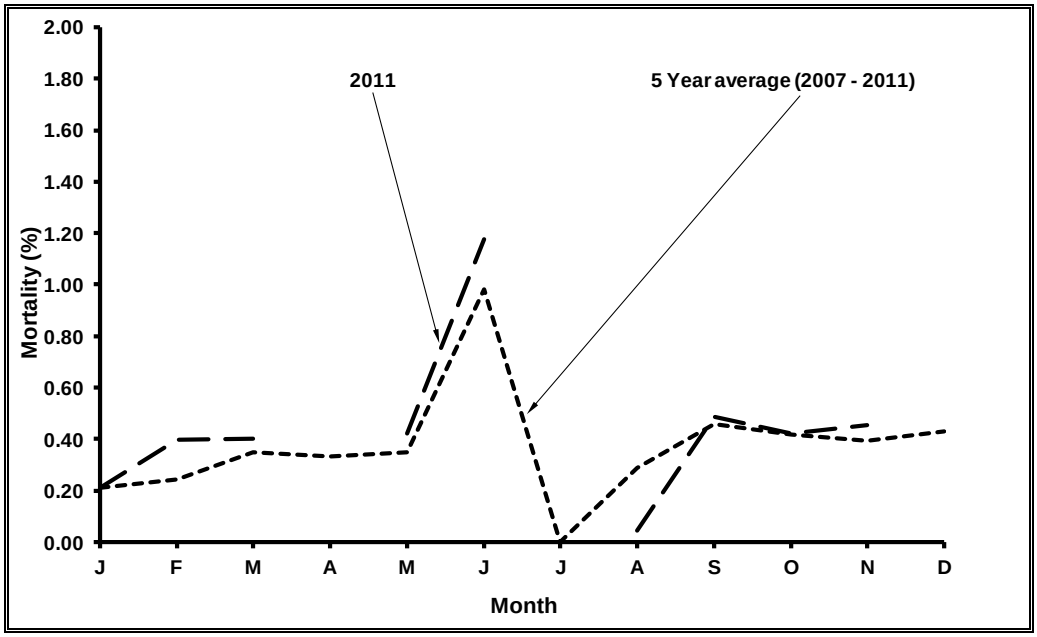
Port	Mortality rate				Total
	Nil 0.0%	Low >0.0–0.5%	Medium >0.5–1.0%	High >1.0%	
Fremantle	2	6	2	0	10
Portland	0	4	0	1	5
Adelaide	0	1	1	0	2
Total	2	11	3	1	17

4.2.6.2 Time of year

Monthly mortality rates (total mortality as a proportion of total loaded for each month) for voyages to Miscellaneous destinations in 2011 were below 0.4% throughout the year except for June (Figure 15).

For the nine months on which voyages occurred during 2011, the monthly mortality profile was similar to the five year average.

Figure 15 Monthly mortality rates of cattle on voyages from all ports to Miscellaneous destinations for 2011 and the 5-year monthly rates for the period 2007 to 2011



4.2.6.3 Ship

The voyages of each ship taking cattle from Australia to Miscellaneous destinations were classified into various mortality categories as shown in Table 26. There was one voyage in the high category involving ship 46. Three voyages in the medium category involved ship 46 twice, and ship 33 once.

Table 26 Number of voyages in nil, low, medium and high mortality categories for shipments to Miscellaneous destinations for 2011

	Mortality rate				
Ship (code)	Nil 0.0%	Low >0.0–0.5%	Medium >0.5–1.0%	High >1.0%	Total
33	0	0	1	0	1
35	0	3	0	0	3
42	0	2	0	0	2
43	0	2	0	0	2
46	0	1	2	1	4
47	0	1	0	0	1
77	0	1	0	0	1
103	0	1	0	0	1
109	2	0	0	0	2
Total	2	11	3	1	17

4.2.6.4 Class of cattle

Mortality rates for each class of cattle exported to Miscellaneous destinations during 2011 are presented in Table 27. Trade to Miscellaneous destinations comprised mainly steers (42%) and bulls (15%) exported to Turkey and dairy cattle (23%) exported to Russia.

In 2011 the highest mortality rates occurred in weaner steers (0.84%) followed by adult steers (0.56%) and weaner bulls (0.48%).

Table 27 Mortality rate, number of voyages and number of cattle in the classes exported to Miscellaneous destinations in 2011

Class	Voyages (No.)	Cattle (No.)	Mortality rate (%)	Mortality rate range (%)
Steer adult*	14	39,804	0.56	0.0 – 2.1
Heifer beef	7	21,324	0.46	0.2 – 1.3
Bull adult*	14	11,573	0.28	0.0 – 0.5
Heifer dairy	1	5,488	0.40	n/a
Bull weaner	5	3,930	0.48	0.0 – 0.8
Steer weaner	4	3,920	0.84	0.3 – 1.1

* may include young as well as mature animals (ie animals not separately classified as "weaner")

4.3 Goats

4.3.1 Performance trend

Figures 16 and 17 show the number of goats exported and the mortality rates during sea transport from all ports in Australia to all destinations since 1993 as well as the trend line (linear regression) across the years. The number of goats exported annually has varied between approximately 600 and 114,000, and the annual mortality has varied between 0.16 and 2.69%. The trend for annual mortality has continued downward.

Figure 16 Number of goats exported by sea from Australia to all destinations since 1993

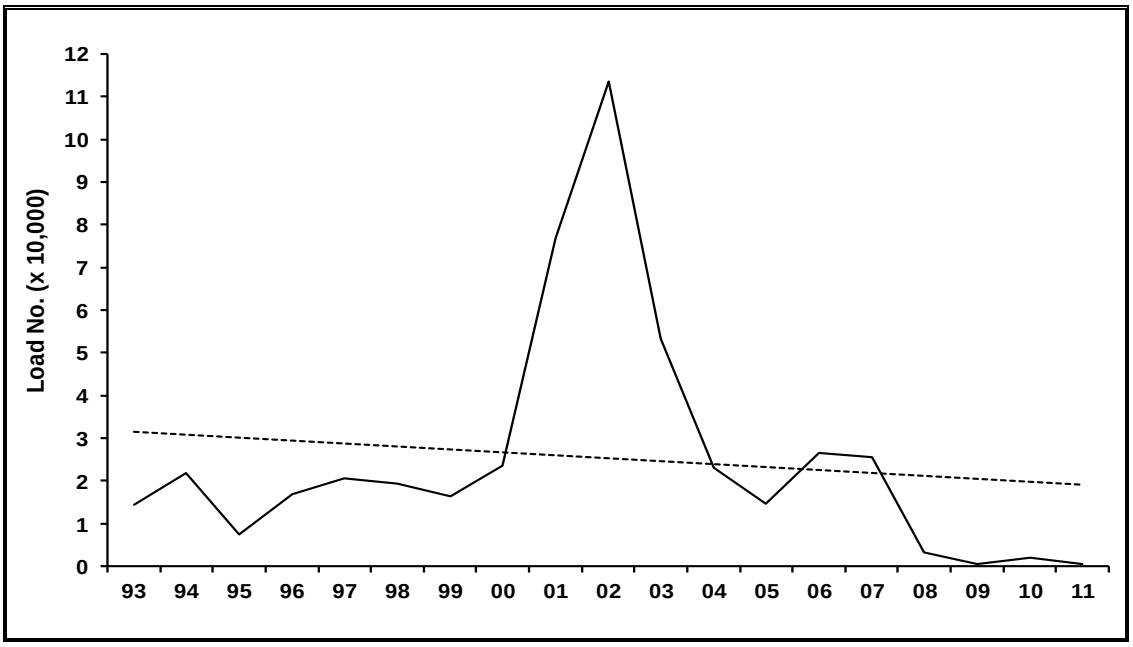
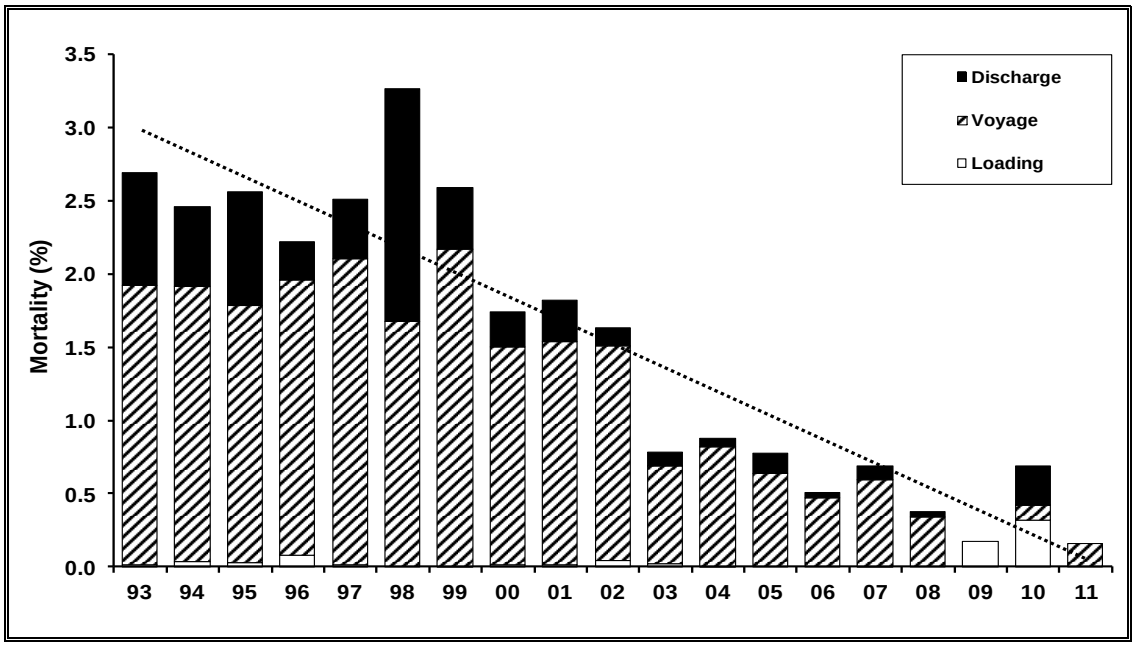


Figure 17 Annual mortality of goats exported by sea from Australia to all destinations since 1993



4.3.2 Overview

All goats (610) exported by sea from Australia in 2011 were carried on a single voyage which departed from the port of Darwin and went to South-East Asia. This voyage experienced a mortality rate of 0.16% (Table 28).

For a number of years the export of live goats has been undertaken mainly by air, with minimal mortalities. The main destination for such goats is South-East Asia.

4.3.3 South-East Asia

The number of goats exported by sea to South-East Asia peaked in 2002, but has fallen substantially since then (Table 28). The mortality rate in 2011 fell to 0.16%, the lowest figure since recording began in 1993.

Table 28 Mortality rates, number of voyages and number of goats exported by sea to South-East Asia from 1993 to 2011

Year	Voyages (No.)	Goats (No.)	Mortality rate overall (%)	Mortality rate range (%)
1993	17	7,497	1.63	0.0 - 4.7
1994	19	7,867	1.89	0.0 - 5.5
1995	11	4,818	2.24	0.0 - 7.8
1996	12	5,208	1.73	0.0 - 4.1
1997	26	14,363	2.53	0.0 - 7.0
1998	14	10,698	4.55	0.0 – 28.8*
1999	19	10,143	2.44	0.0 - 5.0
2000	28	14,728	1.65	0.0 - 8.7
2001	45	31,150	1.37	0.0 - 6.9
2002	49	42,032	1.05	0.0 - 9.9
2003	41	36,048	0.76	0.0 - 3.1
2004	29	20,801	0.93	0.0 - 2.6
2005	25	14,694	0.78	0.0 – 2.0
2006	25	25,353	0.49	0.0 – 3.0
2007	21	21,204	0.35	0.0 – 1.1
2008	8	3,180	0.50	0.0 – 2.9
2009	2	577	0.17	0.0 – 0.3
2010	5	1,885	0.69	0.0 – 1.2
2011	1	610	0.16	n/a

* One voyage delayed at discharge, resulting in excessive discharge mortality

4.3.4 Air transport of live goats

Air transport has played a significant role in the export of live goats for many years, and during 2011 accounted for the 98.8% of live goat exports (51,487 out of 52,097 goats exported). The number of goats exported by air in 2011 fell by 35% compared to 2010.

4.3.4.1 Load point / destination

The loading points and destination countries for goats transported by air from Australia in 2011 are shown in Table 29.

The majority of these goats were loaded at Adelaide, Sydney and Melbourne airports, accounting for 50%, 32% and 10% respectively.

The main importing countries for goats exported by air in 2011 were Malaysia (94% of total exports) and Singapore (5%).

Table 29 Load point and destination country for goats exported by air from Australia during 2011

Country	Adelaide	Brisbane	Melbourne	Perth	Sydney	Total
Malaysia	23,338	2,647	5,126	940	16,449	48,500
Philippines					276	276
Singapore	2,350					2,350
Other*	77		277		7	361
Total	25,765	2,647	5,403	940	16,732	51,487

SOURCE – Department of Agriculture, Fisheries and Forestry

* Other includes Brazil, Indonesia, Sarawak and Turkey

4.3.4.2 Mortalities

Goats exported by air experienced few mortalities during 2011. Similar levels of mortality were seen over 2008 to 2010 (Table 30).

Table 30 Mortality rates and number of goats exported by air to all destinations from 2008 to 2011

Year	Goats (No.)	Total Mortalities (No.)	Mortality rate overall (%)
2008	73,167	1	0.001
2009	84,923	0	0.000
2010	78,905	8	0.010
2011	51,487	1	0.002

SOURCE – Department of Agriculture, Fisheries and Forestry

5 Conclusion and recommendations

5.1 Sheep, cattle and goats

This report successfully summarises the mortalities of sheep, cattle and goats for the 2011 calendar year. Mortality trends were analysed and the overall mortalities for sheep, cattle and goats exported by sea were 0.76%, 0.12% and 0.16%. It is recommended that this project continue to be funded and reported on an annual basis in the future. This is the only comprehensive report of its type and is of interest and importance to a wide range of stakeholders.

In the past much of the analysis for South-East Asia was derived from ship Master's Reports (voyage mortality reports that must provided to AMSA and DAFF for all shipments of livestock). In 2011 95.2% of cattle exported to South-East Asia could be identified by class, up from 94% in 2010. This improvement required much extra input from Industry which would have been unnecessary using an earlier version of the Master's Report.

In an unusual event, 19.6% of cattle exported to North-East Asia could not be identified by class. This information would have been available if an earlier version of the Master's Report was currently in use. It is recommended that the Master's Report be revised to provide this information.

It is proposed for 2012 onward that graphs and tables presenting long-term overviews be restricted to a rolling ten-year basis. The older data does not reflect the current state of the trade in terms of standards required of industry, ships participating and markets serviced.

It is proposed for 2012 onward that the growing markets of Turkey and the Black Sea be included in the new destination regional name of “South-East Europe”. This reflects the fact that they are no longer minor, “Miscellaneous” destinations, which also don’t fit the Middle East / North Africa region because of geographical and climatic differences.

6 Appendices

6.1 Appendix 1 – Research update

6.1.1 Investigating cattle morbidity and mortality to the Middle East

This project was initiated in response to concerns regarding elevated mortalities in some cattle voyages to the Middle East that were attributed to bovine respiratory disease (BRD). The project aims to describe the causes of death in cattle exported from Australia to the Middle East and to develop systems that can be used by industry to describe causes of death in future.

A new Veterinary Export Handbook was developed that included a detailed description of how to perform a necropsy, common findings, sample collection and protocols for numbers of animals to be sampled.

Voyages were enrolled if they met the following criteria: 3000 or more cattle; long haul voyages (greater than10 days duration). From July 2010 to September 2011, the project has enrolled 17 voyages from a total of 29 eligible voyages.

The cooperation from exporters and AAVets is gratefully acknowledged. The forecast completion date for the project is May 2013.

6.1.2 Veterinary pathology and disease investigation course for AAVets

A training needs analysis conducted as part of the MLA/LiveCorp R&D project 'Developing cattle data collection systems' reviewed the current levels of veterinary expertise required on board livestock ships and identified areas where further training would ensure optimal and standardised disease investigation and data collection techniques

As a result, a veterinary training course was developed with the aim of:

1. Delivering two training courses for AQIS Accredited Veterinarians (AAVets) to:
(i) Provide conceptual frameworks, using scenarios and case studies, to assist the monitoring of animal health and the investigation of animal disease events on sea voyages.
(ii) Provide hands-on training in the safe and systematic necropsy of an animal to determine cause of death, including gross description (written and photographic) and collection and packaging of specimens for subsequent examination by a pathologist.

2. Providing reference information and material, and checklists that can be used on voyages to assist optimal investigation and management of health and disease.

3. Producing a high-quality DVD as an ancillary training aid for post mortem procedures.

The first training courses for was held at Murdoch University, Murdoch, WA in January 2011. The two-day course was completed by ten participants with an additional five attendees from the School of Veterinary and Biomedical Sciences, Murdoch University. It was considered to be very successful, being held in an excellent venue, with all planned activities completed on time. Participant feedback was very positive and reflected the high level of organisation, planning and expertise of the instructors in preparing and delivering the course.

The second training course was held at Murdoch University in July 2011 but was only completed by 4 participants after a number of the AAVets were constrained by work schedules. Again, it was considered to be successful, with positive feedback from participants.

The necropsy DVD has been completed.

The project is awaiting completion of the final report.

6.1.3 Monitoring and evaluation of the HotStuff model

Cattle and sheep being shipped to ports north of the equator can be exposed to conditions that impose thermoregulatory challenges. The maintenance of homeostasis in these animals can be aided by setting limits to the wet-bulb temperature on the animal decks. The wet-bulb temperature on the animal decks is, in turn, influenced by the ambient conditions and the stocking density.

A heat stress risk assessment model (named 'HotStuff') was developed for MLA / LiveCorp for use on long haul live export voyages to the Middle East. The HotStuff model predicts restrictions in stocking density on live export ships based on expected ambient conditions and the ship characteristics (especially the ventilation rate, or 'pen air turnover' on the animal decks).

In 2009 a technical review was undertaken by a panel of experts to examine the scientific basis, methodology and assumptions of the core elements that underpin HotStuff. Overall, the panel concluded that the methodology and assumptions underpinning HotStuff were sound, reasonable and supported by scientific literature. The model developers had followed well-defined and logical principles of adaptive management in the presence of uncertainty.

The Review findings can be found at the internet site - http://www.mla.com.au/Publications-tools-and-events/Publication-details?pubid=4854

The panel made 13 recommendations which were designed to refine the operation of the model, test for biases and trends in the climate data, assess the suitability of historical data to validate the model and, most importantly, establish a data collection system to validate the model into the future.

The objectives of the current Monitoring and Evaluation Project are:
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 model enhancement.

To date the project has completed the review of data (objective 1) and has established the data collection system (objective 2). For the years 2011-2012, research officers will continue to deploy loggers measuring dry bulb temperature and relative humidity on board the animal decks of ships carrying livestock across the equator. So far the project has gathered over 20 voyages worth of data.

Measurements of the deck wet-bulb temperature have been determined and compared to the predictions of the HotStuff model. So far these data indicate that conditions are mostly as Hot Stuff predicts. Researchers are looking in more detail at those times when pen air turnover seems to deviate from the HotStuff prediction.

The Project is expected to be completed in March 2013.

6.1.4 Refining shipboard stocking densities

The purpose of this project is to:

1. Build on the outcomes of previous research to develop justifiable stocking density standards

2. Determine the animal welfare outcomes in cattle and sheep during sea transport at different stocking densities.

3. For each class of livestock there will be three stocking densities investigated:
(i) Current ASEL or the allometric standard (LIVE.233)
(ii) 10% less than ASEL or allometric standard and
(iii) 10% greater than ASEL or allometric standard

At least one class of cattle and at least two classes of sheep will be investigated. This will be determined in consultation with MLA, and by the vessel, voyage and logistics of undertaking the research work.

Animal welfare indicators to be considered will include at least;
(i) Body weight
(ii) Animal behaviour including proportion of time animals spend lying, active or standing
(iii) Incidence of ill health or disease

Currently the sheep experiments have been completed, but the cattle experiment is waiting on a suitable voyage.

6.1.5 Scabby mouth

The project, Investigating the Incidence of Scabby Mouth has been completed and a final report is to be published subject to the project Management Committee approval.

The project objectives were to:
1. Review relevant literature relating to scabby mouth and scabby mouth vaccination as it affects sheep in Australia both on farm and in the live export industry
2. Determine the current use of scabby mouth vaccination for both the Western and Eastern Australian sheep flocks
3. Determine the incidence of scabby mouth in Australian sheep prior to departure and at the point of discharge in the Middle East
4. Provided recommendations to industry on the current vaccination protocols for sheep destined for Middle East markets

6.2 Appendix 2 - Published studies

A list of scientific and extension publications, relevant to the livestock export trade, is shown below.

Norris, RT and Richards, RB (1989) Deaths in sheep exported by sea from Western Australia – analysis of ship Master's reports Aust Vet J **66:** 97-102

Norris, RT, Richards, RB and Dunlop, RH (1989a) An epidemiological study of sheep deaths before and during export by sea from Western Australia Aust Vet J **66:** 276-279

Norris, RT, Richards, RB and Dunlop, RH (1989b) Pre-embarkation risk factors for sheep deaths during export by sea from Western Australia Aust Vet J **66:** 309-314

Richards, RB, Norris, RT, Dunlop, RH and McQuade, NC (1989) Causes of death in sheep exported live by sea Aust Vet J **66:** 33-38

McDonald, CL, Norris, RT, Ridings, H and Speijers, EJ (1990) Feeding behaviour of Merino wethers under conditions similar to lot-feeding before live export Aust J Exp Agric **30:** 343-348

Norris, RT, McDonald, CL, Richards, RB, Hyder, MW, Gittins, SP and Norman, GJ (1990) Management of inappetant sheep during export by sea Aust Vet J **67:** 244-247

Thomas, KW, Kelly, AP, Beers, PT and Brennan, RG (1990) Thiamine deficiency in sheep exported live by sea Aust Vet J **76:** 215-218

Higgs, ARB, Norris, RT and Richards, RB (1991) Season, age and adiposity influence death rates in sheep exported by sea Aust J Agric Res **42:** 205-214

Norris, RT (1991) Studies of factors affecting sheep deaths during lot-feeding and sea transport PhD Thesis, Murdoch University, Perth

Richards, RB, Hyder, MW, Fry, JM, Costa, ND, Norris, RT and Higgs, ARB (1991) Seasonal factors may be responsible for deaths in sheep exported by sea Aust J Agric Res **42:** 215-226

Norris RT, Richards RB and Norman, GJ (1992) The duration of lot-feeding of sheep before sea transport Aust Vet J **69**: 8-10

Scharp, DW (1992) Performance of Australian wethers in Arabian Gulf feedlots after transport by sea Aust Vet J **69:** 42-43

Higgs, ARB, Norris, RT and Richards, RB (1993) Epidemiology of salmonellosis in the live sheep export industry Aust Vet J **70:** 330-335

Richards, RB, Norris, RT and Higgs, ARB (1993) Distribution of lesions in ovine salmonellosis Aust Vet J **70:** 326-330

McDonald, CL, Rowe, JB and Gittins, SP (1994) Feeds and feeding methods for assembly of sheep before export Aust J Exp Agric **34:** 589-94

Higgs, ARB, Norris, RT, Baldock, FC, Campbell, NJ, Koh, S and Richards, RB (1996) Contagious ecthyma in the live sheep export industry Aust Vet J **74:** 215-220

Higgs, ARB, Norris, RT, Love, RA and Norman, GJ (1999) Mortality of sheep exported by sea: evidence of similarity by farm group and of regional differences Aust Vet J **77:** 729-733

Norris, RT, Richards, RB, Creeper, JH, Jubb, TF, Madin, B and Kerr JW (2003) Cattle deaths during sea transport from Australia Aust Vet J **81:** 156-161

Norris, RT, (2005) Transport of animals by sea Rev Sci Tech Off Int Epiz **24:** 673-681

Beatty, DT, Barnes, A, Taylor, E, Pethick, D, McCarthy, M and Maloney, SK (2006) Physiological responses of Bos taurus and Bos indicus cattle to prolonged, continuous heat and humidity J Anim Sci **84:** 972-985

Stockman, CA (2006) The physiological and behavioural responses of sheep exposed to heat load within intensive sheep industries PhD Thesis, Murdoch University, Perth

Beatty, DT, Barnes, A, Taplin, R, McCarthy, M and Maloney, SK (2007) Electrolyte supplementation of live export cattle to the Middle East Aust J Exp Agric **47:** 119-124

Phillips, CJC, Pines, MK, Latter, M, Muller, T, Petherick, JC, Norman, ST and Gaughan, JB (2010) The physiological and behavioural responses of steers to gaseous ammonia in simulated long distance transport by ship J Anim Sci **88:** 3579-3589

Pines, MK and Phillips, CJ (2011) Accumulation of ammonia and other potentially noxious gases on live export shipments from Australia to the Middle East J Environ Monit **13:** 2798-2807

Stockman, CA, Barnes, AL, Maloney, SK, Taylor, E, McCarthy, M and Pethick, D (2011) Effects of prolonged exposure to continuous heat and humidity similar to long haul live export voyages in Merino wethers Anim Prod Sci **51:** 135-143

Australian Government Department of Agriculture, Fisheries and Forestry (2011) Australian standards for the export of livestock (version 2.3) and Australian position statement on the export of livestock

6.3 Appendix 3 - Acknowledgements

The cooperation of ships' officers in recording details of daily mortalities is gratefully acknowledged.

The cooperation of Exporters, Ship Agents and Port Authorities for additional help in collating data is also gratefully acknowledged.

The Australian Maritime Safety Authority (AMSA) is gratefully acknowledged for provision of Master's Reports

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