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National Data Recording System for the Live Sheep Export Industry

Report No. 4

July to December 1990

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Contents

Introduction

This is the fourth report from the National Data Recording System (NDRS) that provides summary information on the export of livestock from Australia to the Middle East and South East Asia. A reduced version of the NDRS has been proposed, with the emphasis shifting from research to surveillance. The type and frequency of reporting is yet to be decided.

The format of the present report follows that used previously and provides information on sheep exported from the ports of Fremantle, Adelaide and Portland during the six months to December 31, 1990. Additional information is provided on current research together with comments on data collected during the two years of the recording system. Codes for ships and ports of discharge were used throughout the series to maintain confidentiality.

Numbers of livestock exported

To the Middle East and South East Asia

The combined effects of few voyages to Saudi Arabia and low sheep prices changed the pattern of exports from Australia to the Middle East. The number of sheep exported from Fremantle in the second half of 1990 (Table 1) was similar to that exported in each of the three previous six month periods.

However, sheep exports from Fremantle increased from 46 per cent of all sheep exported from Australia (in the first half of 1989) to 83 per cent in the current period (Figure 1).

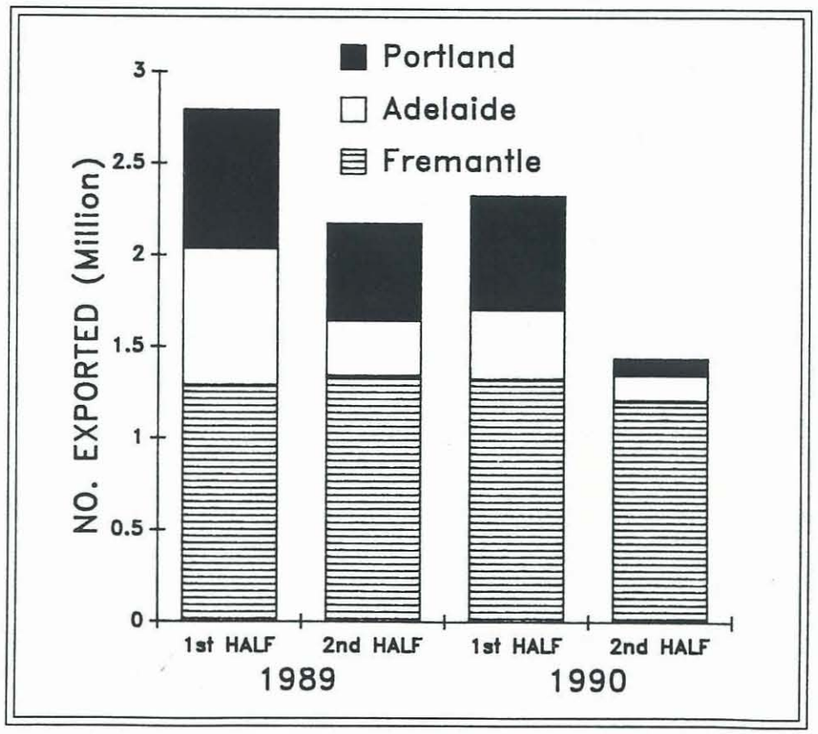


Figure 1. Six monthly total of sheep exported from Fremantle, Adelaide and Portland to the Middle East in 1989 and 1990

Table 1. The number and class of sheep and the number of goats and cattle exported by sea from Fremantle, Adelaide and Portland in the six months to December 31, 1990

		Fremantle Middle East	Fremantle SE Asia	Adelaide M. East	Portland M. East	Total
Wethers	- adult	1,108,166	7,958	114,372	89,773	1,320,269
	- hogget	†	0	5,673	0	5,673
	- lambs	74,051	0	5,380	2,019	81,450
Rams	- adult	32,688	7,643	12,795	1,015	54,141
	- lambs	11,982	0	6,349	510	18,841
Ewes	- adult	0	0	0	0	0
	- lambs	6,700	0	0	0	6,700
Total	- sheep	1,233,587	15,601	144,569	93,317	1,487,074
	- goats	2,820	407	0	296	3,523
	- cattle	188	1,641	192	0	2,021

† Hoggets were included in the adult wether category in records held at Fremantle

The number of ram lambs exported continued to decline. Exports decreased to less than half that of the corresponding period in 1989.

By destination country (sheep only)

The United Arab Emirates was the largest importer of Australian sheep in the current period, accounting for approximately 40 per cent of exports (Table 2). Trade difficulties lead to substantial reductions in exports to Saudi Arabia and Kuwait. Saudi Arabia imported 67 per cent fewer sheep and Kuwait 85 per cent fewer sheep than in the corresponding period in 1989.

Jordan and Romania were added to the list in Table 2 and accounted for 6.5 per cent of the total exported in the second half of 1990. The number of sheep exported to Oman increased by 11 per cent in the second half of the year.

Table 2. The destination country and number of live sheep exported from Fremantle, Adelaide and Portland in the six months to December 31, 1990

Country	Fremantle	Adelaide	Portland	Total
Bahrain	109,919	0	15,000	124,919
Jordan	28,337	0	31,599	59,936
Kuwait	96,882	0	28,508	125,390
Oman	191,538	0	9,710	201,248
Qatar	152,665	0	0	152,665
Saudi Arabia	99,522	62,124	0	161,646
S.E. Asia	15,601	0	0	15,601
U.A.E.	508,348	82,445	8,500	599,293
Yemen	10,000	0	0	10,000
Other (Romania)	36,376	0	0	36,376
Total	1,249,188	144,569	93,317	1,487,074

Mortality rates

Sheep

The mortality rate for sheep exported from Fremantle in 1990 was 2.88 per cent, which is slightly more than in 1989 (Figure 2a). The death rate during the discharge phase accounted for 35 per cent of deaths aboard ship in 1990. The proportion of voyages with three or more ports of discharge in 1989 and 1990 was approximately double that for 1985 to 1988. This change was associated with higher discharge death rates in the past two years.

Mortalities for sheep exported from Adelaide and Portland are presented in Figures 2b and 2c. The low number of voyages from these ports contribute to greater variability from year to year as very high or low mortality rates from a few shipments greatly influence the annual figure.

There was a higher death rate in sheep exported from Fremantle in the second half of 1990 (Figure 3) which is consistent with previous findings (Higgs *et al.* 1991). Closer examination of the change in mortality rates during the year showed a strong pattern of higher average monthly death rates from June to December. Figure 4 shows the average monthly mortality rate for shipments from Fremantle from 1985 to 1990. There was little variation in this pattern from year to year.

The death rate in wether hoggets and lambs was approximately half that of adult wethers in the second half of 1990 (Table 3, Figure 5). Data from 1989 and the first half of 1990 showed similar patterns although death rates in wether hoggets in 1989 were approximately one third that of adult wethers.

Death rates in other classes of sheep were less consistent from year to year. The relatively low numbers of sheep exported in each of these classes contributes to greater variability in the summary figures. Similarly, data on death rate by class was only available for two voyages from Adelaide and one from Portland in the report period which is insufficient to make any meaningful comparisons.

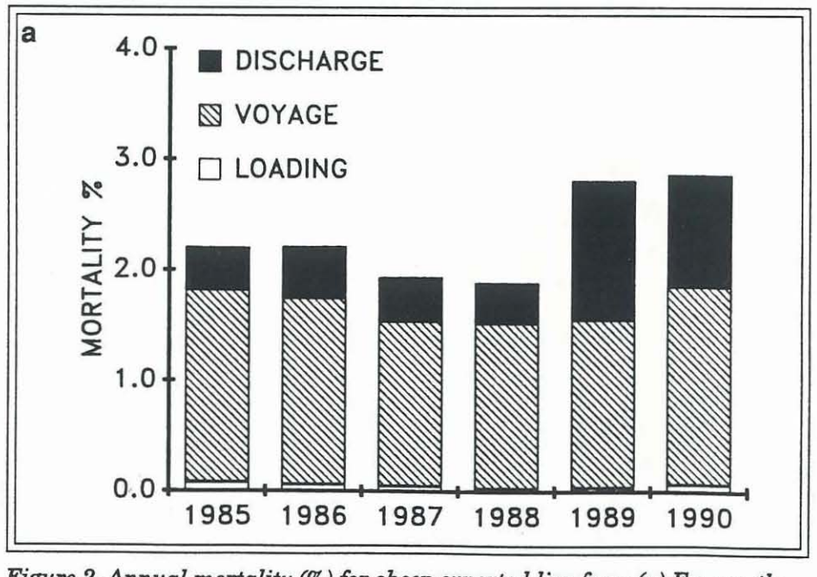
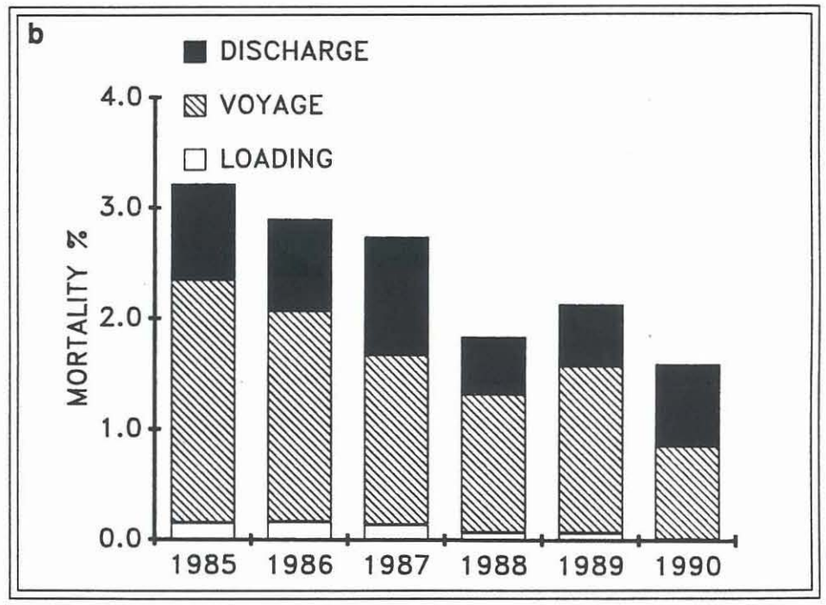
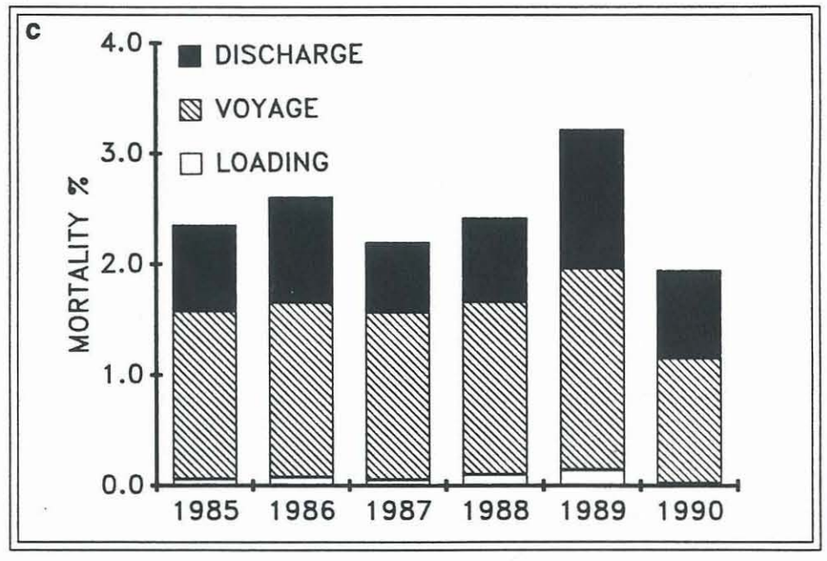


Figure 2. Annual mortality (%) for sheep exported live from (a) Fremantle, (b) Adelaide and (c) Portland to the Middle East.





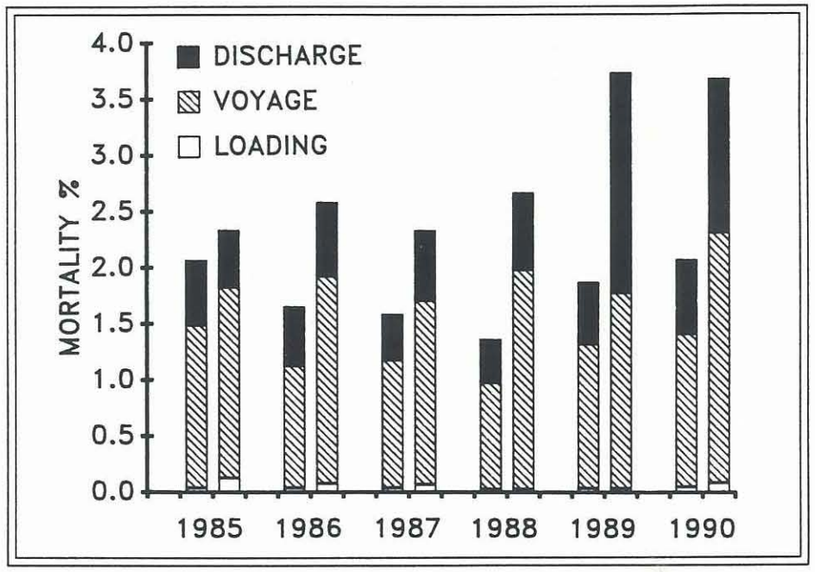


Figure 3. Mortality (%) for sheep exported live from Fremantle to the Middle East for the first and second halves of each year from 1985 to 1990

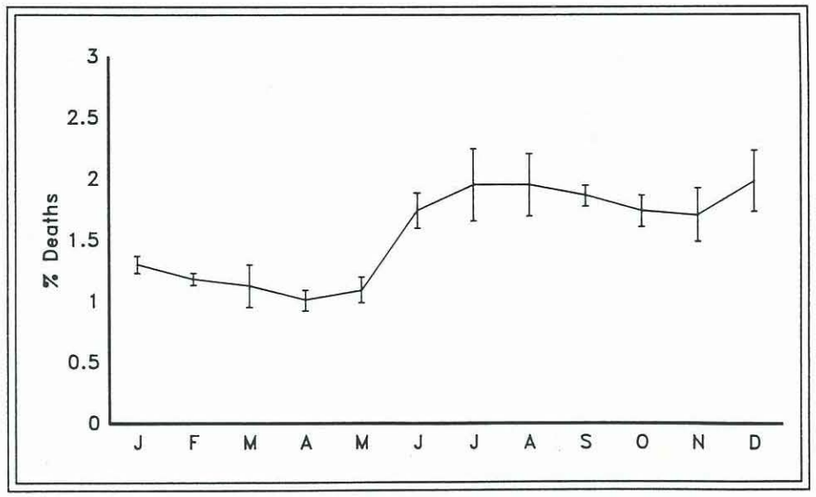


Figure 4. Average monthly shipboard death rates (s.e.m.) to the first port of discharge for shipments from Fremantle to the Middle East in 1985 to 1990

Table 3. Mortality (%) by class of sheep for voyages from Fremantle, Adelaide and Portland to the first destination port in the Middle East in the second half of 1990

Sheep		Fremantle	Adelaide	Portland
Wethers	- adult	2.55	0.48	†
	- hogget	1.34	1.84	n/a
	- lambs	1.31	0.65	†
Rams	- adult	0.87	0.86	†
	- hogget	1.23	n/a	n/a
	- lambs	1.59	1.80	†
Ewes	- adult	1.38	n/a	n/a
	- lambs	0.07	n/a	n/a
Total	- sheep	1.02	0.74	0.74

† Mortality by class not available
n/a not applicable (no sheep of this class were loaded)

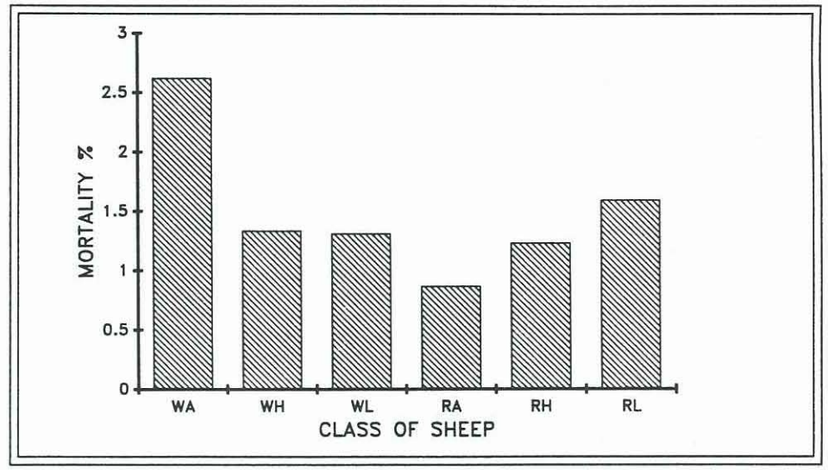


Figure 5. Mortality (%) by class of sheep for 23 voyages from Fremantle to the first port of discharge in the Middle East in the second half of 1990

Wa = wether adults *WH = wether hoggets* *WL = wether lambs*
RA = ram adults *RH = ram hoggets* *RL = ram lambs*

Goats

The total death rate for goats exported from Fremantle in the second half of 1990 (Table 4) was slightly higher than in the corresponding period in 1989 (6.95 per cent). The highest mortality rate for a single voyage was 16.0 per cent (15.9 per cent in the second half of 1989).

High death rates in goats were recorded in each of the previous reporting periods. There was a seasonal pattern of higher mortality in the second half of 1989 and 1990.

Table 4. Mortality (%) of goats during all stages of shipping (loading, voyage and discharge) from Fremantle, Adelaide and Portland to the Middle East and South East Asia in the second half of 1990

Goats	Fremantle		Adelaide	Portland
	M East	SE Asia	M East	M East
1990 (July to December)				
No. of voyages	5	2†	0	1
No. loaded	2,820	239	0	296
No. dead	217	10	0	0
Per cent dead	7.70	4.18	0	0

† Data unavailable for one voyage

Cattle

Only four consignments of cattle were sent from Australia to the Middle East in the second half of 1990. The death rates (Table 5) were characteristically low.

Mortality rates in cattle were markedly lower than in sheep throughout 1989 and 1990. The total death rate (loading, voyage and discharge) for cattle exported from Fremantle to the Middle East in 1989 and 1990 was less than 0.5 per cent.

Table 5. Mortality (%) of cattle during all stages of shipping (loading, voyage and discharge) from Fremantle, Adelaide and Portland to the Middle East and South East Asia in the second half of 1990

Goats	Fremantle		Adelaide	Portland
	M East	SE Asia	M East	M East
1990 (July to December)				
No. of voyages	3	9†	1	0
No. loaded	188	1,641	192	n/a
No. dead	1	2	0	n/a
Per cent dead	0.53	0.16	0	n/a

† Data unavailable for two voyages

Mortality by quarter of the year

Only one shipment departed from Adelaide and Portland in each quarter of the current period (Table 6). Consequently, analysis was restricted to voyages from Fremantle.

Death rates in each quarter were not significantly different. However, the total mortality rate (adult wethers and all sheep) was significantly higher in the second half than in the first. The pattern of higher voyage death rates in the second half has now been observed in five of the last six years.

Table 6. Mortality for all stages of shipping (loading, voyage and discharge) and all classes of sheep loaded at Fremantle, Adelaide and Portland for the third and fourth quarters of 1990

All sheep	Fremantle	Adelaide	Portland
July to September			
No. of voyages	13†	1	1
No. loaded	536,583	62,124	62,014
No. dead	22,632	802	1,183
Per cent dead	4.22	1.29	1.91
October to December			
No. of voyages	14†	1	1
No. loaded	671,823	82,445	31,599
No. dead	22,112	2,907	1,742
Per cent dead	3.29	3.53	5.51

† Data unavailable for one voyage in each quarter. These voyages carried a total of 26,964 sheep

Mortality by ship (for adult wethers)

Several factors may affect mortality during shipping. Three major factors are the class of sheep carried, the time of year and the port of loading. These factors must be considered when making comparisons between ships.

For practical purposes, mortality data were collected for the major classes of sheep exported. Wethers were divided into adults, hoggets and lambs. However, it is clear from previous records that, even within the 'adult' wether category, mortality rates differ according to age. There were four shipments from Fremantle in 1990 with voyage mortality rates below 0.5 per cent; all consignments included wethers with 6 permanent teeth or less (and all were in the first half of the year).

Conversely, mortalities on ship 12 showed a dramatic change in the current period when compared with the previous 18 months. Eleven of 12 voyages were classified as low mortality voyages (<1.0%) in 1989 and the first half of 1990, but in the current period, three of four voyages were in the high mortality category (Table 7a). The higher death rates were attributed to the change to older wethers carried in the second half of 1990. This example emphasises the need for caution when making comparisons between ships.

The effect of the age of wethers on mortality was also seen in shipments leaving Adelaide (Table 7b) and Portland (Table 7c). Young wethers intended for export to Saudi Arabia were loaded at Adelaide and had low death rates. The age restriction (6 permanent teeth or less) was not placed on wethers loaded at Portland.

Table 7a. Number of voyages in low, medium and high mortality rate categories (wethers only, to first port of discharge) for ships loaded at Fremantle

Ship (code)	Mortality rate Low <1.0%	Medium 1.0-2.0%	High >2.0%	Total
1	-	2	2	4
3	-	-	1	1
7	-	1	1	2
8	-	1	-	1
9	-	-	2	2
11	-	-	1	1
12	-	1	3†	4
15	-	1	3	4
17	1	2†	-	3
23	-	1	2	3
Total	1	9	15	25

† Includes mortality for all classes of sheep on one voyage

Table 7b. Number of voyages in low, medium and high mortality rate categories (wethers only, to first port of discharge) for ships loaded at Adelaide

Ship (code)	Mortality rate Low <1.0%	Medium 1.0-2.0%	High >2.0%	Total
22	1	-	-	1
27	1	-	-	1
Total	2	0	0	2

Table 7c. Number of voyages in low, medium and high mortality rate categories (wethers only, to first port of discharge) for ships loaded at Portland

Ship (code)	Mortality rate Low <1.0%	Medium 1.0-2.0%	High >2.0%	Total
10	-	1†	-	1
23	-	1	-	1
Total	0	2	0	2

† Includes mortality for all classes of sheep

Spatial pattern of mortality

Comparisons of mortality data from various areas of ships produced consistent results throughout 1989 and 1990. The major comparisons were by deck, deck type, tier and forward vs aft sections.

Two factors, deck type and tier, influenced death rates throughout the study period. However, the importance of these factors is minor compared to the persistent inappetance syndrome.

Open and enclosed decks

Death rates in enclosed decks were significantly higher than in open decks on 12 of 21 voyages (57 per cent) in the second half of 1990 (Table 8). The pattern for the first half was not as strong with only 32 per cent of voyages having higher death rates but was similar to the total for 1989 of 53 per cent of voyages.

Approximately 21 per cent of sheep exported by sea from Australia were carried in enclosed decks during 1989 and 1990. Sheep in enclosed decks had a 15 per cent higher death rate than sheep in open decks. Extra deaths associated with enclosed decks amounted to 500 per 1 million sheep exported which is equivalent to 2.9 per cent of the total voyage mortality.

Table 8. The number of shipments by vessel where wether mortality to the first port was higher (P<0.05), similar (P>0.05) or lower (P<0.05) in open decks compared to enclosed decks

Ship (code)	Relative mortality rate between deck types Open>enclosed	Not different	Enclosed>open	Totals
1	1	-	3	4
7	-	1	1	1
8	-	1	-	1
9	1	-	2	3
11	-	-	1	1
12	1	1	2	4
15	1	-	3	4
17	-	2	-	2
Total	4	5	12	21

Upper and lower tiers

The 'tier effect' was demonstrated strongly in the second half of 1990 with 13 of 22 voyages (59 per cent) having higher death rates in upper tiers (Table 9). In the second half of 1989, 52 per cent of voyages had higher death rates in upper tiers. There was no voyage with higher death rates in lower tiers during the current period.

During 1989 and 1990, 47 per cent of sheep were carried on upper tiers and they had a 17 per cent higher death rate than those on lower tiers. The extra losses associated with upper tiers amounted to 1,200 per 1 million sheep exported or 7.0 per cent of the total voyage mortality.

During discharge

Deaths during the discharge phase may also follow the same pattern of higher rates in upper tiers and enclosed decks. However, collection of

Table 9. The number of shipments by vessel where wether mortality to the first port was higher in upper tiers (P<0.05), not different (P>0.05) or higher in lower tiers (P<0.05)

Ship (code)	Relative mortality rate between deck types: Upper>lower	Not different	Lower>upper	Totals
1	2	2	-	4
3	1	-	-	1
7	2	-	-	2
8	1	-	-	1
9	3	-	-	3
11	1	-	-	1
15	-	4	-	4
17	-	2	-	2
23	2	1	-	3
27	1	-	-	1
Total	13	9	0	22

mortality information during this phase is complicated by lack of manpower to collect data during discharge, restrictions on the disposal of carcases, the movement of sheep out of the sheep house and rapid changes in environmental conditions. Therefore, data for this phase are not available, but it is likely that higher death rates in enclosed decks and upper tiers continue during discharge.

High mortality voyages and epidemic spikes

A voyage mortality rate of 5.94 per cent was recorded on one shipment (ship 23) that departed from Fremantle in the second half of 1990. The daily death rate remained at high levels throughout the voyage (25 to 40 deaths/10,000 loaded per day).

Departure of the vessel was delayed for seven days after the completion of loading. Under normal circumstances, discharge would have commenced by the time the vessel was mid-voyage. The death rate for the first 13 days after the completion of loading was 2.95 per cent, which is only 50 per cent of the actual voyage mortality to the first port (5.94 per cent).

Results of this voyage emphasise the importance of minimizing the time in the export system. The main factor predisposing to death in export sheep is failure to eat the pelleted feed. Therefore, the daily mortality rate will be influenced by the time since the sheep left the farm.

Discharge mortality

The importance of discharge mortality increased in 1989 and 1990 with 45 per cent and 35 per cent of deaths aboard ship occurring during the discharge phase. Data from 1985 to 1988 showed that between 18 per cent and 21 per cent of deaths aboard ship occurred during discharge. As described above, this corresponds with a doubling in the number of voyages with more than three ports of discharge in 1989 and 1990.

Death rates at port 5 were consistently high during the current period (Tables 10 and 11) and are in common with previous reports.

Table 10. The number of shipments by port of discharge (single port voyages only) in low, medium and high death rate categories during discharge

Port of discharge (code)	Discharge mortality rate: <0.1%	0.1 to 0.5%	>0.5%	Total %
4	-	1	-	1
5	-	-	4	4
8	-	1	-	1
24	-	-	2	2
27	-	-	1	1
Total	0	2	7	9

Table 11. Total discharge mortality rate and range by port of discharge for single port voyages only

Port of discharge (code)	Discharge mortality rate: Total %	Range %	Number of voyages
4	0.13	-	1
5	2.11	0.62 - 3.97	4
8	0.36	-	1
24	1.70	0.59 - 5.13	2
27	0.72	-	1
Total	1.11	0.59 - 5.13	9

Research update

Persistent inappetance and salmonellosis

In recent Western Australian work on the inanition (failure to eat) syndrome a group of 59 non-feeders were chosen from an original intake of 10,000 adult wethers after 13 days in the feedlot. They were taken back to the laboratory and held in individual pens together with 10 control sheep (strong feeders) and offered fresh shipper pellets every day.

Over the next 12 days, 22 sheep, which still refused to eat, died or were killed because they were sick. The causes of death (sickness) were:

salmonellosis ..... (14)

massive diffuse oedema of the lungs ..... (4)

low blood calcium ..... (2)

low blood magnesium ..... (1)

severe inflammation of the liver ..... (1)

Four sheep did regain their appetites but gradually, starting with daily intakes of about 100 to 200 g and stepping up to maximum daily intakes of 500 to 1,200 g over five or six days. Control sheep ate well throughout.

The remaining sheep (33) refused to eat standard W.A. shipper pellets despite being housed in individual pens and offered fresh feed each day. Biochemical tests showed they were comfortably utilising body fat as a source of energy. At necropsy on day 22 they showed no evidence of having suffered stress. Although most of these sheep (30) had salmonella in their intestines, none had gastroenteritis.

No salmonella were recovered from the faeces of 262 sheep sampled at receival. However, 14 days after receival the excretion rate was 85 per cent in non-feeding sheep and 80 per cent in feeders. The excretion was even higher (90 per cent) in sheep that died or were killed during the 14-21 day observation period and was 91 per cent in non-feeding survivors at day 22.

The study confirmed shipboard observations that persistently inappetant sheep often die of salmonellosis and that, under relatively stress-free conditions, they can survive for protracted periods in a clinically healthy state.

Anthrax vaccination of export sheep

Although many sheep are vaccinated against anthrax before export from Australia, little is known of the effect of vaccination on appetite and survival. Anecdotal observations have suggested that appetite may be reduced for 1 or 2 days after vaccination.

In a Western Australian experiment, three farm groups were selected on receival at the feedlot, and half of each group was vaccinated (n=575) with the remainder being unvaccinated controls (n=573). The study was terminated at the end of lot-feeding, four days after receival.

Rectal temperatures were significantly higher in sheep 24 hours after vaccination (40.1°C in vaccinated sheep, 39°3C in controls) but were not elevated 48 hours after vaccination. There were more ($P<0.01$) non-feeders in vaccinated sheep 48 hours (25.1 per cent in vaccinated sheep, 16.9 per cent in controls) and 96 hours (19.9 per cent in vaccinated sheep, 13.2 per cent in controls) after vaccination.

It was expected that there would be more non-feeders in vaccinated than control sheep 48 hours after vaccination. There are many reports in the scientific literature indicating depressed appetites in animals with fever. However, it was not expected that there would be more non-feeders at 96 hours after vaccination. This observation supports the hypothesis that vaccination may contribute to persistent inappetance thereby leading to death from inanition or salmonellosis during the sea voyage.

Failure to eat can be changed by physical feed form

In its latest experiment, the Victorian research team have manipulated the rate of failure-to-eat from 2.7 per cent down to 0.7 per cent by using various physical forms of the same ration. Previous work had shown that feed form was associated with failure-to-eat. In this experiment five different forms were tested, ranging from unprocessed hay to hammer-milled material, with 1,000 sheep on each group.

Long-stemmed hay produced the least failure-to-eat (0.8 per cent). Hay is not a practical solution for the industry because it is too bulky and difficult to distribute, but it is a yardstick by which to measure other rations. The processed feeds all gave higher levels of failure-to-eat, but pellets were similar to both chaff and a pellet/chaff mix (all about 1.7 per cent failure-to-eat). Hammer-milled hay was substantially worse (2.9 per cent).

The results support and strengthen the theory that failure-to-eat is caused by 'unfamiliar' forms of feed. Hay is apparently familiar enough that nearly all sheep adapt to it. Pellets and chaff are more novel to the sheep, and more of them fail to adapt. And the hammer-milled form, which was almost a powder, is the most difficult to recognize.

This means that pellets, which have been used in the industry for many years, are as good as any other practical shipboard feed in terms of avoiding failure-to-eat, and that no better feed can be recommended at this stage.

Water supplements cannot stop failure-to-eat

A method for attacking the failure-to-eat syndrome, by adding energy supplements to the water supply was shown to be ineffective in recent Victorian work. The research team tested the method in co-operation with a private Queensland company (Aqua Nutrients) and, after some preliminary studies, a large trial was undertaken at Hamilton in February and March. The trial showed no reduction in the rate of failure-to-eat in any of the supplemented groups.

Two supplements were used - sugar and propylene glycol. Both were given at 3 per cent of drinking water throughout the assembly feedlot period (one week) to 1,600 sheep each. Automatic dispensing machines were used to add the supplements constantly. But failure-to-eat occurred in about 2.5 per cent of the sheep in both groups, which was also the level seen in the control group.

Laboratory estimation of digestibility of pelleted sheep diets

The Pastoral Research Institute in Hamilton, Victoria has been measuring the nutritive value of pelleted diets for the live sheep trade since 1980.

Laboratory determined values for digestibilty are compared with actual values determined from feeding 'standard pellets' to wethers. Until recently, the 'standards' did not include pellets with a significant lupin content. Consequently, digestibility for pellets containing lupins was being underestimated.

In 1990, several trials were conducted in co-operation with various pellet manufacturers. The in *vivo* data were used to create a new set of standards which are now being used as the basis for the prediction of digestibility (DMD) of pelleted diets.

Problems with pellet analysis emphasise the need to regularly monitor the degree to which laboratory techniques relate to animal performance, particularly when there are significant changes to feed formulations. It is one thing to use a series of laboratory tests to ensure compliance with certain specifications, but quite another to accurately predict digestibility of a diet for sheep.

Published studies

A number of studies relevant to the live sheep export industry are published in the scientific literature. The following is a list of recent publications.

Higgs, A.R.B., Norris, R.T. and Richards, R.B. (1991). Season, age and adiposity influence death rates in sheep exported by sea. *Aust. J. Agric. Res.* 42:205-14.

Richards, R.B., Hyder, M.W., Fry, J., Costa, N.D., Norris, R.T. and Higgs, A.R.B. (1991). Seasonal metabolic factors may be responsible for deaths in sheep exported by sea. Aust. J. Agric. Res. 42:215-26.

Acknowledgements

Many people assisted in the collection of this information and I am again indebted to the ships' Masters and Officers who willingly documented the data.

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The exporting and shipping companies have continued with their support for which I am grateful.

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