Department of Primary Industries and Regional Development

GOVERNMENT OF WESTERN AUSTRALIA

LIVECORP

mla MEAT & LIVESTOCK AUSTRALIA

final report

Project code: W.LIV.2016

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Date published: November 2020

PUBLISHED BY
Meat and Livestock Australia Limited
Locked Bag 1961
NORTH SYDNEY NSW 2059

National livestock export industry sheep, cattle and goat transport performance report 2019

Meat & Livestock Australia acknowledges the matching funds provided by the Australian Government to support the research and development detailed in this publication.

Executive summary

The objective of this report was to summarise the performance of the Australian livestock export industry in terms of mortality levels of sheep, cattle and goats exported by sea and air from Australia during 2019. It has a new format compared to that of the report series covering years 1988 to 2018.

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 report provides the only comprehensive breakdown by species, ships, load ports and major destinations over the calendar year.

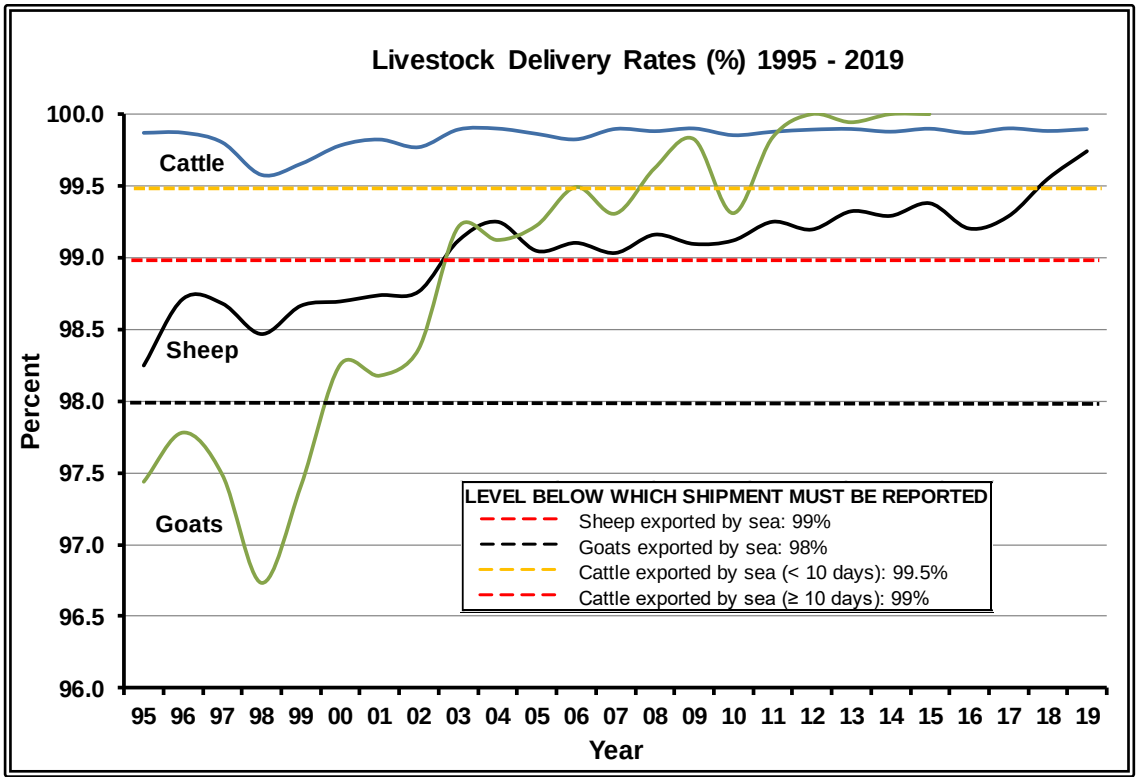
Previously documented comparisons over time (year on year, region to region) have been disrupted by the Middle East export restrictions introduced in 2018. These comparisons will again be made in the future when enough data describing the new export timeframes has been gathered to allow meaningful results.

The overall mortality rate for sheep during sea transport to all destinations during 2019 was 0.26% (2,824 mortalities in 1.08 million sheep exported). This was a 42% fall compared the mortality rate of 0.46% observed in 2018. The main port of loading was Fremantle, which exported 1,074,000 sheep with a mortality rate of 0.26% (2,814 mortalities), followed by Portland which exported 2,600 sheep with a mortality rate of 0.38% (10 mortalities).

The overall mortality rate for cattle during sea transport to all destinations during 2019 was 0.11% (1,373 mortalities in 1.29 million cattle exported). This was a 9% decrease compared to the mortality rate of 0.12% observed in 2018. The overall regional mortality rates were: Middle East/North Africa, 0.24% (221 mortalities in 93,000 cattle exported); South-East Europe, 0.16% (60 mortalities in 37,000 cattle exported); North-East Asia, 0.14% (240 mortalities in 172,000 cattle exported); and South-East Asia, 0.9% (852 mortalities in 990,000 cattle exported).

No goats were exported by sea from Australia in 2019.

Percentages of sheep, cattle and goats successfully delivered by sea since 1995 are shown below.



Summary information regarding the 41,505 sheep, 11,466 cattle and 16,059 goats exported by air during 2019 has also been included in this report. These experienced overall mortality rates of 0.01% (5 mortalities), 0.00% (nil mortalities) and 0.03% (4 mortalities) respectively.

Contents

1 Background

In 2019 the live export of sheep, cattle and goats made a significant contribution to the Australian economy, valued at around $1,623 million, and provided employment in the many services that support this industry. The livestock export trade provides important support for the sheep, cattle and goat industries of Australia and is the only market outlet for producers in some areas of the country.

This current report summarises information about mortalities in sheep, cattle and goats during sea and air transport from Australia during the calendar year 2019, providing ongoing evidence of the industry's willingness to fully expose its performance to public scrutiny.

The Australian Government Department of Agriculture, Water and Environment (DAWE) also presents mortality data, though in a different format, under "Reports to Parliament' at their website:

http://www.agriculture.gov.au/export/controlled-goods/live-animals/live-animal-export-statistics/reports-to-parliament.

It should be noted that the DAWE mortality figures refer only to voyages for which data was *received* during the calendar year, in contrast to this current report which refers to the complete set of data for all voyages which *departed* during the calendar year.

DA undertakes investigations into voyages that exceed certain mortality limits, publishing their findings under "Investigations into mortalities" at their website:

https://www.agriculture.gov.au/export/controlled-goods/live-animals/livestock/regulatory-framework/compliance-investigations/investigations-mortalities

For this current report, where high mortality figures are detailed, the relevant investigation(s) can be viewed at the above website.

Summary information on areas of new and ongoing research can be viewed at the following website:

https://livecorp.com.au/researchAndDevelopment

2 Project objectives

The project objectives were to:

a) Produce a report which summarises the mortality of sheep, cattle and goats exported from Australia for the 2019 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 voyage livestock mortalities dates and times for ports of loading and discharge), other tailored shipboard records and from "Yellow Books", which record more-detailed information than is available from the Master's Report (including daily mortality for each deck by type-age-sex categories over the loading, voyage and discharge phases).

It should be noted that high-mortality voyages have always been and will continue to be included in summary figures in this series of publications.

This current report is for all voyages and flights which departed Australia during the calendar year 2019. Information on the number of sheep exported to various destination countries from ports in Australia was compiled from records supplied by ships and Livestock Export Companies. Information for livestock exported by air was provided by DAWE.

Readers should be aware that additional mortality information for a particular year may be received after publication of that year's summary report. Such information will be 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 in this report.

Summary information was produced using Statistix 10.0 (Analytical Software, 2015, Tallahassee, Florida USA).

3.1 Voyage

The majority of voyages by sea involve loading at one port and discharge at one port. But each year a number of voyages involve loading at multiple Australian ports (split-load voyages), and discharge at multiple destination ports, often in different countries. Where analyses involved split-load voyages, the consignments of livestock from each load port were considered as separate "voyages", so that the definition of a "voyage" came to be "consignment from load port to discharge region".

More recently shipboard reporting has become so comprehensive that in most cases it allows tracking of consignments from individual load ports to individual discharge ports. This is a great credit to the diligence of ships' officers.

To take advantage of this comprehensive reporting, where it has been possible, all voyages have been split into separate "voyages" based on loading and discharge ports. This breakdown better reflects the actual conditions that occurred for the livestock consigned to those destinations.

It can be seen that a comprehensively reported voyage involving one or more load ports and an extended discharge phase over a number of ports, has the potential to generate numerous "voyages". So, a ship might load at three ports and discharge at two ports, effectively generating six "voyages" if livestock were sent to each discharge port from each load port. In most cases the current high quality of the information supplied allows this close description of the actual conditions experienced.

So, the definition of "voyage" has almost completely shifted from "consignment from load port to discharge region", to "consignment from load port to discharge port". While this widens the scope for voyage analyses and related research work, results in this series of publications will continue to be reported on the basis of discharge regions for the foreseeable future.

3.1.1 Load, Voyage and Discharge phases

The shipboard part of the export process is divided into three distinct phases; Load; Voyage and Discharge. These phases are precisely demarcated by dates and times.

Date and time for the end of loading marks the end of the Load phase and the beginning of the Voyage phase. Date and time for the beginning of discharging marks the end of the Voyage phase and the beginning of the Discharge phase.

In the few cases where a ship delivers livestock to more than one discharge port without providing comprehensive information, all the mortalities after the beginning of discharge at the first port through to the end of discharge at the last port have been combined into one overall Discharge phase.

4 Results and discussion

4.1 Sheep

4.1.1 Performance trend

Figures 1 and 2 show the number of sheep exported and the percentage of mortalities during sea transport from all ports in Australia to all destinations over the last decade as well as the trend line (linear regression) across those years. The 1.08 million sheep exported in 2019 was the lowest number exported since recording began in 1985. The number of sheep exported annually since 2010 has varied between 3.0 and 1.1 million, and the annual mortality has varied between 0.88 and 0.26%. The trend for numbers of sheep exported and annual mortality continues downward.

Figure 1 Number of sheep exported by sea from Australia to all destinations since 2010

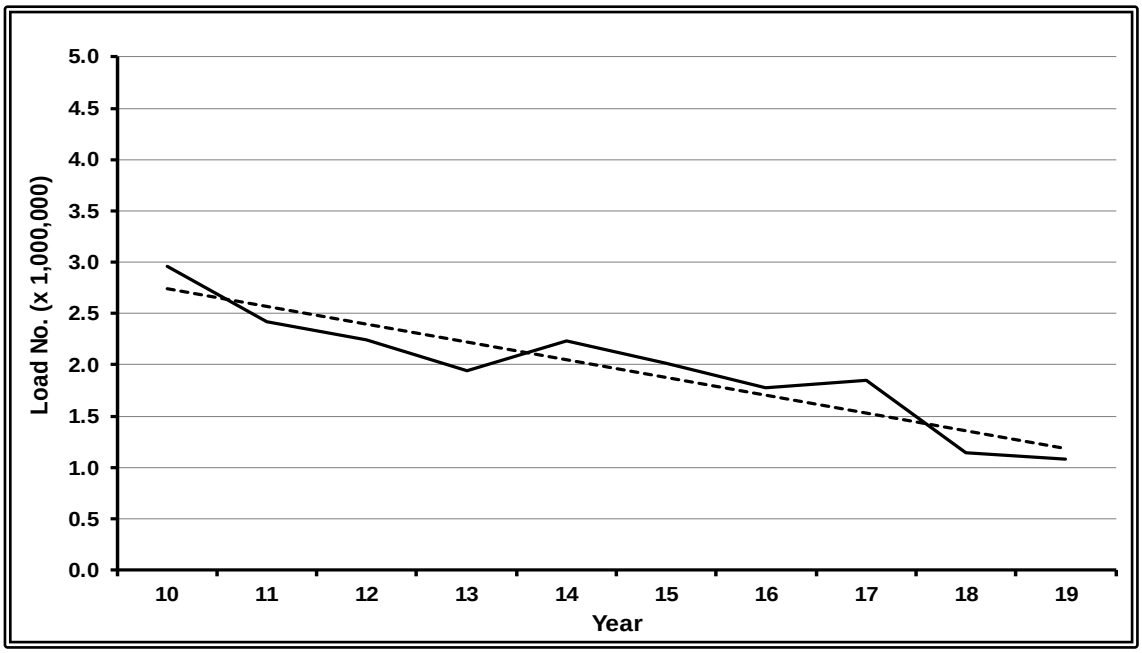
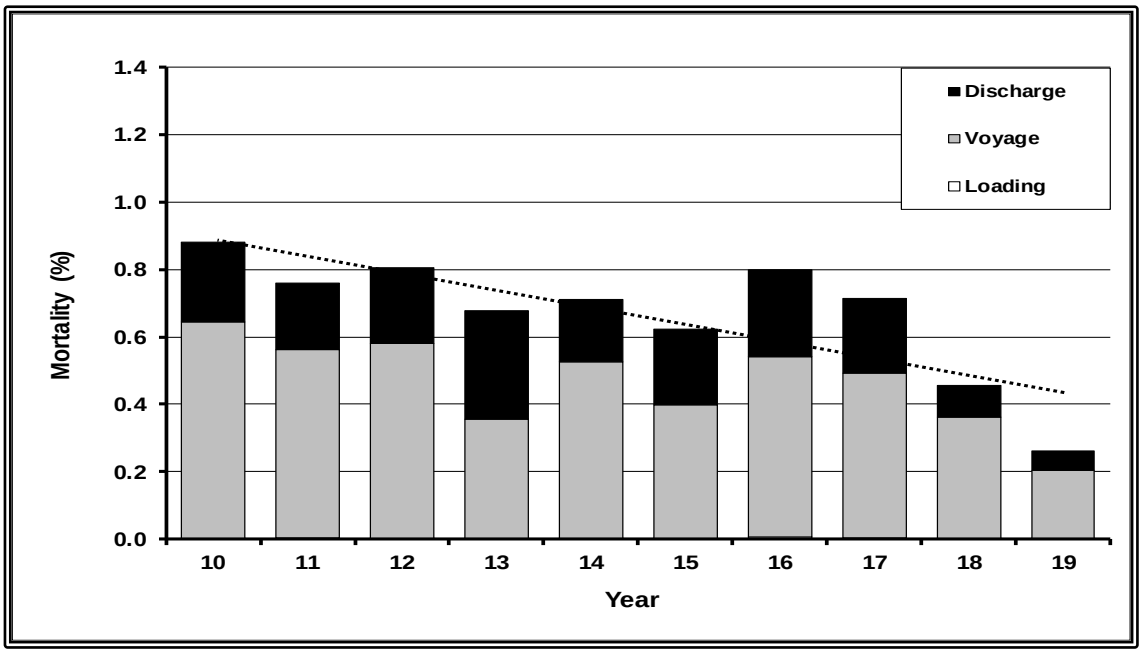


Figure 2 Annual mortality of sheep exported by sea from Australia to all destinations since 2010



4.1.2 Overview

All sheep exported live by sea from Australia in 2019 were loaded either at Fremantle (99.75%), or Portland (0.25%). The overall average voyage and discharge lengths were 17.65 and 3.02 days respectively (Table 1, below).

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 usually 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. See the Methodology (3.1 Voyage) section of this report for a more detailed explanation of the voyage phases and instances of split-loading and split-discharging.

There was only one voyage to the Middle East/North Africa or South-East Europe in 2019 for which sheep were loaded at more than one port in Australia (split-load voyage). Mortalities for this voyage were able to be attributed to the port of loading. Where analysis involves split-load voyages, the consignments of sheep from each load port are considered as separate “voyages”.

Using the above definition of voyage, there were 25 "voyages" of sheep to the Middle East/North Africa and South-East Europe during 2019. This involved 21 ship journeys, one of which was split-loaded, and three of which were split for discharge.

1,060,274 sheep were exported to the Middle East/North Africa (98.4% of all sheep exported) and the average voyage length (voyage to first discharge port) for exports to this region was 16.76 days with 3.20 days for discharge. Most voyages had multiple discharge ports, but the recent fall in discharge days indicates the extent to which reporting has moved to individual consignments tracked from load port to discharge port. The overall mortality for these sheep was 0.26%.

11,723 sheep were exported to South-East Europe (1.1% of all sheep exported) and the average voyage length (voyage to first discharge port) for exports to this region was 28.24 days with 0.69 days for discharge. The overall mortality for these sheep was 0.22%.

4,997 sheep were exported on a single voyages from Fremantle to South-East Asia (0.5% of all sheep exported). The voyage length (voyage to first discharge port) was 16.83 days with 3.52 days for discharge, and the overall mortality was 0.66%. These sheep will not be examined further in this report.

The overall 2019 mortality rate of 0.26% is a reduction of 42% on the 2018 figure of 0.46%.

During 2019, 56% of exports were in the hogget and lamb wether classes. The vast majority of sheep were exported from Western Australia, which over time has shown a significantly lower overall mortality rate than other sources.

Table 1 Mortality rates, number of voyages, voyage and discharge days, and number of sheep exported for voyages to major destination regions during 2019

Parameter	ME/N Africa	SE Asia	SE Europe	Total
Voyages (No.)	23	1	2	26
Sheep (No.)	1,060,274	4,997	11,723	1,076,994
Mortality rate overall (%)	0.26	0.66	0.22	0.26
Mortality rate range (%)	0.11 – 0.62	n/a	0.18 – 0.38	0.11 – 0.62
Voyage days (Ave.)	16.76	16.83	28.24	17.65
Discharge days (Ave.)	3.20	3.52	0.69	3.02

4.1.3 Destination country

Countries that imported Australian sheep in 2019 are shown in Table 2. The main importing countries were Kuwait (34% of all Australian sheep exports), followed by Qatar (30%) and Jordan (17%).

Overall export numbers fell by 5% compared to 2018. Exports to Turkey fell by 100%, while those to Jordan, UAE and Kuwait rose by 63%, 37% and 36% respectively. Exports to Oman and Israel also fell, by 86% and 30% respectively.

Table 2 Destination countries for sheep exported from Australia during 2019

Country	Fremantle	Portland	Other	Total
Israel	43,719			43,719
Jordan	188,781			188,781
Kuwait	384,661			384,661
Oman	6,000			6,000
Qatar	335,040			335,040
Russia	9,073	2,650	10	11,733
U.A.E.	102,073			102,073
S.E. Asia	4,997		39,720	44,717
N.E. Asia			1,126	1,126
Other			649	649
Total	1,074,344	2,650	41,505	1,118,499

Note: figures include exports by air.

4.1.4 Middle East/North Africa

Over the last decade the numbers of sheep shipped to the Middle East/North Africa and the overall mortality experienced has fallen by two thirds.

The number of sheep exported to the Middle East/North Africa in 2019 was 1,060,274 (98.4% of all sheep exported) and the average voyage length (voyage to first discharge port) for exports to this region was 16.76 days with 3.20 days for discharge (Table 3). The overall mortality for these sheep was 0.26%.

Table 3 Mortality rates, number of voyages, average voyage and discharge length, and number of sheep exported to Middle East/North Africa from 2010 to 2019

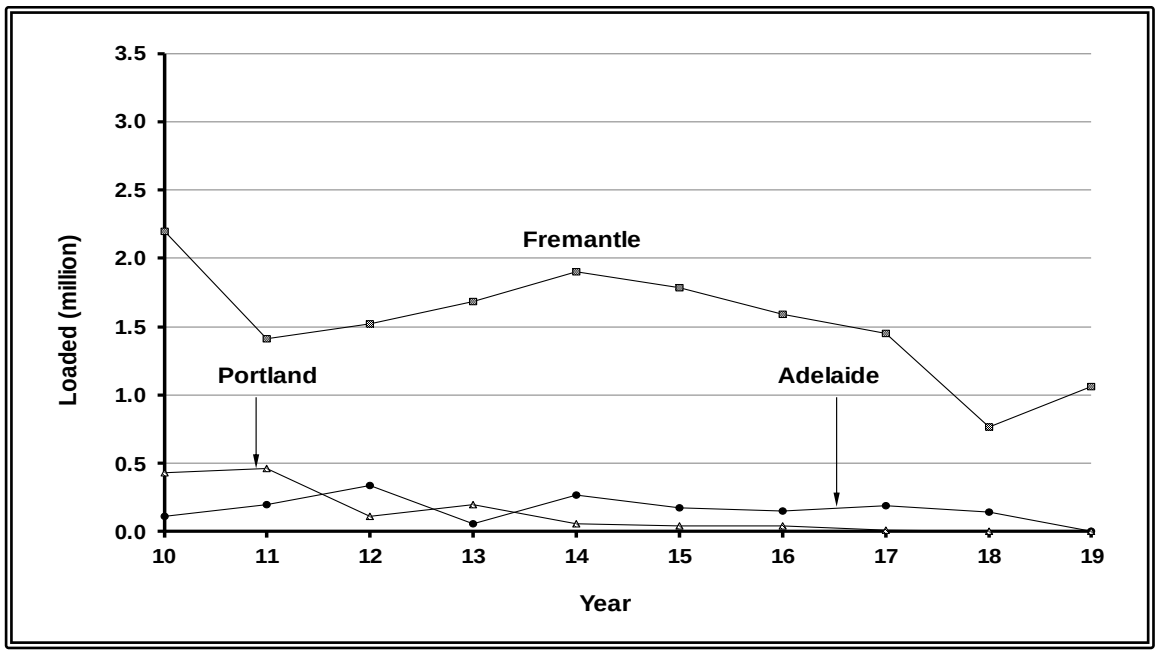
Year	Voyages (No.)	Sheep (No.)	Mortality rate overall (%)	Mortality rate range (%)	Voyage days	Discharge days
2010	49	2,740,354	0.861	0.31 – 3.64	16.30	5.13
2011	45	2,068,498	0.746	0.25 – 2.42	17.02	5.81
2012	37	1,978,618	0.811	0.18 – 4.23	17.01	4.14
2013	37	1,939,501	0.680	0.16 – 7.28	16.31	6.25
2014	42	2,227,868	0.709	0.22 – 3.89	17.20	5.92
2015	38	2,005,913	0.623	0.15 – 1.75	16.96	5.73
2016	41	1,758,898	0.795	0.20 – 2.99	17.15	5.12
2017	57	1,646,965	0.741	0.15 – 4.58	17.45	3.14
2018	25	903,149	0451	0.13 – 1.96	17.13	4.15
2019	23	1,060,274	0261	0.11 – 0.62	16.76	3.20

4.1.4.1 Port of loading

All sheep exported by sea from Australia to the Middle East/North Africa during 2019 were loaded at the port of Fremantle (Table 3, above). This is the first time that one port has borne all the trade to the region since recording began in 1985.

The number and class of sheep exported by sea to the Middle East/North Africa during 2019 are shown in Figure 3. Overall numbers exported to the region in 2019 rose by 17.4% compared to 2018, with exports from Adelaide falling by 100%, while those from Fremantle rose by 39.1%. As in 2018, no sheep were exported to the region from Portland.

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 2010



4.1.4.2 Mortality rates

The total mortality rate for all sheep exported to all destination regions during 2019 was 0.26% (see Table 1 above).

For sheep exported to the Middle East/North Africa during 2019, the Fremantle total mortality rate fell to 0.26% in 2019, a fall of 36% compared to the 2018 figure of 0.41%.

No sheep were exported to the region from either Adelaide or Portland.

Since 2018, regional and annual mortality rates are no longer comparable because of the legislated restrictions imposed on exports to the Middle East/North Africa region during the Middle-Eastern summer.

When a substantial body of data representing these changed conditions has been gathered, analyses involving trends over time will be re-introduced to this series of reports.

4.1.4.3 Class of sheep

The numbers and mortality rates of the various classes of sheep exported from Australia to the Middle East/North Africa are shown in Table 4 and Figure 4. The highest total mortality rates by class for 2019 were in adult and hogget ram classes (0.59% and 0.40% respectively), followed by wether lambs and adult ewes with 0.31% and 0.30% respectively.

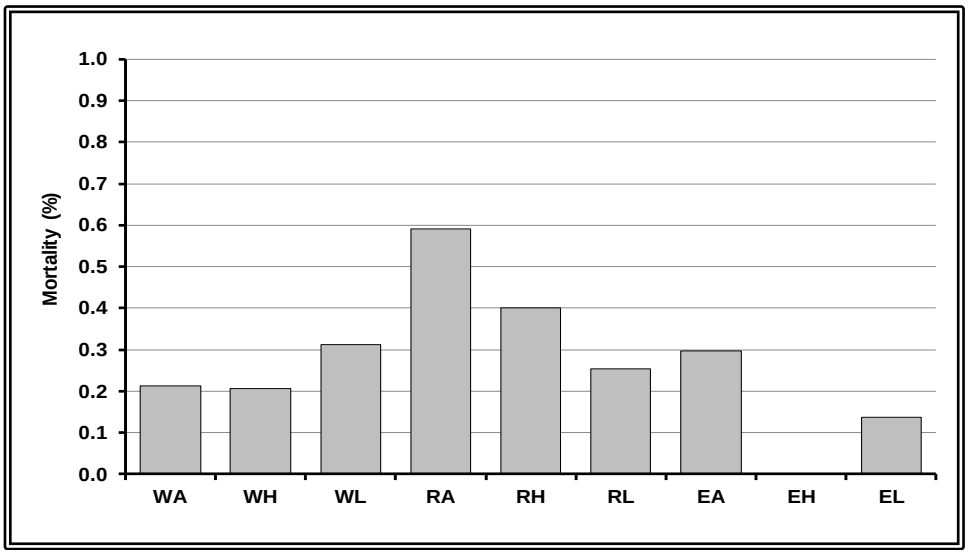
Class comparisons between 2019 and 2018 are not valid due to the exclusion of one 2018 split-loaded voyage of 62,668 sheep for which class details were not available.

Table 4 The numbers and classes of sheep exported by sea to the Middle East/North Africa from Fremantle, Adelaide and Portland during 2019

Livestock		Fremantle	Total
Wethers	adults	418,761	418,761
	hoggets	171,473	171,473
	lambs	421,292	421,292
Rams	adults	23,528	23,528
	hoggets	1,995	1,995
	lambs	7,506	7,506
Ewes	adults	12,808	12,808
	hoggets	0	0
	lambs	2,911	2,911
Total	sheep	1,060,274	1,060,274

Figure 4 Overall mortality (%) for classes of sheep exported from Fremantle to the Middle East/North Africa in 2019

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



A number of class-related mortality patterns have prevailed over the duration of the Live Sheep Export Trade. These have been clearly demonstrated in previous reports in this series.

The overall annual mortality rate is closely linked to the adult wether mortality rate. This is because historically this class has comprised the vast majority of Trade.

All the ram classes and adult ewes have consistently returned higher mortality rates, their contribution to overall mortality being limited by their lower numbers exported.

Wether hoggets and lambs, and ewe lambs have consistently returned lower mortality rates, again their contribution being limited by their lower numbers exported.

These patterns are broadly reflected in the 2019 class mortality results (Figure 5, above).

4.1.4.4 Time of year and age of sheep

Previous reports in this series show clearly that there are indisputable patterns of seasonal difference in mortality rates for all classes of sheep when examined by sex and age. The only exception is for ewe hoggets, which are not exported in sufficient numbers to allow reliable conclusions to be drawn.

These established patterns include:

- A significantly lower mortality rate in the first half of the year compared to the second half
- An annual pattern of monthly mortality rate with lower mortalities over the months February to May and higher mortalities over the months June to September.
- A higher mortality rate seen in adults compared to the younger hoggets or lambs – though this distinction has become blurred in recent years, as less sheep, and particularly lower proportions of wethers, have been exported.

4.1.4.5 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 5).

There were no voyages carrying sheep to the region from either Adelaide or Portland during 2019.

There were no voyages in the “high” category during 2019. All voyages from Fremantle were in the “low” category.

Table 5 Number of voyages in low, medium and high mortality categories for ships loaded at Fremantle in 2019

Ship (code)	Mortality rate			Total
	Low <1.0%	Medium 1.0 – 2.0%	High >2.0%	
32	7	0	0	7
34	5	0	0	5
35	8	0	0	8
43	1	0	0	1
50	3	0	0	3
103	1	0	0	1
139	1	0	0	1
Total	26	0	0	26

4.1.5 South-East Europe

Sheep have been exported live by sea to South-East Europe since 2010. Over the time, the mortality rate has progressively fallen from 1.16% to 0.22%.

After a four year hiatus, from 2013 to 2016, exports to the region resumed in 2017.

The number of sheep exported to South-East Europe during 2019 was 11,723 (1.1% of all sheep exported) and the average voyage length (voyage to first discharge port) for exports to this region was 28.24 days with 0.69 days for discharge (Table 6). The overall mortality for these sheep was 0.22%.

Table 6 Mortality rates, number of voyages, average voyage and discharge length, and number of sheep exported to South-East Europe from 2010 to 2018

Year	Voyages (No.)	Sheep (No.)	Mortality rate overall (%)	Mortality rate range (%)	Voyage days	Discharge days
2010	4	215,038	1.16	0.74 – 1.47	23.10	8.05
2011	10	351,722	0.85	0.47 – 1.07	25.72	5.35
2012	7	249,602	0.78	0.34 – 1.35	26.94	3.41
2017	5	198,303	0.50	0.41 – 0.62	26.48	3.99
2018	7	230,818	0.48	0.25 – 1.24	23.99	4.43
2019	2	11,723	0.22	0.18 – 0.38	28.27	0.69

Since 2018, regional and annual mortality rates are no longer comparable because of the legislated restrictions imposed on exports to the Middle East/North Africa region during the Middle-Eastern summer.

The South-East Europe region is directly affected, as ship movements through the Red Sea and Suez Canal also fall under the restrictions.

When a substantial body of data representing these changed conditions has been gathered, analyses involving trends over time will be re-introduced to this series of reports.

4.1.5.1 Port of loading

Sheep exported to South-East Europe in 2019 departed from Fremantle (77%) and Portland (23% - Table 7). The destination country for sheep exported to the region was Russia.

The voyages from each port were classified into various mortality categories as shown in Table 8. During 2019 all voyages were in the low category.

Table 7 Mortality rates, number of voyages, average voyage and discharge length, and number of sheep exported from various ports to South-East Europe for 2019

Port	Voyages (No.)	Sheep (No.)	Mortality rate overall (%)	Mortality rate range (%)	Voyage days	Discharge days
Fremantle	1	9,073	0.18	n/a	25.34	0.69
Portland	1	2,650	0.38	n/a	31.13	0.69

Table 8 Number of voyages in the low, medium and high mortality categories for shipments from various ports to South-East Europe during 2019

Port	Mortality rate			Total
	Low <1.0%	Medium 1.0 – 2.0%	High >2.0%	
Fremantle	1	0	0	1
Portland	1	0	0	1
Total	2	0	0	2

4.1.5.2 Ship

The voyages of each ship taking sheep from Australia to South-East Europe were classified into various mortality categories as shown in Table 9.

During 2019 there was only one ship that carried sheep to the region, with all voyages being in the low category. It should be noted that this ship code has been excluded to prevent equation of the ship name and code.

Table 9 Number of voyages in the low, medium and high mortality categories for shipments from various ports to South-East Europe during 2019

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

4.1.5.3 Class of sheep

Mortality rates for classes of sheep exported to South-East Europe during 2019 are presented in Table 10.

During 2019 the South-East Europe sheep trade comprised adult ewes and rams (99% and 1% respectively) exported to Russia.

The mortality rate for these classes were 0.75% in the ram adults followed by 0.22% for the ewe adults.

Table 10 Mortality rate, number of voyages and number of sheep in the classes exported to South-East Europe in 2019

Class		Voyages (No.)	Sheep (No.)	Mortality rate overall (%)	Mortality rate range (%)
Rams	adults	1	134	0.75	n/a
Ewe	adults	2	11,589	0.22	n/a

4.2 Cattle

4.2.1 Performance trend

The number of cattle shipped from all ports in Australia to all destinations since 2010 as well as the trend line (linear regression) across those years is shown in Figure 5. Figure 6 shows the number of cattle mortalities during sea transport since 2010. The number of cattle exported annually has varied from approximately 620,000 to 1,310,000, and the annual mortality has varied between 0.10 and 0.15%. The overall trend for numbers of cattle exported is upwards while the trend for annual mortality continues slightly downward.

Figure 5 Number of cattle exported by sea from Australia to all destinations since 2010

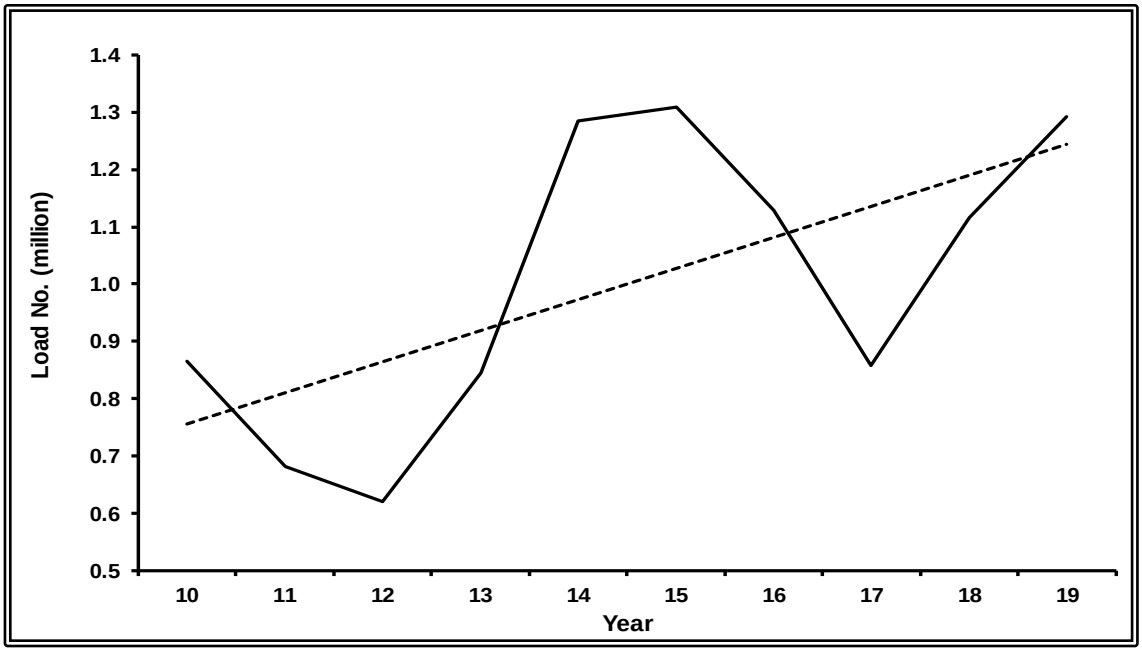
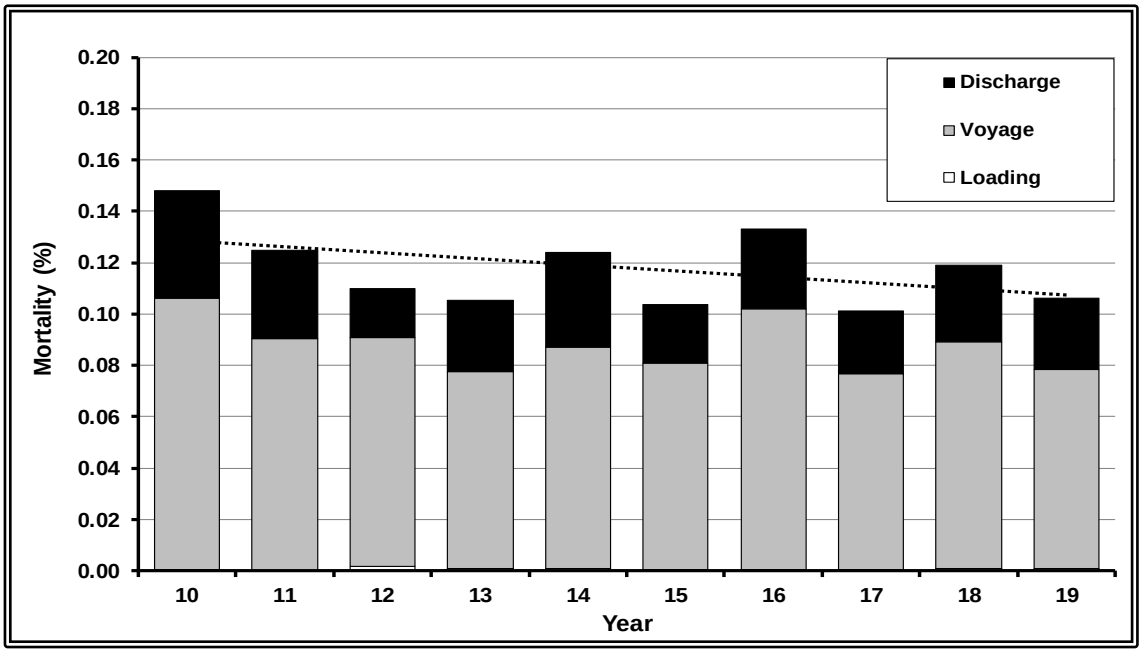


Figure 6 Annual mortality of cattle exported by sea from Australia to all destinations since 2010



4.2.2 Overview

The live cattle trade from Australia continues to be characterised by the large number of loading ports in Australia and the widely distributed destination ports. This differs from the live sheep trade which usually has only three southern ports of loading, with the majority of sheep being shipped to the Middle East/North Africa.

There were 406 cattle "voyages" during 2019. This involved 355 ship journeys, which was 10% more than in 2018. There were 42 ship journeys which were split for loading or discharge, and these generated a further 51 “voyages” as a result.

Where analysis involving split-load/discharge voyages has been performed, cattle consignments from each load port to each discharge port have been considered as separate “voyages’. See the Methodology (3.1 Voyage) section of this report for a more detailed explanation of the voyage phases and the involvement of split-loading and split-discharging.

The overall number of cattle exported from Australia in 2019 rose by 16% compared to 2018, to 1.29 million (Table 11, below). This rise is attributable to an extra 0.15 million cattle exported to South-East Asia. The overall mortality rate in 2019 was 0.106%, a fall of 11% on the figure of 0.119% observed in 2018. 61% of all cattle voyages returned a nil mortality rate during 2019.

The highest overall mortality rate on a regional basis was for exports to Middle East/North Africa (0.24%), while the lowest overall mortality rate, as expected, was for exports to South-East Asia (0.09%). There were no exports to either Mexico or Miscellaneous destinations in 2019.

The number of cattle exported to the Middle East/North Africa in 2019 rose by 40% compared to 2018. The number of voyages also rose by 80%, partly as a result of increased port-to-port reporting of data, rather than an increase in ship journeys. The mortality rate to the region rose by 74%.

Exports to South-East Asia rose by 18% in 2019 compared to 2018. This made up the majority of the overall rise in live cattle exports for 2019. The number of voyages rose by 11%, from 269 in 2018 to 299 in 2019. Trade to South-East Asia accounted for 77% of all cattle exported in 2019.

Exports to South-East Asia involves a mix of smaller ships performing short single-load/single-discharge voyages, and larger ships that load and/or discharge at more than one port. In 2019, these larger vessels accounted for 38% of the cattle exported and 21% of the voyages made to South-East Asia.

Exports to North-East Asia in 2019 rose by 16% compared to 2018. The mortality rate for the region fell by 43%, from 0.24% in 2018 to 0.14% in 2019.

Exports to South-East Europe in 2019 fell by 40% compared to 2018, while the mortality fell by 0.32%, from 0.24% in 2018 to 0.16% in 2019.

Table 11 Mortality rates, number of voyages, voyage and discharge days, and number of cattle exported for voyages to major destination regions during 2019

Parameter	ME/N Africa	SE Asia	NE Asia	SE Europe	Total
Voyages (No.)	51	299	50	6	406
Cattle (No.)	93,730	989,627	172,427	36,839	1,292,623
Mortality rate o/all (%)	0.24	0.09	0.14	0.16	0.11
Mortality rate range (%)	0.00 – 1.39	0.00 – 2.87	0.00 – 1.37	0.04 – 0.23	0.00 – 2.87
Voyage days (Ave.)	17.86	8.23	16.04	34.47	10.79
Discharge days (Ave.)	0.81	1.16	0.79	4.22	1.12
Voyages with nil mortalities (No.)	31	83	8	0	122

4.2.3 Middle East/North Africa

The number of live cattle exported to the Middle East/North Africa during 2019 rose by 40% compared to 2018 (Table 12), and the number of voyages rose by 82%.

It should be noted that the rise in voyage numbers is partly due to the high quality of reporting, which allows increased port-to-port analysis, but artificially inflates the number of "voyages" – see Section 3.1 Voyage.

Overall mortality rates have remained below 0.5% over the last decade. In 2019 the mortality rate was 0.24%.

It should also be noted that since 2018, regional and annual mortality rates are no longer comparable because of the legislated restrictions imposed on exports to the Middle East/North Africa region during the Middle-Eastern summer.

Table 12 Mortality rates, number of voyages, average voyage and discharge length, and number of cattle exported to the Middle East/North Africa from 2010 to 2019

Year	Voyages (No.)	Cattle (No.)	Mortality rate overall (%)	Mortality rate range (%)	Voyage days	Discharge days	Nil mortality voyages (No.)
2010	37	163,869	0.40	0.00 – 1.62	17.57	3.75	14
2011	28	80,180	0.17	0.00 – 0.67	17.91	3.14	10
2012	31	98,236	0.16	0.00 – 0.86	18.53	2.74	11
2013	33	121.780	0.17	0.00 – 0.44	19.28	3.99	12
2014	25	106.065	0.36	0.00 – 2.75	19.21	4.72	11
2015	31	99,558	0.26	0.00 – 0.78	19.10	3.21	12
2016	28	72,721	0.30	0.00 – 0.72	17.77	4.33	14
2017	26	41,384	0.17	0.00 – 1.00	17.14	4.13	15
2018	28	67,006	0.14	0.00 – 0.60	18.04	3.47	10
2019	51	93,730	0.24	0.00 – 1.39	17.86	0.81	31

4.2.3.1 Port of loading

There were only two ports of loading for voyages to the Middle East/North Africa in 2019, with 83% of cattle being exported from Fremantle and the remainder from Portland (Table 13). The port with the highest mortality rate in 2019 was Fremantle.

The percentage of voyages in the nil or low mortality categories was 89% for Fremantle, and 100% for Portland (Table 14).

Table 13 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 2019

Port	Voyages (No.)	Cattle (No.)	Mortality rate overall (%)	Mortality rate range (%)	Voyage days	Discharge days
Fremantle	45	78,092	0.26	0.00 – 1.39	17.50	0.83
Portland	6	15,638	0.11	0.00 – 0.22	20.55	0.60

Table 14 Number of voyages in nil, low, medium and high mortality categories for shipments from various ports to the Middle East/North Africa for 2010

Port	Mortality rate				Total
	Nil 0.0%	Low >0.0 – 0.5%	Medium >0.5 – 1.0%	High >1.0%	
Fremantle	29	11	3	2	45
Portland	2	4	0	0	6
Total	31	15	3	2	51

4.2.3.2 Ship

The voyages of each ship carrying cattle from Australia to the Middle East/North Africa were classified into four mortality categories: nil (no mortalities); low (mortality rate up to 0.5%); medium (from 0.5 to 1.0%); and high (greater than 1.0%).

Table 15 shows the number of voyages in the various mortality categories for each ship. There were five voyages in the medium or high categories, involving ships 34, 35 and43. 90% of voyages were in the nil or low categories.

Table 15 Number of voyages in nil, low, medium and high mortality categories for shipments to the Middle East/North Africa for 2019

Ship (code)	Mortality rate				Total
	Nil 0.0%	Low >0.0 – 0.5%	Medium >0.5 – 1.0%	High >1.0%	
32	17	1	0	0	18
34	9	2	0	1	12
35	2	3	3	0	8
43	1	0	0	1	2
44	1	1	0	0	2
47	1	1	0	0	2
59	0	1	0	0	1
103	0	1	0	0	1
139	0	5	0	0	5
Total	31	15	3	2	51

4.2.3.3 Class of cattle

Bull classes made up 66% of all cattle shipped to Middle East/North Africa in 2019.

The highest overall class mortality rate occurred in beef heifers (0.58%; Table 16).

Table 16 Mortality rates, number of voyages and number of cattle in various classes exported to the Middle East/North Africa in 2019

Class	Voyages (No.)	Cattle (No.)	Mortality rate overall (%)	Mortality rate range (%)
Bull weaners	10	34,817	0.26	0.00 – 0.53
Bull adults*	24	26,889	0.12	0.00 – 0.63
Heifers beef	11	10,821	0.58	0.00 – 2.02
Heifers dairy	5	9,353	0.12	0.00 – 0.22
Steer adults*	29	7,802	0.15	0.00 – 1.39
Steer weaners	6	4,048	0.16	0.00 – 0.93

* may include young as well as mature animals (i.e. animals not separately classified as "weaner")

4.2.4 South-East Asia

The number of cattle exported to South-East Asia in 2019 rose by 18% compared to 2018 and the number of voyages rose by 11% (Table 17). The overall mortality rate has remained under 0.1% over the last decade, at an average of 0.07%. The overall mortality rate for voyages to the region has remained at 0.09% for the last four years.

Cattle exports to the region accounted for 77% of the overall numbers shipped in 2019.

A nil mortality rate was reported on 28% of the voyages to the region.

Table 17 Mortality rates, number of voyages, average voyage and discharge length, and number of cattle exported to South-East Asia from 2010 to 2019

Year	Voyages (No.)	Cattle (No.)	Mortality rate overall (%)	Mortality rate range (%)	Voyage days	Discharge days	Nil mortality voyages (No.)
2010	202	551,761	0.04	0.00 – 0.44	6.47	0.86	105
2011	113	446,708	0.04	0.00 – 0.79	6.95	1.72	55
2012	127	361,383	0.04	0.00 – 0.80	6.71	1.32	63
2013	177	594,457	0.08	0.00 – 0.73	7.27	1.92	71
2014	266	995,138	0.08	0.00 – 3.52	7.66	1.55	96
2015	310	1,066,664	0.08	0.00 – 3.68	8.34	1.52	102
2016	272	863,960	0.09	0.00 – 1.42	7.96	1.47	86
2017	231	704,683	0.09	0.00 – 10.05	7.46	1.44	83
2018	269	838,283	0.09	0.00 – 1.85	8.13	1.24	65
2019	299	989,627	0.09	0.00 – 2.87	8.23	1.16	83

4.2.4.1 Port of loading

Most cattle exported to South-East Asia in 2019 were loaded at Darwin (38%) followed by Townsville (37%) and Broome (12%, Table 18). The mortality rate was highest for cattle exported from Port Alma (0.23%) followed by Fremantle (0.12%) and Townsville (0.11%).

The voyages from each port were classified into various mortality categories as shown in Table 19. 98% of voyages were in the nil or low categories in 2019. There were four voyages in the medium and two in the high category involving the ports of Townsville, Darwin, and Port Alma.

The ports of Townsville, Darwin, and Broome accounted for 86% of voyages to the region.

Table 18 Mortality rates, number of voyages, average voyage and discharge length, and number of cattle exported from various ports to South-East Asia in 2019

Port	Voyages (No.)	Cattle (No.)	Mortality rate overall (%)	Mortality rate range (%)	Voyage days	Discharge days
Darwin	141	378,083	0.06	0.00 – 1.19	6.77	1.03
Townsville	90	361,641	0.11	0.00 – 2.87	10.35	1.28
Broome	27	114,283	0.04	0.00 – 0.32	6.32	1.33
Fremantle	18	54,871	0.12	0.00 – 0.43	9.92	1.37
Port Alma	10	45,835	0.23	0.04 – 0.52	11.95	1.50
Wyndham	5	13,239	0.08	0.00 – 0.15	5.88	0.53
Geraldton	3	10,477	0.01	0.00 – 0.04	7.50	0.68
Port Hedland	2	6,447	0.00	0.00 – 0.00	4.00	0.53
Portland	2	3,151	0.06	0.05 – 0.08	16.45	2.75
Geelong	1	1,600	0.00	n/a	14.17	1.05

Table 19 Number of voyages in nil, low, medium and high mortality categories for shipments from various ports to South-East Asia for 2019

Port	Mortality rate				Total
	Nil 0.0%	Low >0.0 – 0.5%	Medium >0.5 – 1.0%	High >1.0%	
Darwin	52	87	1	1	141
Townsville	18	69	2	1	90
Broome	6	21	0	0	27
Fremantle	1	17	0	0	18
Port Alma	0	9	1	0	10
Wyndham	1	4	0	0	5
Geraldton	2	1	0	0	3
Port Hedland	2	0	0	0	2
Portland	0	2	0	0	2
Geelong	1	0	0	0	1
Total	83	210	4	2	299

4.2.4.2 Ship

Voyages for each ship from Australia to South-East Asia were classified into various mortality categories as shown in Table 20. 98% of voyages were in the nil or low categories. There were four voyages in the medium and two in the high category.

The number of voyages to the region rose from 269 in 2018 to 299 in 2019, an increase of 11%.

Ships with a carrying capacity of 6,000 or more head accounted for 21% of voyages to South-East Asia in 2019. They also accounted for 38% of cattle exported to the region, 38% of mortality, 23% of voyage days and 38% of discharge days.

It should be noted that the larger ships undergoing more complex loading and discharging schedules, can generate more “voyages”, as discussed in “Voyage”, Section 3.1 of the Methodology.

Table 20 Number of voyages in nil, low, medium and high mortality categories for shipments to South East Asia for 2019

Ship (code)	Mortality rate				Total
	Nil 0.0%	Low >0.0 – 0.5%	Medium >0.5 – 1.0%	High >1.0%	
35	0	3	0	0	3
43	2	6	0	0	8
44	3	4	0	0	7
47	0	8	1	0	9
49	2	9	0	0	11
50	0	14	0	0	14
59	3	7	0	1	11
77	5	4	2	0	11
95	5	12	0	1	18
103	1	1	0	0	2
120	10	13	0	0	23
124	5	11	0	0	16
125	5	15	0	0	20
126	6	9	0	0	15
127	4	8	0	0	12
128	2	3	0	0	5
129	0	8	0	0	8
130	3	9	1	0	13
131	7	10	0	0	17
132	1	11	0	0	12
133	4	14	0	0	18
134	1	2	0	0	3
135	7	10	0	0	17
136	6	8	0	0	14
137	0	3	0	0	3
138	0	5	0	0	5
140	1	3	0	0	4
Total	83	210	4	2	299

4.2.4.3 Class of cattle

The highest class numbers exported to South-East Asia in 2019 were adult steers (46%) followed by beef heifers (19%), weaner steers (14%) and adult bulls (11%; Table 21).

The highest class mortality rates occurred in adult bulls (0.21%) followed by beef cows (0.18%).

Table 21 Mortality rates, number of voyages and number of cattle in various classes exported to the South-East Asia in 2019

Class	Voyages (No.)	Cattle (No.)	Mortality rate overall (%)	Mortality rate range (%)
Steer adults*	269	456,491	0.08	0.00 – 2.32
Heifers beef	185	192,362	0.04	0.00 – 2.56
Steer weaners	61	140,564	0.05	0.00 – 0.32
Bull adults*	166	112,106	0.21	0.00 – 5.00
Bull weaners	46	46,794	0.05	0.00 – 0.71
Cows beef	75	37,286	0.19	0.00 – 2.46
Heifers dairy	9	4,024	0.03	0.00 – 0.05

* may include young as well as mature animals (i.e. animals not separately classified as "weaner")

4.2.5 North-East Asia

The number of cattle exported to North-East Asia in 2019 rose by 16% compared to 2018, with the number of voyages rising by just 2% (Table 22).

The mortality rate for voyages to the region during 2019 was 0.14%. Except for 2018, the mortality rate has remained under 0.2% over the last decade, at an average of 0.14%.

A nil mortality rate was reported on 16% of voyages to the region.

The North-East Asia cattle trade has been characterised by steers exported exclusively to Japan and dairy classes sent to China, but in 2019 slaughter cattle made up 19% of classes sent to China.

Table 22 Mortality rates, number of voyages, average voyage and discharge length, and number of cattle exported to North-East Asia from 2010 to 2019

Year	Voyages (No.)	Cattle (No.)	Mortality rate overall (%)	Mortality rate range (%)	Voyage days	Discharge days	Nil mortality voyages (No.)
2010	34	69,638	0.08	0.00 – 0.33	18.25	0.62	10
2011	31	68,773	0.15	0.00 – 0.46	18.08	0.87	5
2012	30	74,941	0.17	0.00 – 0.70	17.55	0.76	7
2013	31	81,521	0.15	0.00 – 1.18	17.63	0.68	5
2014	39	123,583	0.14	0.00 – 2.04	17.47	0.76	10
2015	32	98,213	0.08	0.00 – 0.56	17.35	0.66	7
2016	35	102,487	0.14	0.00 – 0.64	17.28	0.75	8
2017	31	87,877	0.11	0.00 – 0.52	17.18	0.81	4
2018	49	148,943	0.24	0.00 – 1.51	16.96	0.80	5
2019	50	172,427	0.14	0.00 – 1.37	16.04	0.79	8

4.2.5.1 Port of loading

The majority of cattle exported to North-East Asia in 2019 departed from Portland (75%), followed by Fremantle (11%) and Brisbane (8%; Table 23). All cattle loaded at Brisbane were exported to Japan while those loaded at other ports were exported to China.

The voyages from each port were classified into various mortality categories as shown in Table 24. During 2019 there were two voyages in the medium or high mortality category, while 96% of all voyages were in the nil or low categories.

Table 23 Mortality rates, number of voyages, average voyage and discharge length, and number of cattle exported from various ports to North-East Asia for 2019

Port	Voyages (No.)	Cattle (No.)	Mortality rate overall (%)	Mortality rate range (%)	Voyage days	Discharge days
Portland	27	129,471	0.12	0.00 – 0.31	16.77	0.95
Fremantle	10	19,310	0.33	0.00 – 1.37	15.27	0.81
Brisbane	10	14,640	0.06	0.00 – 0.20	14.72	0.31
Geelong	2	6,994	0.14	0.08 – 0.20	15.34	0.82
Geraldton	1	1,742	0.00	n/a	18.55	0.60

Table 24 Number of voyages in nil, low, medium and high mortality categories for shipments from various ports to North-East Asia for 2019

Port	Mortality rate				Total
	Nil 0.0%	Low >0.0 – 0.5%	Medium >0.5 – 1.0%	High >1.0%	
Portland	1	26	0	0	27
Fremantle	1	7	1	1	10
Brisbane	5	5	0	0	10
Geelong	0	2	0	0	2
Geraldton	1	0	0	0	1
Total	8	40	1	1	50

4.2.5.2 Ship

The voyages of each ship taking cattle from Australia to North-East Asia were classified into various mortality categories as shown in Table 25.

During 2019 there were two voyages in the medium or high mortality categories, involving ships 126 and 127.

96% of voyages were in the nil or low categories.

Table 25 Number of voyages in nil, low, medium and high mortality categories for shipments to North-East Asia for 2019

Ship (code)	Mortality rate				Total
	Nil 0.0%	Low >0.0 – 0.5%	Medium >0.5 – 1.0%	High >1.0%	
43	0	3	0	0	3
44	0	3	0	0	3
47	0	1	0	0	1
49	0	1	0	0	1
50	0	1	0	0	1
59	0	1	0	0	1
95	0	1	0	0	1
103	0	2	0	0	2
122	5	5	0	0	10
126	0	1	1	0	2
127	1	0	0	1	2
128	0	5	0	0	5
130	1	1	0	0	2
132	0	4	0	0	4
134	0	3	0	0	3
135	0	3	0	0	3
138	0	1	0	0	1
140	1	4	0	0	5
Total	8	40	1	1	50

4.2.5.3 Class of cattle

Mortality rates for classes of cattle exported to North-East Asia during 2019 are presented in Table 26. The North-East Asian cattle trade comprised mainly steers exported to Japan, and dairy and slaughter classes exported to China (81% and 19% respectively).

The highest class numbers exported to North-East Asia in 2019 were dairy heifers (55%) followed by adult steers (23%) and beef heifers (19%).

The highest class mortality rates occurred in dairy cows (0.25%) followed by adult steers (0.21%).

Table 26 Mortality rate, number of voyages and number of cattle in the classes exported to North-East Asia in 2019

Class	Voyages (No.)	Cattle (No.)	Mortality rate overall (%)	Mortality rate range (%)
Heifers dairy	26	94,567	0.13	0.00 – 0.31
Steer adults*	23	39,295	0.21	0.00 – 1.37
Heifers beef	18	33,156	0.09	0.00 – 1.22
Cows dairy	1	3,677	0.25	n/a
Bull adults*	10	1,732	0.06	0.00 – 0.39

* may include young as well as mature animals (i.e. animals not separately classified as "weaner")

4.2.6 South-East Europe

The significant rise in livestock exports to Turkey and the Black Sea over the last decade initially had the effect of excessively boosting numbers of cattle exported to the Miscellaneous region. In 2012 a new destination region, South-East Europe, was introduced to allow a more meaningful examination of exports to this area.

The number of voyages and cattle exported to South-East Europe almost halved during 2019 compared to 2018

The overall mortality rate for cattle exported to the region was 0.16% in 2019. The mortality rate has remained at or below 0.5% over the last decade, at an average of 0.33% (Table 27).

Table 27 Mortality rates, number of voyages, average voyage and discharge length, and number of cattle exported to South-East Europe from 2010 to 2019

Year	Voyages (No.)	Cattle (No.)	Mortality rate overall (%)	Mortality rate range (%)	Voyage days	Discharge days	Nil mortality voyages (No.)
2010	11	78,673	0.44	0.00 – 0.83	25.08	5.03	1
2011	15	83,033	0.51	0.19 – 1.43	26.78	5.00	0
2012	14	75,170	0.28	0.00 – 0.87	28.78	3.58	1
2013	5	44,560	0.18	0.00 – 0.61	24.58	3.87	0
2014	5	54,006	0.47	0.34 – 0.60	25.62	3.88	0
2015	4	40,666	0.53	0.23 – 0.79	30.52	3.59	0
2016	12	86,846	0.29	0.08 – 0.65	24.71	1.97	0
2017	3	20,791	0.21	0.00 – 0.32	25.61	3.26	1
2018	10	61,657	0.24	0.00 – 0.47	24.80	4.68	3
2018	6	36,839	0.16	0.00 – 0.23	34.47	4.22	0

4.2.6.1 Port of loading

All cattle exported to South-East Europe in 2019 were loaded at southern ports, with most being loaded at Portland (52%) followed by Geelong (39%; Table 28).

The mortality rate was highest for cattle exported from Geelong (0.17%) followed by Portland (0.16%).

The voyages from each port were classified into various mortality categories as shown in Table 29. All voyages were in the low or nil categories in 2019

Table 28 Mortality rates, number of voyages, average voyage and discharge length, and number of cattle exported from various ports to South-East Europe in 2019

Port	Voyages (No.)	Cattle (No.)	Mortality rate overall (%)	Mortality rate range (%)	Voyage days	Discharge days
Portland	3	19,326	0.16	0.04 – 0.23	38.53	2.70
Geelong	1	14,488	0.17	n/a	29.58	8.01
Fremantle	2	3,025	0.13	0.11 – 0.18	30.84	4.61

Table 29 Number of voyages in nil, low, medium and high mortality categories for shipments from various ports to South-East Europe for 2019

Port	Mortality rate				Total
	Nil 0.0%	Low >0.0 – 0.5%	Medium >0.5 – 1.0%	High >1.0%	
Portland	0	3	0	0	3
Fremantle	0	2	0	0	2
Geelong	0	1	0	0	1
Total	0	6	0	0	6

4.2.6.2 Ship

The voyages of each ship carrying cattle from Australia to South-East Europe were classified into various mortality categories as shown in Table 30. All voyages for 2019 were in the nil or low mortality categories.

Table 30 Number of voyages in nil, low, medium and high mortality categories for shipments to South-East Europe for 2019

Ship (code)	Mortality rate				Total
	Nil 0.0%	Low >0.0 – 0.5%	Medium >0.5 – 1.0%	High >1.0%	
50	0	3	0	0	3
103	0	1	0	0	1
138	0	2	0	0	2
Total	0	7	0	0	6

4.2.6.3 Class of cattle

Exports to South-East Europe were mostly in steer classes (81%), followed by dairy heifers (18%), all of which went to Russia.

Mortality rates for each class of cattle exported to South-East Europe during 2019 are presented in Table 31. The highest mortality rates occurred in adult steers (0.17%) followed by dairy heifers (0.15%).

Table 31 Mortality rate, number of voyages and number of cattle in the classes exported to South-East Europe in 2019

Class	Voyages (No.)	Cattle (No.)	Mortality rate overall (%)	Mortality rate range (%)
Steer adults*	3	25,959	0.17	0.06 – 0.19
Heifers dairy	3	6,765	0.15	0.04 – 0.23
Steer weaners	3	4,056	0.12	0.00 – 0.50
Bull adults*	1	39	0.00	n/a
Heifers beef	1	20	0.00	n/a

* may include young as well as mature animals (i.e. animals not separately classified as "weaner")

4.3 Air Transport

4.3.1 Air transport of live sheep

During 2019 air transport accounted for the 3.71% of live sheep exports (41,505 out of 1,118,499 sheep exported). The 41,505 sheep exported by air in 2019 represents a rise of 30% compared to 2018, exceeding the average export figure of approximately 39,000 for the 2010 to 2019 period.

Air transport of live sheep comprises a mix of breeding and slaughter types. In 2019, 87% of air-transported sheep were for slaughter.

4.3.1.1 Load point / destination

The loading points and destination countries for sheep transported by air from Australia in 2019 are shown in Table 32. Almost all sheep were loaded at Adelaide, Perth and Sydney airports, each accounting for 48.0%, 34.9%, and 12.7% of the number exported respectively.

The main importing countries for Australian sheep exported by air in 2019 were Malaysia (84.4%) and China (9.5%).

Table 32 Load point and destination country for sheep exported by air from Australia during 2019

Country	Adelaide	Melbourne	Perth	Sydney	Total
Malaysia	19,936		10,578	4,514	35,028
Singapore			3,924		3,924
China		1,126			1,126
India		480			480
Philippines				433	433
Sarawak				224	224
New Zealand		47		47	94
Kazakhstan		75			75
Indonesia				58	58
Thailand		53			53
Russia				10	10
Total	19,936	1,781	14,502	5,286	41,505

SOURCE – Department of Agriculture, Water and the Environment, Mar 2020

4.3.1.2 Mortalities

The reportable level for air-transported sheep is 2.0% or 3 sheep, whichever is the greater number of animals. There was one high mortality flight in 2013 (38.39%), 2014 (7.91%) and 2015 (18.66%). If these flights were excluded, the mortality rates for those years would have been 0.01%, 0.01% and 0.02% respectively.

For air transported sheep from 2010 to 2019, all but 4 mortalities occurred in slaughter types and all but 16 mortalities occurred in the second half of the year. Mortalities occurred on 3.0% of flights over the decade (41 of 1,359).

Sheep exported by air experienced 0.01% mortalities during 2019 (Table 33).

Table 33 Mortality rates and number of sheep exported by air to all destinations from 2010 to 2019

Year	Flights	Sheep (No.)	Total Mortalities (No.)	Mortality rate overall (%)
2010	82	21,201	3	0.01
2011	94	30,865	42	0.14
2012	120	23,688	0	0.00
2013	139	35,875	45	0.13
2014	162	39,227	177	0.45
2015	194	56,945	137	0.24
2016	308	62,588	10	0.02
2017	138	42,144	16	0.04
2018	53	31,834	4	0.01
2019	69	41,505	5	0.01

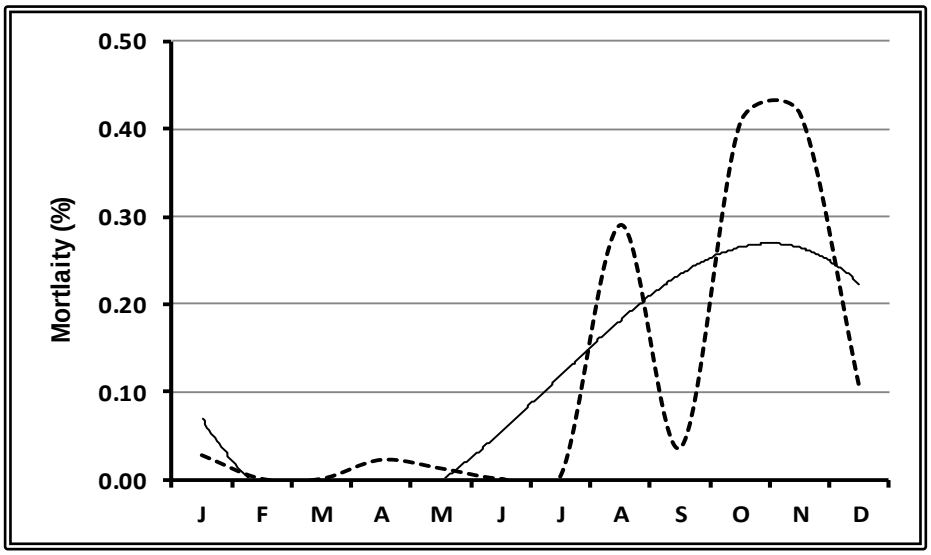
SOURCE – Department of Agriculture, Water and the Environment, Mar 2020

Over the period 2010 to 2019, mortalities were significantly higher in the second half of the year ($P < 0.05$, Figure 7).

All but 16 mortalities occurred in the second half of the year over the period 2010 to 2019.

It is of interest to note that the trend line for the annual mortality profile approximates the enduring reverse tilde pattern seen in sheep exported by sea.

Figure 7 Monthly mortality (%) of sheep exported by air from Australia to all destinations since 2008



Mortalities were significantly higher in slaughter sheep than breeder sheep ($P < 0.05$) with all but 4 mortalities occurring in slaughter types.

4.3.2 Air transport of live cattle

During 2019 air transport accounted for 0.88% of live cattle exports (11,466 out of 1,304,089 cattle exported).

The 11,466 cattle exported by air in 2019 represents a fall of 1.5% compared to 2018. The 2019 figure exceeds the average export figure of just over 9,000 for the 2010 to 2019 period.

Air transport of live cattle is almost exclusively confined to breeding types. 2015 and 2016 saw 7% and 11% respectively of slaughter cattle exported by air, but this figure was 1.1% in 2019.

4.3.2.1 Load point / destination

Load points and destinations for cattle transported by air from Australia in 2019 are shown in Table 34. Almost all cattle were loaded at Melbourne and Sydney airports, accounting for 58.0% and 32% respectively.

The main importing countries for Australian cattle exported by air in 2019 were Japan (28%), Kazakhstan (22%), and Malaysia (21%).

Table 34 Load point and destination country for cattle exported by air from Australia during 2019

Country	Adelaide	Avalon	Melbourne	Perth	Sydney	Total
Japan			1,853	832	528	3,213
Kazakhstan			2,471			2,471
Malaysia	173				2,205	2,378
Indonesia		218	390		372	980
Taiwan			762		184	946
Philippines			235		297	532
China			339			339
Thailand			278			278
Bangladesh			225			225
UAE			74			74
Sarawak					30	30
Total	173	218	6,627	832	3,616	11,466

SOURCE – Department of Agriculture, Water and the Environment, Mar 2020

4.3.2.2 Mortalities

The reportable level for air-transported cattle is 0.5% or 3 cattle, whichever is the greater number of animals. There were two high mortality flights in 2013 (6.45% and 15.26%). If these flights were excluded, the mortality rates for the year would have been nil.

Cattle exported by air experienced nil mortalities during 2019 (Table 35).

Mortalities occurred on 1.0% of flights over the 2010 to 2019 period (6 of 623).

Table 35 Mortality rates and number of cattle exported by air to all destinations from 2010 to 2019

Year	Flights	Cattle (No.)	Total Mortalities (No.)	Mortality rate overall (%)
2010	43	8,271	1	0.01
2011	48	8,738	0	0.00
2012	41	7,825	1	0.01
2013	54	9,691	67	0.69
2014	74	9,458	0	0.00
2015	76	11,315	2	0.02
2016	57	6,060	0	0.00
2017	72	9,261	0	0.00
2018	79	11,646	0	0.00
2019	85	11,466	0	0.00

SOURCE – Department of Agriculture, Water and the Environment, Mar 2020

4.3.3 Air transport of live goats

Air transport has played a significant role in the export of live goats for many years, and during 2019 accounted for all live goat exports.

The 16,059 goats exported by air in 2019 represent a fall of 29% compared to 2018, and are just over one quarter of the average figure of 55,000 for the years 2010 to 2019.

Air transport of live goats comprises a mix of breeding and slaughter types, the majority of which are for slaughter. 2019 represents a significant change, in that air-transported goats for breeding (58%) overtook numbers for slaughter (42).

4.3.3.1 Load point / destination

The loading points and destination countries for goats transported by air from Australia in 2019 are shown in Table 36.

32% of these goats were loaded at Sydney airport, followed by Melbourne and Adelaide airports, with 32% and 31% respectively.

The main importing countries for Australian goats exported by air in 2019 were Malaysia (43%), China (28%) and Sabah (6%).

Table 36 Load point and destination country for goats exported by air from Australia during 2019

Country	Adelaide	Brisbane	Melbourne	Perth	Sydney	Total
Malaysia	5,025			859	1,016	6,900
China			4,462			4,463
Sabah					2,562	2,562
Philippines					737	737
Nepal		6	176		254	436
Sarawak					391	391
Indonesia			270		85	355
Sri Lanka			100			100
Thailand			46		23	69
Kazakhstan			25			25
Russia					21	21
Total	5,025	6	5,080	859	5,089	16,059

SOURCE – Department of Agriculture and Water Resources, Mar 2020

4.3.3.2 Mortalities

The reportable level for air-transported goats is 2.0% or 3 goats, whichever is the greater number of animals. For the years 2010 to 2019, there has been only one flight with a reportable mortality level.

All mortalities for goats transported by air from 2010 to 2019 occurred in slaughter types except for one breeder goat in 2017 and three breeder goats in 2018. It should be noted that slaughter types continue to make up the vast majority of goats exported (87.4% of goats exported over 2010 to 2019).

Mortalities occurred on 3.8% of flights (43 out 1,143) over the decade.

Goats exported by air experienced 0.025% mortalities during 2019 (Table 37).

Table 37 Mortality rates and number of goats exported by air to all destinations from 2010 to 2019

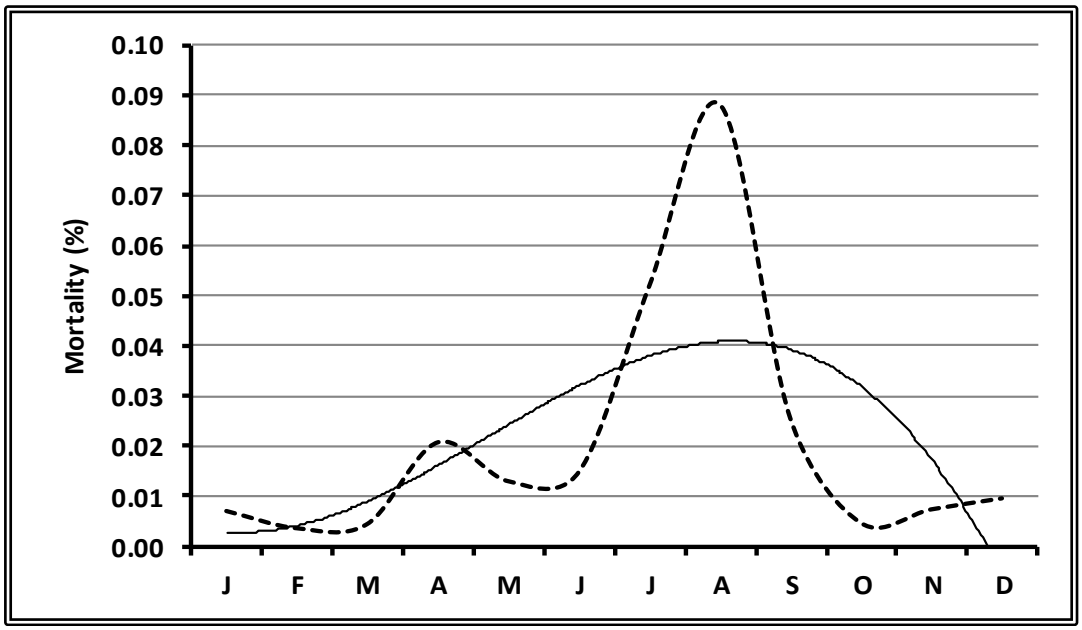
Year	Flights	Goats (No.)	Total Mortalities (No.)	Mortality rate overall (%)
2010	214	78,089	8	0.010
2011	99	49,860	1	0.002
2012	90	64,209	0	0.000
2013	111	74,484	9	0.012
2014	160	86,859	11	0.013
2015	130	86,927	74	0.085
2016	130	83,959	22	0.041
2017	54	12,245	2	0.016
2018	69	22,644	12	0.053
2019	88	16,059	4	0.025

SOURCE – Department of Agriculture, Water and the Environment, Mar 2020

Over the period 2010 to 2019, mortalities were significantly higher in the second half of the year ($P < 0.05$, Figure 8).

Overall, 79% of mortalities occurred in the second half of the year over the period 2010 to 2019.

Figure 8 Monthly mortality (%) of goats exported by air from Australia to all destinations since 2008



5 Conclusion and recommendations

5.1 Sheep, cattle and goats

This report successfully summarises the mortalities of sheep, cattle and goats exported live for the 2019 calendar year. Mortality trends were analysed and the overall mortalities for sheep and cattle exported by sea were shown to be 0.262% and 0.106% respectively, while overall mortalities for sheep, cattle and goats exported by air were 0.012%, 0.000% and 0.025% respectively. No goats were exported by sea in 2019.

This is the only comprehensive report of its type, providing breakdowns by ship, species, time of year, load ports and major destinations over the calendar year for both shipboard and air exports, as well as summary analyses of trends over time.

It is recommended that expression of results move from rates (mortality/loaded) to median values, with comparisons made to standardised measures of performance in the trade for classes of animal, time of year, destination etc. This use of standardised rates is intended to further clarify trends over time.

Much of the analysis for the South-East Asia region has been derived from the ship Master's Report, a voyage report for all shipments of livestock that must provide details meeting the reporting requirements of AMSA and DAWE. Unfortunately a version of the ship Master's Report introduced in 2009 excluded details crucial to this study, therefore we needed additional and ongoing Industry input from that time. Only recently, in mid-2018, a newer Master's Report version saw much of the previous information re-introduced, once again enabling much of the analysis for the South-East Asia region to be taken from this source. This has removed a significant burden for ships' Officers who have voluntarily filled the gap over the previous decade. Industry cooperation in the matter is laudable for the wholehearted support shown.

It is recommended that the list of DA mortality investigations be replaced by the one reference, as mentioned in the project Background (Section 1), to their website where all their investigations are noted. These can be found at:

https://www.agriculture.gov.au/export/controlled-goods/live-animals/livestock/regulatory-framework/compliance-investigations/investigations-mortalities

It is also recommended that the Research Update section, outlining areas of new and ongoing research in the Live Export Trade, be replaced by references in the Bibliography section to MLA / LiveCorp summary information that can be viewed at the following website:

https://livecorp.com.au/researchAndDevelopment

As mentioned in the Executive Summary, previously documented comparisons over time (year on year, region to region) have been disrupted by the 2018 Middle East export restrictions. It is recommended that these comparisons be made again in the future when enough data describing the new export timeframes has been gathered to allow meaningful results.

6 Appendices

6.1 Appendix 1 - Published studies

A list of scientific and extension publications, relevant to the Livestock Export Trade, follows in date order.

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 (2012) 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 (2012) 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 (2012) Australian standards for the export of livestock (version 2.3) and Australian position statement on the export of livestock (Note – this publication is now available for download onto mobile devices by entering "asel handbook app" into your internet browser and choosing the method most appropriate to you)

Pines MK, Phillips CJ (2013) Microclimatic conditions and their effects on sheep behavior during a live export shipment from Australia to the Middle East J Anim Sci **91(9):** 4406-4416

The Veterinary Handbook for Cattle, Sheep and Goats Application (2014) is available for download onto mobile devices at: http://www.veterinaryhandbook.com.au/

Moore SJ, Madin B, Norman G, and Perkins N (2015) Risk factors for voyage mortality in cattle during live export from Australia by sea Aust Vet J **93:** 339-348

Phillips CJ (2016) The welfare risks and impacts of heat stress on sheep shipped from Australia to the Middle East Vet J **28:** 78-85

Zhang Y, Lisle AT, Phillips CJ (2017) Development of an effective sampling strategy for ammonia, temperature and relative humidity measurement during sheep transport by ship Biosystems Engineering **155:** 12-23

Collins T, Hampton JO, A Barnes AL (2018) Systematic Review of Heat Load in Australian Livestock Transported by Sea Animals **8(10):** 164-180

Fleming P, Wickham S, Dunston-Clarke E, Willis R, Barnes A, Miller D, Collins T (2020) Review of Livestock Welfare Indicators Relevant for the Australian Live Export Industry Animals **10(7): 1236**

6.2 Appendix 2 - Acknowledgements

The cooperation of ships' officers in recording details of daily mortalities for this series of reports is again acknowledged with thanks. Some of these officers have faithfully contributed to the work for over 30 years, and their dedication to the project and to the voluntary exposure of their Industry to public scrutiny is remarkable and worthy of high praise and grateful appreciation.

The cooperation of Exporters, Shipping Agencies and Port Authorities for additional help in collating data is also gratefully acknowledged. Again, some of these Industry participants haven faithfully and unstintingly contributed to the work for over 30 years, marking an exemplary willingness to see their industry fully presented for public scrutiny, and their great trust in the integrity of this surveillance work and its findings.

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

The cooperation of the Australian Government Department of Agriculture, Water and the Environment for provision of miscellaneous information and data regarding the transport of livestock by air is again also gratefully acknowledged.

This work was funded by Meat and Livestock Australia, LiveCorp and the Department of Agriculture and Food, Western Australia.