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Minimising mortality risks during export of live goats by sea from Australia

Voyage Report prepared for MLA and Livecorp by:

Drs Simon More (AusVet Animal Health Services) and Tony Brightling (Alwani Pty Ltd)

AusVet Animal Health Services
PO Box 3180
South Brisbane 4101
Ph: (07) 3201 1386
Fax: (07) 3201 0085
Email : simon@ausvet.com.au

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B	2MAR03	Revision following comments at an industry meeting on 11FEB03	Drs Simon More and Tony Brightling
C	14MAY03	Revision following further comments after submission of Revision B	Drs Simon More and Tony Brightling

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Executive summary

Background

Live goat exports to the Middle East, particularly for the hajj pilgrimage, are an important market opportunity for Australian producers. There is also a significant and expanding live goat export trade to Malaysia. Live goat exports are especially important to producers in marginal pastoral country, where there are few alternative production options. However, the future of the live goat export trade is in doubt because of government concern about voyage mortality rates. There is a strong view in government that goat mortality rates are too high, and that more can and must be done to ensure that voyage mortality rates below 2% are consistently achieved.

Project objectives

This work has sought to identify, assess and recommend management of the risks associated with high mortality during live goat exports by sea from Australia. A risk management plan has been developed in the context that live goat exports can only continue if there is a very low probability that the mortality rate on any future voyage will exceed 2%.

This study specifically relates to the live export of goats by sea. Issues relating to air transport of goats have not been considered in this review.

Risk identification and assessment

This work has been conducted using accepted principles of risk management. Using information from the scientific literature, expert opinion and a retrospective analysis of voyage data collected over the last two years, factors that increase mortality risk during the shipboard phase were found at all stages of the export process; including the selection of goats for export, on-farm preparation, and management during feedlotting and on-ship.

With a semi-qualitative process of risk assessment, the most important risk factors for voyage mortality were found to be:

- inclusion of unmanaged feral goats;
- capture management below best-practice (for unmanaged goat populations);
- inadequate pre-feedlot domestication (for unmanaged goat populations);
- shelter problems during feedlotting;
- inclusion of older bucks;
- inclusion of sexually mature does;
- inadequate management of dominance; and
- length of the on-sea voyage.

Risk management principles

Being a biological system, live goat export mortality risks cannot be eliminated or managed with complete certainty. However, a risk management plan that addresses each of the risk factors listed above will significantly reduce the overall mortality risk.

The proposed risk management procedures must be economically sustainable and there must be processes in place to ensure compliance.

More rigorous risk management is needed on long-haul as compared with short-haul voyages.

Industry feedback

An initial draft of this report was considered at an industry workshop held in Adelaide on 11 February 2003.

At the industry workshop, a case was mounted that goats are inherently more difficult to export than either sheep or cattle, and a higher mortality threshold should therefore apply for goats. It was noted that the mortality rate during transportation and in abattoir lairages in Australia is much higher for goats than for sheep.

An argument was also put that the live goat export industry is at an earlier stage of development than the live sheep and cattle export industries, the average mortality rate for goats is trending down, and that more time rather than more regulation is needed.

Whilst acknowledging the challenges associated with exporting large numbers of goats, we believe that increasing the acceptable mortality threshold for goats would not meet community expectations, and would therefore be very difficult to sell to government. We also believe that to achieve the required outcome, there must be a significant change from the *status quo*.

Recommendations

Animals suitable for live export from Australia

a. Feral goats

1. On voyages of 10 days or more duration *(long-haul voyages),* captured feral goats are not selected for export. Only goats that have been in a managed production system since birth are exported on long-haul voyages.

2. On voyages of less than 10 days duration *(short-haul voyages),* captured feral goats are not selected for live export from 1 January 2005. During the phase-out period to 1 January 2005, captured feral goats are only eligible for export on short-haul voyages if they are accustomed to people, and relatively stress-free in their presence, and are used to eating and drinking from troughs at the time of arrival at the pre-export assembly depot.

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Notes: Under a managed production system, goats can be identified by property-of-origin and have been husbanded (or managed) throughout their lives. In the eastern states, management is generally conducted *'behind wire'*. In contrast, stock control in pastoral WA is often achieved using a system of yards at permanent watering points.

The phase-out period for captured feral goats on short-haul voyages recognises that in WA about 90% of the goats available for export are goats of feral origin, derived from an unmanaged production system. On-farm investment and management change is needed to meet the proposed live export requirements.

The system of selection and management at both the domestication site and pre-export assembly depot must be documented and auditable.

b. Goat bucks

3. Goat bucks of feral origin are not selected for export if they have a full mouth of permanent incisor teeth.

c. Goat does

4. There have been significant problems, mainly relating to spontaneous abortion, with the export of does from Australia. This problem can be reduced, but not eliminated, through pregnancy testing. Although this risk is removed in animals prior to sexual

maturity, detailed information linking sexual maturity and bodyweight in Australian feral does is currently lacking. For these reasons, it is recommended that goat does should not be selected for export as slaughter animals.

Management on-ship

a. Target voyage mortality rate

5. The overall voyage mortality rate (covering the period from loading on-ship to subsequent unloading) should not exceed 2.0%. As indicated below, an expert investigation will be conducted on each occasion where the voyage mortality rate exceeds this level.

b. Penning at sea

6. Goats exported by sea should be penned on the ship in lines, with the liveweight range in each line of goats not exceeding 10kg.

7. The following 'Best practice' box is added to the *Australian Livestock Export Standards:*

> *Best practice:*
>
> *Where possible, does and entire bucks should not be held on the same deck during export.*

This 'best practice' may be difficult to achieve on ships carrying both cattle and goats. In these situations, it is critical that goats are loaded in areas of the ship that will remain dry during cattle wash-downs, and other strategies may be needed to ensure that does and entire bucks cannot mix during the voyage.

8. The following 'Best practice' box is added to the *Australian Livestock Export Standards:*

> *Best practice:*
>
> *Where possible, goats should be penned on the vessel in single-tier pens.*

c. Shipboard fodder

9. The shipboard fodder provided for goats exported by sea includes at least 200 gms / head / day of chaff and/or hay.

In general

a. Use of antimicrobial agents

10. Oral antimicrobial agents must not be used prophylactically (as a preventive measure to apparently-health animals) unless prescribed by a veterinarian.

b. Mortality investigations

11. All mortality incidents (consignments with a voyage mortality rate of more than 2%) are expertly investigated, to identify the cause and enable a continuous improvement in the health and welfare of goats during live export. There may be an additional requirement regarding pre-voyage mortality, depending on the results of the current ALES review.

c. Sunset clause

12. A critical and independent re-evaluation of the live goat export industry is undertaken within three years of this report, to assess progress and the need for further change in a developing industry.

d. Australian Livestock Export Standards

13. To enhance compliance with the recommendations listed above, we strongly recommend that they are embedded in the *Australian Livestock Export Standards*, and therefore in the quality assurance program for each live goat exporter.

Other issues

In addition to the recommendations listed above, the following issues are flagged for further consideration by industry and government:

- The Australian Livestock Export Standards (ALES) are currently being changed from a practice-based to an outcome-based standard. As a consequence, there may soon be a requirement for industry to monitor mortality rates prior to shipping (covering the period from time of departure from the farm/station/property-of-capture to loading on-ship) as well as during the shipping period.

- Goats are very susceptible to cold stress. Because the peak demand for goats will move forward by about ten days each year, to coincide with Ramadan and the hajj, as the years progress, increasing efforts will need to be paid to the prevention of hypothermia in goats exported from southern Australia.

- Entire bucks are much more difficult to manage than wethers during live export. Because standards in risk management vary throughout the industry, the industry should consider a progressive reduction in the proportion of goats exported as entire males. The authors recognise current constraints to change, given the current preference for entire bucks in most of Australia's live goat export markets.

- There is very limited information concerning fibre requirements and optimal pen heights and animal densities during live goat export. Further research in these areas would be warranted.

- Veterinary reports of voyage mortalities during live export have been of variable quality. In order to improve the value of these reports, it is recommended that industry require a detailed report, following the guidelines outlined in a accompanying document (More, 2002c), from all veterinarians accompanying live animal export voyages from Australia.

1. Introduction

1.1 Background to the industry

Live goat exports to the Middle East, particularly for the hajj pilgrimage, are an important market opportunity for Australian producers. There is also a significant and expanding live goat export trade to Malaysia. Live goat exports are especially important to producers in marginal pastoral country, where there are few alternative production options. Furthermore, live goat exports are likely to be attractive for some years, given the general shortage of sheep in Australia and the increasing supply difficulties created as a result of the earlier hajj date each year. There were 135,532 goats exported live during 2002, with an FOB value of just over A$11million. This compares with less than 50,000 goats and an FOB value of A$3 million in 2000.

1.2 Constraints to live goat export

The future of the live goat export trade is in doubt because of government and community concern about voyage mortality rates. Although the average voyage mortality rate is relatively low, unacceptable levels of voyage mortality have been more frequent among goats in comparison to sheep or cattle. The average voyage mortality rate for the 140 live goat export voyages between 20SEP00 and 19OCT02 was 1.41%. For 23 (16.4%) of these voyages the 2% reportable 'trigger level' was exceeded. Since September 2000 there have been ten live goat export shipments with a mortality rate above 4%. By contrast, despite the much larger number of sheep and cattle shipments, during the same period there have been only three consignments of sheep and four consignments of cattle with mortalities above 4%.

It is widely accepted that goats are inherently more difficult to export than sheep or cattle. However, there is a strong view in government that more can and must be done to ensure that voyage mortality rates below 2% are consistently achieved.

1.3 The purpose of this work

At the joint meeting in Canberra between AFFA and LiveCorp on 17 October 2002, and as a way to move this issue forward, it was agreed to recommend to the Independent Reference Group that industry consultants:

- Conduct a retrospective investigation of all shipments for the previous 24 months to identify factors contributing to mortalities.
- Identify contributing causes, where problems have occurred with shipments.
- Identify risks from the above investigation, covering all stages from paddock to customer.
- Produce industry wide management plans, using full risk management procedures, in order to gain ICC, AFFA and Ministerial agreement.
- Monitor all 2003 hajj shipments, with an on-board veterinarian carrying out predetermined investigations.

The importance of this work has been reinforced in a press release from the Federal Minister for Agriculture, Fisheries and Forestry on 31 October 2002[1].

In response to these concerns, this work has sought to identify, assess and recommend management of the risks associated with high mortality during live goat exports from Australia. A risk management plan has been developed in the context that live goat export can only continue if there is a minimum likelihood of the voyage mortality rate on any future voyage exceeding 2%.

[1] Sheep exports from Portland to resume if tough new conditions are met. Press release from The Hon Warren Truss, Federal Minister for Agriculture, Fisheries and Forestry. AFFA02/301WT, 31 October 2002. www.affa.gov.au/ministers/truss/releases/02/02301wt.htm.

This study specifically relates to the live export of goats by sea. Issues relating to air transport of goats have not been considered in this review.

In an accompanying project (reported separately), a simple protocol has also been developed to assist voyage veterinarians during their investigation of mortalities during each voyage.

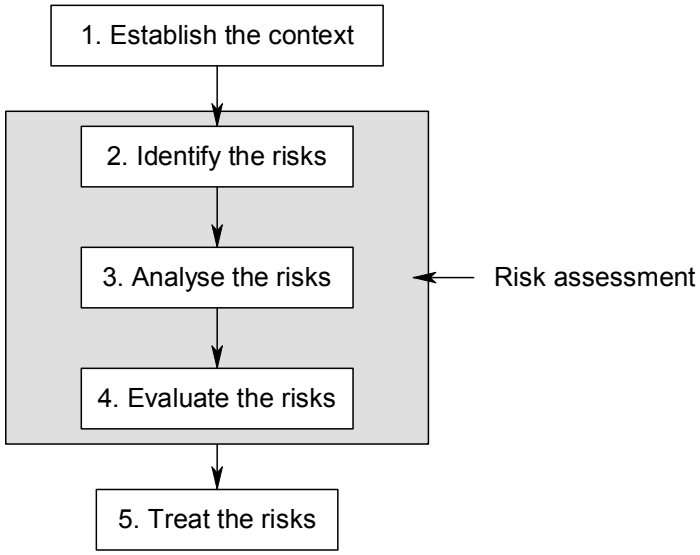
2. Risk identification and assessment

2.1 Introduction

This work has been conducted using accepted principles of risk management, which is a formal process for evaluating, managing, determining and communicating the impact of a risk. The process includes:

- Risk assessment answers the following questions: What can go wrong? How likely is the event to occur? What are the consequences if it occurs?
- Risk management is a pragmatic decision-making process aimed at the adoption of actions or policies to mitigate risk. It answers the key questions: *Should any action be taken, and if so, what action should be taken?*
- Risk communication, which allows the unambiguous exchange of information among relevant individuals or groups concerning any phase of the risk analysis process.

These stages are represented in the following framework from the Australian Standards AS/NZS 4360: 1999:



2.2 Risk identification

The mortality risks associated with live goat export have been identified using two different methods:

- Firstly, relevant literature was critically evaluated and detailed discussions were held with a number of key industry players. *Results of this evaluation are presented in Appendix 1.*
- Secondly, a retrospective evaluation of all live goat export voyages has been conducted between 20 September 2000 and 19 October 2002, with the aim to identify factors associated with high voyage mortality. *Results of this evaluation are presented in Appendix 2.*

As indicated in Appendix 1, factors relating to increased mortality risk during the shipboard phase of live export are present at each of the preceding stages of live export. They include:

a. Animals suitable for export (section A1.2)
- Breed, with unmanaged feral goats posing the greatest mortality risk
- Sex, particularly adult female goats
- Age, particularly older animals
- Condition score, with low condition score animals being unsuitable for export

b. On-farm preparation
- In general terms, standards of health and husbandry
- Specific to unmanaged ferals, management at and following capture and the subsequent domestication process

c. Management during feedlotting
- The general standard of management during transport from the property-of-origin to the feedlot
- The general standard of management during feedlotting, and particularly practices that would impact on potential health problems (such as salmonellosis and pneumonia)
- The management of non-feeders
- The management of dominance behaviour

d. Management on-ship
- Length of voyage
- Stocking density
- Deck configuration
- Nutrition, particularly with respect to roughage
- The management of dominance behaviour

The retrospective investigation was undertaken using data routinely collected by LiveCorp. This investigation considered all live export voyages from Australia with at least 300 goats during the period between 20 September 2000 and 19 October 2002. During this period, there were 107 voyages with an average voyage mortality rate of 1.63%. This distribution is substantially right skewed, with the mortality rate remaining below 1.0% during 54 (50.5%) voyages, and exceeding 2% on 21 (19.6%) voyages. Risk factors for voyage mortality were identified by comparing voyages with high (that is, equal to or greater than 2%) and low (less than 2%) levels of voyage mortality. The results from these analyses are in general agreement with current knowledge. The key results indicate that the voyage mortality rate tends to be higher on long-haul voyages to non-southeast Asian ports. Because the daily mortality rate was similar regardless of destination, it is concluded that the increased mortality rate on long-haul voyages is a direct result of increased voyage length. Clearly, risk management is particularly critical on long-haul voyages.

2.3 Risk assessment

2.3.1 Methodology

Following the identification of risk factors for voyage mortality, it was then necessary to assess each of these factors in terms of their likelihood and consequence. This step is critical, providing the potential to maximise the effectiveness of any subsequent risk management plan. Logically, risk management will be most effective if applied to those factors that are assessed to be of significant likelihood and consequence.

Risk assessment can be either qualitative or quantitative. Due to the nature of available data, the current assessment has been conducted in a semi-quantitative manner, with verbal expressions being used to describe the level of certainty concerning the risk assessment and the strength of association between the factor and mortality risk.

The following criteria were used to assess each of the risk factors that had been identified previously:

A. The source(s) of evidence that were available to support the assessment*, including:*
- extrapolation from accepted biological principles;
- anecdotal information from industry; and/or
- evidence from scientific publications

B. The level of certainty concerning the assessment, based on available evidence:
- 1 – very low *(based on available evidence, there is very little certainty regarding the accuracy of the assessment)*
- 2 – low *(there is little certainty regarding the accuracy of the assessment)*
- 3 – moderate *(there is moderate certainty regarding the accuracy of the assessment)*
- 4 – high *(there is a high level of certainty regarding the accuracy of the assessment)*
- 5 – very high *there is a very high level of certainty regarding the accuracy of the assessment)*

C. The likelihood of an event or practice *(that is, how common is this event during the live export process?)*
- 1 – very uncommon *(based on available evidence, this event is very uncommon during the live export process)*
- 2 – uncommon *(this event is uncommon during live export)*
- 3 – moderately common *(this event is moderately common during live export)*
- 4 – common *(this event is common during live export)*
- 5 – very common *(this event is very common during live export)*

D. The consequences of the event or practice *(that is, if the event were to occur or the practice were to be adopted, what would be the impact on mortality during the live export process?)* This can be considered equivalent to an estimate of the epidemiological strength of association between the factor and mortality risk:
- 1 – very low *(if this event were to occur, the impact on mortality during the live export process is most likely to be very low)*
- 2 – low *(the impact on mortality is likely to be low)*
- 3 – moderate *(the impact on mortality is likely to be moderate)*
- 4 – high *(the impact on mortality is likely to be high)*
- 5 – very high *(the impact on mortality is likely to be very high)*

2.3.2 Results

Table 1 provides a summary of the final semi-qualitative risk assessment, and has been constructed using the assessment criteria described in the previous section and data from Appendices 1 and 2. Using *'inclusion of unmanaged feral goats'* as an example, Table 1 is interpreted as follows:
- *Sources of evidence* for this assessment include 'extrapolation from accepted biological principles' and 'anecdotal information from industry'. No 'evidence from scientific publications' is available
- The *level of certainty* or accuracy of this assessment has been considered 'very high' (5), based on available evidence
- *Likelihood:* this event is considered very common (5) during live export (that is, unmanaged feral goats form part of most live export consignments)
- *Consequences:* if this event were to occur, the impact on voyage mortality is likely to be very high (that is, when unmanaged feral goats are present in a consignment, there is an increased risk of increased voyage mortality)

In summary, unmanaged feral goats significantly increase the risk of mortality for many of the consignments within this trade. Consequently, there would be significant benefits to industry if this risk factor could be effectively managed.

On the basis of this assessment process, *the most important risk factors for voyage mortality* (that is, those with likelihood and consequences each being equal to or greater than 4) are:

- inclusion of unmanaged feral goats;
- capture management below best-practice (for unmanaged goat populations);
- inadequate pre-feedlot domestication (for unmanaged goat populations);
- shelter problems during feedlotting;
- inclusion of older bucks;
- inclusion of sexually mature does;
- inadequate management of dominance; and
- length of the on-sea voyage.

A matrix presenting likelihood versus consequence for identified risk factors is presented in Figure 1.

3. Risk management

3.1 Principles underpinning the risk management plan

As stated previously, government has clearly stated that industry must ensure that *'voyage mortality rates below 2% are consistently achieved'*. In order to achieve this outcome, and on the basis of work presented throughout this document and summarised above, there are a number of 'principles' that must underpin any plan to successfully manage mortality risk during live goat export, as follows:

- Because goat management is a biological system, it is not possible to manage risk with complete certainty. While no guarantees are possible, it should be possible to deliver an outcome where *'there is minimal likelihood that voyage mortality rates meet or exceed 2% on any one voyage'*
- Although there has been substantial improvement to the voyage mortality rate in recent years, much of this progress can be attributed to changes to the demographics of shipped goats. Because most shipments now carry low-risk animals (those that are young and weighing between 22 and 40 kg), there are unlikely to be further improvements without industry attention to other known 'risk factors'. Therefore, further improvement towards the desired outcome will only occur if there is significant change from the *status quo*
- There is a higher risk of incident voyages during long- as compared with short-haul voyages. Consequently, more rigorous risk management will be needed on long- as compared with short-haul voyages to achieve equivalent levels of risk
- Although there has been ongoing improvement, there remains a need for considerable further improvement before the government requirement can be met. Given the 'distance' between the current and desired situations, it is likely that the risk management plan will need to simultaneously address all of the above-mentioned 'important risk factors'. A key theme in this list concerns the type of animals presented for export and the management of these animals prior to arrival at the feedlot.
- There must be an economic advantage in support of best-practice. For example, at present there is little-to-no economic benefit for suppliers of managed as opposed to unmanaged feral goats for live export.
- There must be processes in place to ensure compliance with best-practice. For example, the strategies would need to result in consistent improvement in the standard of management of captured feral goats prior to feedlotting.

3.2 Risk management strategies

The following recommendations are made, after taking into account the identified risk factors, desired reduction in mortality risk and economic impact on both producers and exporters.

3.2.1 Animals suitable for live export from Australia

3.2.1.1 Feral goats

On voyages of 10 days or more duration *(long-haul voyages),* captured feral goats should not be selected for export. Only goats that have been in a managed production system since birth should be exported on long-haul voyages.

On voyages of less than 10 days *(short-haul voyages),* captured feral goats should not be selected for export live from 1 January 2005. During the phase-out period to 1 January 2005, captured feral goats should only be selected for export on short-haul voyages if they are accustomed to people, and relatively stress-free in their presence, and are used to eating and drinking from troughs at the time of arrival at the pre-export assembly depot.

Under a managed production system, goats can be identified by property-of-origin and have been husbanded (or managed) throughout their lives. In the eastern states, management is generally conducted *'behind wire'*. In contrast, stock control in pastoral WA is often achieved using a system of yards at permanent watering points.

The phase-out period for captured feral goats on short-haul voyages recognises that in WA about 90% of the goats available for export are goats of feral origin, derived from an unmanaged production system. On-farm investment and management change is needed to meet the proposed live export requirements.

The system of selection and management at both the domestication site and pre-export assembly depot must be documented and auditable.

3.2.1.2 Feral bucks

Goat bucks of feral origin should not be selected for export if they have a full mouth of permanent incisor teeth.

3.2.1.3 Goat does

There have been significant problems, mainly relating to spontaneous abortion, with the export of does from Australia. Although pregnancy testing can reduce this risk in mature does, testing is an additional stressor and its accuracy can be low when large numbers are being tested. Although this risk is removed in animals prior to sexual maturity, detailed information linking sexual maturity and bodyweight in Australian feral does is currently lacking. For these reasons, it is recommended that goat does should not be selected for export as slaughter animals.

3.2.2 Management on-ship

3.2.2.1 Target voyage mortality rate

The overall voyage mortality rate (covering the period from loading on-ship to subsequent unloading) should not exceed 2.0%. As indicated below, an expert investigation will be conducted on each occasion where the voyage mortality rate exceeds 2.0%.

3.2.2.2 Penning at sea

Goats exported by sea should be penned on the ship in lines, with the liveweight range in each line of goats not exceeding 10kg.

Where possible, does and entire bucks should not be held on the same deck during export. However, this may be difficult to achieve on ships carrying both cattle and goats. In these situations, it is critical that goats are loaded in areas of the ship that will remain dry during cattle wash-downs, and other strategies may be needed to ensure that does and entire bucks cannot mix during the voyage.

Where possible, goats should be penned on the vessel in single-tier pens.

3.2.2.3 Shipboard fodder

The shipboard fodder provided for goats exported by sea should include at least 200 gms / head / day of chaff and/or hay.

3.2.3 In general

3.2.3.1 Use of antimicrobial agents

Oral antimicrobial agents must not be used prophylactically (as a preventive measure to apparently-health animals) unless prescribed by a veterinarian.

3.2.3.2 Mortality investigations

All mortality incidents (consignments with a voyage mortality rate of more than 2%) should be expertly investigated, to identify the cause and enable a continuous improvement in the health and welfare of goats during live export. These investigations should consider all stages of export, including capture, domestication, transport, feedlotting and export. Where possible, they should involve relevant government veterinarians, rangers and livestock advisors, and should provide detailed feedback to all relevant industry players. There may be an additional requirement regarding pre-voyage period mortality, depending on the results of the current ALES review (see below).

3.2.3.3 Sunset clause

Another critical and independent evaluation of the live goat export industry should be undertaken within three years of this report, to assess progress and the need for further change in a developing industry.

3.2.3.4 Australian Livestock Export Standards

To enhance compliance with the recommendations listed above, we strongly recommend that they are embedded in the *Australian Livestock Export Standards,* and therefore in the quality assurance program for each live goat exporter.

3.2.4 Other issues

In addition to the issues listed above, the following matters need further consideration by industry and government:

- The Australian Livestock Export Standards (ALES) are currently being changed from a practice-based to an outcome-based standard. As a consequence, and with an increased interest in health and welfare outcomes throughout the export process, it is anticipated that there may soon be a requirement for industry to monitor mortality rates prior to shipping (covering the period from time of departure from the farm/station/property-of-capture to loading on-ship) as well

as during the shipping period. Current pre-voyage mortality rates during live goat export are currently unknown. For comparison, average pre-voyage mortality rates during live sheep export are approximately 0.26% (More, 2002a).

- Goats are very susceptible to cold stress. For a range of reasons, and particularly the timing of Ramadan and the hajj, most goats are currently being exported through southern Australia during summer months. However, because these religious festivals are based on the lunar calendar which is approximately 10 days shorter rather than the Gregorian calendar, the demand for goats will progressively be brought forward with each passing year. Therefore, increasing efforts will need to be paid as the years progress to the prevention of hypothermia in goats exported from southern Australia.

- As detailed in the report proper, there are a number of health and welfare issues associated with the live shipment of entire bucks. These issues are all resolvable, but only with detailed attention to risk management through all stages of export. There are significantly fewer risks associated with the live export of castrated male animals (wethers). Because there are varying standards in risk management throughout the industry, and as part of the recommended move away from unmanaged goat production, the industry should consider a progressive reduction in the proportion of goats exported as entire males. These animals would be replaced with male goats castrated prior to reaching sexual maturity. The authors recognise current constraints to change, given the current preference for entire bucks in most of Australia's live goat export markets.

- There is very limited information concerning fibre requirements and optimal pen heights and animal densities during live goat export. Further research in these areas would be warranted. Concern has been raised that heavy animals have proportionately less space than lighter animals under the current ALES recommendations. Currently there are no objective data concerning penning requirements. However, it should be noted that there is currently a requirement under ALES for the minimum pen area per head to be increased by 10% for goat bucks. Furthermore, under the Saudi Livestock Export Program (SLEP) goats are allowed 10% and 15% more pen space per head when shipped during the northern winter and summer months, respectively.

- Veterinary reports of voyage mortalities during live export have been of variable quality. In order to improve the value of these reports to the broader industry, a document has been developed entitled 'Veterinary investigation of mortalities during live animal export' (More, 2002c). It is recommended that industry require a detailed report, following the guidelines outlined in this document and within 7 days of voyage end, from all veterinarians accompanying live animal export voyages from Australia.

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Table 1. A semi-quantitative assessment of factors likely to increase the risk of mortality during live goat export from Australia. The criteria for this risk assessment (source(s) of evidence, level of certainty, likelihood and consequences) are explained in the text.

Identifying number	Practice or event	A. Source of evidence: General principles	A. Source of evidence: Anecdotal information	A. Source of evidence: Scientific evidence	B. Level of certainty	C. Likeli-hood	D. Conseq-uences	Comments
	Selection of animals for export							
1	Inclusion of unmanaged feral goats	x	x		5	5	5	A recognised contributor to mortality risk
2	Inclusion of unscanned does	x	x		5	1	5	Not permitted by AQIS
3	Inclusion of older billies	x	x	x	5	4	4	
4	Inclusion of animals with body score 1	x	x	x	5	1	5	Not permitted by AQIS
5	Inclusion of below-weight goats	x	x		5	2	4	
6	Inclusion of goats with pre-existing disease or injury	x	x		4	1	4	Not permitted by AQIS
	On-farm preparation							
	In general							
7	Failure to fully-complete AQIS health requirements	x	x		4	3	3	Incl. vacc., treat for int./ext. parasites
	Relating to unmanaged populations							
8	Capture management below best-practice	x	x		5	4	4	A recognised contributor to mortality risk
9	Inadequate pre-feedlot domestication	x	x	x	4	4	5	A recognised contributor to mortality risk
	During feedlotting							
	During transport							
10	Transport management below best-practice	x	x		4	3	4	Includes problem of chilling
	During feedlotting							
	Feedlot management	x	x					
11	Problems with management of water	x	x	x	5	3	4	
12	Problems with management of feed	x	x	x	5	3	4	
13	Shelter problems	x	x	x	5	4	5	
14	Inadequate management of dominance	x	x	x	5	4	5	

	Management on-ship							
	Concerning the overall voyage							
15	Port of loading	x	x	x	4	5	2	See Appendix 2
16	Length of voyage	x	x	x	5	5	5	See Appendix 2
17	Port of unloading	x	x	x	4	5	2	See Appendix 2
	Concerning the ship and livestock accommodation							
18	Excessive stocking density	x	x		3	3	3	Aspects of this issue remain uncertain
19	Use of double-tiered pens	x	x		4	5	3	Aspects of this issue remain uncertain
20	Insufficient dietary fibre	x	x	x	3	3	4	Aspects of this issue remain uncertain
21	Inadequate management of dominance	x	x	x	5	4	5	A recognised contributor to mortality risk
	Post-arrival management							
22	Feedlot management below best-practice	x	x	x	5	3	5	

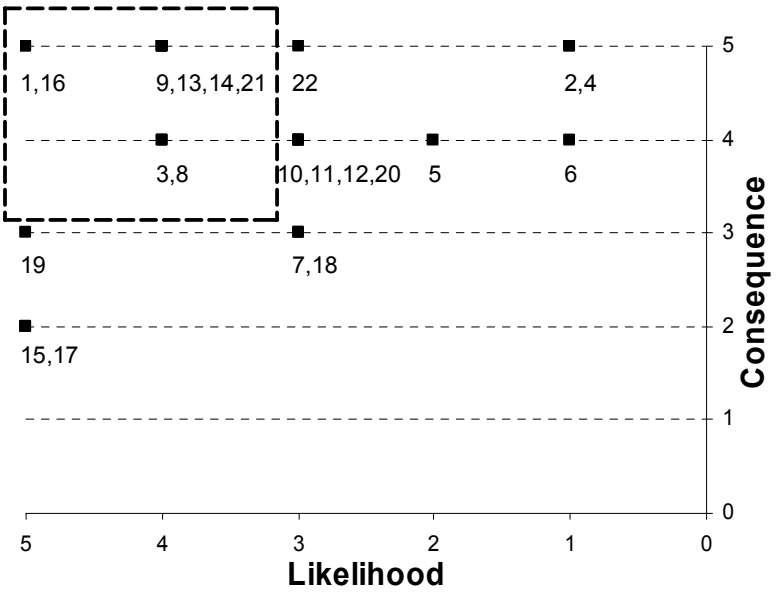

Figure 1. Diagrammatic presentation of the semi-quantitative assessment of factors likely to increase the risk of mortality during live goat export from Australia. The most important risks (those considered both likely and of consequence) are highlighted by the box and include inclusion of unmanaged feral goats (1), inclusion of older billies (3), capture management below best-practice (8), inadequate pre-feedlot domestication (9), shelter problems during feedlotting (13), inadequate management of dominance during feedlotting (14) and on-ship (21), and the length of the on-sea voyage (16).

Appendix 1: Risk identification and assessment - a detailed review

A1.1 Introduction

The following section summarises key issues relevant to the health and welfare of goats during live export from Australia. This review has been developed following a critical evaluation of literature and detailed discussions with key industry players, and identifies and assesses the risks associated with mortality during live goat export. This information, in association with results from the retrospective analysis of previous voyages (Appendix 2), provides the basis for an informed risk management plan, as presented in the main part of this report.

A1.2 Animals suitable for live export from Australia

A1.2.1 Breed, with particular attention to feral goats

A1.2.1.1 Background information

Feral goats are common in many pastoral areas of Australia, and particularly the semi-arid pastoral areas of Western Australia, western New South Wales, and central and south-western Queensland (Southwell and Pickles, 1993; Southwell et al., 1993; Land Protection, 2001). In Western Australia, feral goats are mainly located in arid and semi-arid rangelands of the Pilbara (of the southern rangelands), Gascoyne and Mid-West. Recent surveys have suggested that feral goat populations may be increasing (Southwell and Pickles, 1993; Southwell et al., 1993), and on current estimates there are approximately 2.3 million animals nationally. Goat populations have the potential to double every 1.6 years, and will only remain stable if 35 percent of animals are removed annually (Land Protection, 2001).

Although landholders have variously considered the feral goat as a pest or resource, depending on their value at the time (Land Protection, 2001), in recent years there has been a significant increase in goat meat exports in line with increasing international demand. Significant numbers of feral animals are now harvested each year, either for slaughter or live export, and Australia is currently the world's largest exporter of goat meat (Goat Industry Council of Australia and Meat & Livestock Australia, 1999). In Western Australia, during the three years to mid-2002, 670,830 (81.4%) goats were processed at abattoirs and 152,818 (18.6%) goats were sent for live export[2].

Over the last three years there has been a significant shift in goat production systems in Western NSW, with harvesting of feral goats replaced by goat farming. This change has occurred in part because alternative uses for some areas (wool, cattle, and/or cropping) are not economic or environmentally sustainable as goats. Change in the Western Division of NSW has been greatly accelerated with government support for on-farm investment in fencing, handling facilities and other infrastructure for farming goats. Increasing goat prices have also encouraged the shift to managed goat production systems.

Goat production in the pastoral areas of Western Australia is still based largely on trapping feral goats. In Western Australia, an estimated 10% of feral goats are now managed within domesticated enterprises on the rangelands[3].

[2] Bob Nickels, Department of Agriculture Western Australia (email, 19 December 2002)
[3] Tim Johnson, Department of Agriculture Western Australia (phone conversation, 4 December 2002)

There have been significant programs to upgrade the Australian meat goat industry, particularly following the introduction of the South African Boer goat (Goat Industry Council of Australia and Meat & Livestock Australia, 1999). Other meat goat breeds, including the Condobolin, have also played a role in flock upgrading (Murray, 2003). At this stage, the number of intensively farmed, domesticated goats in Australia remains relatively low. However, in the Eastern states, there is now a significant pool of farmed goats of feral origin. These goats have been born behind wire, and managed intensively from birth. It is likely that goats of feral origin will form a significant part of all large live export consignments for at least the next few years, and that over time the proportion of Boer crosses will steadily increase (Brightling, 2001).

> *Goats of feral origin will form a significant part of all large live export consignments for the next few years. The number of Boer cross goats available for live export is steadily increasing.*

A1.2.1.2 The management of feral goats

The majority of goats exported live from Australia are goats of feral origin. There are a number of feral goat management systems, including unmanaged feral goat production, farmed feral goat production and farmed feral goats production with genetic upgrading.

> *Although there is some overlap between categories, the three main management systems for feral goats are unmanaged harvesting, farmed goats of feral origin and farmed goats of feral origin with genetic upgrading.*

No quantitative data is currently available to critically assess the impact of these various management systems on goat performance during live export. Nonetheless, there is consistent anecdotal evidence to support improved performance from farmed feral goat populations[3,4,5].

> *Based on consistent anecdotal evidence, the performance of feral goats during live export is substantially improved if animals are drawn from farmed rather than unmanaged goat populations.*

The interest in farmed goat production has been fuelled, at least in part, by the improved performance of this class of animal during live export. In Western Australia, there is an increasing demand for farmed goats, translating into a modest premium for producers at sale[3]. Furthermore, using a 'born behind wire' clause in contracts to vendors, over the last twelve months unmanaged goats have been excluded from export to Saudi Arabia.

a. Unmanaged feral goat production

According to Blood (2002), *an unmanaged goat*:
- Exists essentially in a feral state with no permanent means of routine control;
- Has the potential to compete for grazing with other stock (sheep and cattle);

[4] David Blood, Department of Agriculture Western Australia (phone conversation, 3 December 2002)
[5] Greg Curran, NSW Agriculture (phone conversation, 12 December 2002)

- Creates unacceptable impacts on preferred native vegetation types;
- Has access to all parts of the lease [property]; and
- Is opportunistically harvested.

Until recently, the supply of feral goats for live export was mainly based on opportunistic harvesting from unmanaged populations, either by mustering or trapping at water points. Although there has been increasing interest in other management systems, unmanaged feral goats still represent at least 90% of all feral goats in Western Australia[3] and an estimated 40% of feral goats in Queensland[6].

> *Approximately 90% of goats in WA and 40% in Queensland are derived from unmanaged production systems.*

There are a range of conditions known to infect or infest grazing feral animals, including caseous lymphadenitis, pneumonia, cysticercosis, external parasites (including *Damalinia caprae, Linognathus stenopsis* and *Psoroptes* sp.), a range of helminths, sarcosporidiosis and Q fever (Hein and Cargill, 1981; Anderson and Nairn, 1985; Batey et al., 1986; Beveridge et al., 1987). In general, however, these conditions are minor, and feral goats are generally in good health and adequate body condition at the start of the export process (Hawkins, undated). However, following entry to the live export process, a range of problems emerged including mortality, weight loss, clinical disease (including salmonellosis and coccidiosis) and inappetence (Hawkins, undated). Unmanaged feral goats are generally unaccustomed to handling by people at the time of capture, which is believed to significantly exacerbate these problems.

> *Although generally healthy at capture, unmanaged feral goats are at significant risk of experiencing a number of health and welfare problems during the live export process if appropriate management procedures are not instigated.*

b. Managed feral goat production

In recent years, there have been major changes within the goat industry, and managed goat production is now widely practised throughout the western division of NSW. NSW Agriculture has played an important advisory role during this transition[5]. According to Greg Curran, managed goats are much better able to adapt to all stages of live export, including handling, feedlotting, transport and shipping.

> *In NSW, managed goat production is practiced widely throughout the western division.*

The goat domestication program has also been an important initiative of the Department of Agriculture in Western Australia, and managed feral goat production is now being practiced with about 100,000 goats on approximately 25 pastoral leases in this state[7]. Although the management approaches vary from property to property, all utilise a permanent trapyard system for improved management control of these populations. Other common features of farmed goat production include goat-proof fencing, permanent yards and efforts to manipulate herd structure, including the removal of older billies (Blood, 2002). With improvements to

[6] Tony Mills, Department of Primary Industries, Queensland (phone conversation, 5 December 2002)
[7] David Blood, Department of Agriculture Western Australia (phone conversation, 29 November 2002)

infrastructure, producers have increased flexibility to meet live export requirements, including increased options in dealing with out-of-specification animals[8].

Managed goat production has been constrained by a range of factors. In several states, including Western Australia and South Australia, the adoption of management systems for feral goat production is significantly hampered by state legislation. In Western Australia, feral goats are considered a non-approved species in rangeland areas[9]. In addition, there have been practical difficulties associated with the differentiation of unmanaged and farmed goat populations. Because farmed goat production is highly variable and represents a broad spectrum of management systems, the interface between farmed and unmanaged systems is not consistently clear. This difficulty has been addressed to some degree by Blood (2002) who suggests that *a managed goat*:

- Is run according to a plan that includes documented processes for monitoring, stock control, drought and recording;
- Is able to be *routinely* controlled by strategic fencing and/or permanent (…) yards to provide effective control;
- Does not cause obvious impacts on native vegetation;
- As a guiding principle, are run as a single-species herd;
- Is ear-tagged or marked;
- Are contained by effective fences (electric or prefabricated) (…); and
- Are run as a herd with a managed number of bucks (generally less than 10%).

To ensure compliance with minimum standards, it is critical that management systems are demonstrable, documented and audited by relevant authorities[9].

In the commercial world, a farmed goat is generally considered to be one that has been *'born behind wire and reared since birth'*. However, the level to which animals are domesticated depends on a wide range of factors, including the size of the relevant paddock(s) and the frequency of handling. Unfortunately, the term *'born behind wire and reared since birth'* is open to wilful misinterpretation. Because most of the Western Division of NSW is fenced, most feral animals could easily meet this definition, despite being born behind someone else's fence[10].

> *The practical differentiation of unmanaged and farmed goat populations remains somewhat problematic. In eastern states, current industry standards have been based on a concept of 'born behind wire and reared since birth'.*

The SLEP Standards[11] provide a valuable model of quality assurance within the live export trade. These standards have been developed to ensure that industry, government and customer expectations are fully met in relation to the export of Australian live sheep and goats to Saudi Arabia. As part of this quality assurance program and relevant to the above-mentioned concerns, there are requirements that:

- the SLEP Goat Vendor declaration is signed by someone with direct knowledge of the domestication status of the animals presented for export to Saudi Arabia;
- Each Exporter must ensure that trapped feral goats are not exported to Saudi Arabia. Only farmed goats (born behind wire and reared since birth) are eligible for export to Saudi Arabia.

The QA program is comprehensive and covers a wide range of issues.

[8] Bob Nickels, Department of Agriculture Western Australia (phone conversation, 6 December 2002)
[9] Bob Nickels, Department of Agriculture Western Australia (phone conversation, 18 February 2003)
[10] Greg Curran, NSW Agriculture (emailed comment, 14 February 2003)
[11] LiveCorp, 06MAY02

The Saudi Livestock Export Program (SLEP) provides a valuable model of quality assurance within the live export trade.

c. Genetically upgraded feral goat production

Since their introduction into Australia in 1994-95 (Anon., 2002), there has been significant interest in the use of South African Boer goats to upgrade managed feral goat populations. Based on detailed research conducted by the Queensland Department of Primary Industries, a Boer upgrading program brings significant practical benefits to producers. In comparison to domesticated feral animals, Boer-feral cross goats have improved growth performance, but without an adverse effect on reproductive performance or carcass characteristics (Mills, 2002). In addition, the Boer/feral cross animals are preferred by overseas importers and currently command a premium for producers of $5/head[3]. It is estimated that upgrading programs are practiced in half of the managed goat populations in Western Australia, particularly those with high standards in stock management[3].

There is no published information concerning the performance of these animals during live animal export. Nonetheless, there is good anecdotal evidence that mortality risks in farmed goat populations are further decreased with an upgrading program. Because Boer goats are a docile animal, the Boer/feral cross is generally less likely to be affected by stress-related problems during live export. Furthermore, under similar conditions crossbred animals would be expected to be both heavier, younger and in better condition score than feral animals under equivalent conditions, making them more resilient to the stresses of export.

Boer/feral cross animals are a lower mortality risk during live export than feral goats, either unmanaged or farmed.

A1.2.2 Sex of goats

Australian feral goats exhibit only a moderate degree of seasonality in breeding, and the period when does are seasonal anoestrus can be overcome by factors such as the nutrition of the male and the buck effect on the female (Walkden-Brown, 2002). Consequently, in many areas feral does do not appear to have a defined breeding season (Land Protection, 2001). Furthermore, does are capable of conception at 6 months of age, provided body weight is more than 15 kg.

Given the dominant role of the corpus luteum throughout pregnancy, does are particularly susceptible to pregnancy loss following stressful events, including temporary starvation, cold or heat stress, nutritional stress and psychological stress (Baxendell, 2002). Many of these events are common during live export.

Significant problems with this class of animals were encountered during live export in the 1980s, including mortalities and abortion, and the export of female goats by sea is not permitted without specific AQIS approval (Doyle, 1992; Blood, 2002). Shipments of female goats approved by AQIS are generally limited to breeding goats and slaughter goats that have been scanned empty[8].

Pregnancy scanning requires additional handling and hence stress on the goats concerned. With current technology, it is not possible to detect pregnancies during the first month of gestation with any confidence.

Brightling (2001) recommends that female goats are not exported in shipments to Saudi Arabia. This recommendation was based partly on the problems associated with managing pregnancy during the export process and partly on religious concerns in the customer country about the slaughter of pregnant female animals.

> *There have been significant problems associated with the live export of does from Australia.*

A1.2.3 Age of goats

As a general rule, Middle East markets demand a lighter, younger animal (25-35 kg in weight)[8], with peak-demand coinciding with religious festivals. In the past, there has been a strong market preference for entire bucks with full horns. However, market requirements are changing. The 2003 hajj contract allows a proportion of wether goats, and because they are easier to manage, there is an exporter preference for goat wethers. Peak demand for live export goats in Malaysia also coincides with religious festivals. The Malaysian market mainly requires heavier, older goats in the 35-55 kg weight range, but demand has also emerged for younger, lighter 25-35 kg animals[8].

During detailed studies with short-haul voyages in the early 1990s, Hawkins found that older bucks were overrepresented among deaths during live export. On most voyages, this trend was apparent with full-mouth animals, although similar trends were apparent in 6-tooth bucks on some voyages. It has been suggested that older bucks, particularly from unmanaged systems, are less able to adapt to confinement and high stocking densities associated with live export (Hawkins, undated). During the last 2-3 years, shipments from Western Australia have included a larger number of younger bucks due to population changes in the rangelands.

> *Mortality risks during live export increase with increasing age of male animals.*

A1.2.4 Condition score

In general, animals dying during export are generally of low condition score (Hawkins, undated). In these circumstances, as suggested by Hawkins, it is not always possible to determine whether the condition loss preceded the immediate cause of death, or whether weight loss was the result of some other disease process which caused the goats to stop eating. Regardless, it is clear that animals in low body condition (body score 1) are less able to withstand the rigours of export and should be excluded prior to leaving the farm of origin. Under current AQIS regulations, these animals are not permitted to be exported[2].

> *Animals in poor body condition (body score 1) are unsuitable for live export.*

A1.3 On-farm preparation

A1.3.1 General issues relating to health and husbandry

Based on current AQIS requirements, goats must be in a strong healthy condition at the time of presentation for export (Doyle, 1992). In addition, the AQIS requirements state that animals must:

- Have been weaned for at least 21 days;
- Be either polled or have horns that will not interfere with eating or drinking or cause undue danger to other animals;
- Have attained a minimum weight of 18kg for export by sea;
- Have a sound mouth; and
- Be free from evidence of disease and injury.

There is also an AQIS requirement that goats are vaccinated against enterotoxaemia and tetanus and treated for internal and external parasites at the start of the domestication period (Doyle, 1992). However, in practice, these latter procedures are often not done[8].

> *Exporters must meet a range of AQIS requirements concerning on-farm preparation, including a requirement that goats are healthy at the time of presentation for export.*

A1.3.2 Additional on-farm preparation specific to unmanaged goat populations

A1.3.2.1 Management practices at the point of capture

In unmanaged goat populations, there are significant welfare issues associated with the capture of goats[12] (Johnson, 2001). Detailed management strategies, based on common sense, have been developed by the Department of Agriculture in Western Australia to address these concerns (Johnson, 2001), including:

a. During capture

- Conducting mustering when conditions are cool and mild and at the pace set by the tail end of the mob
- Providing 24 hours rest, with food and water, before embarking on journeys of longer than 8 hours
- Holding animals in yards that are shaded and where crowding can be avoided
- Minimising the use of dogs

b. Following capture

- Checking the animals daily
- Humanely destroying animals that do not adapt to confinement, including those that do not eat over a period of 3-4 days
- Providing readily-accepted feed, such as natural scrub and other roughage
- Ensuring that all goats have ready access at all times to water

> *Detailed attention to management is needed, both during and following capture, to safeguard the welfare of wild-caught goats.*

[12] These welfare issues arise due to the possibility of capture myopathy, collapse and sudden death following long-distance pursuit or muster, chronic lameness following injury, injury as a

A1.3.2.2 Domestication

a. The purpose of domestication

The transition from feral to domestic life is generally considered the weakest link in the export chain (Brightling, 2001). Feral goats can become highly stressed during any form of handling or constraint, which can lead to significant mortality problems both prior to and during live export. These changes have been measured physiologically (Greenwood and Shutt, 1992; Nwe et al., 1996; Kannan et al., 2000). A range of stress-related diseases, including inappetence, dehydration and salmonellosis, have been described (Brightling, 2001), and capture myopathy, an additional stress-related problem of wild sheep and goats (Jessup, 1999), could conceivably also be important.

In order to minimise stress-related problems, it is accepted that unmanaged feral goats must receive adequate handling through a process of 'domestication' prior to export (Mitchell, 1988). In general terms, domestication can be defined as the process where an animal is transformed from a life in the wild to a life under some control of humans (Jensen, 2002). Similarly, a 'domesticated' goat could be defined as one that is able to survive and be healthy in an managed environment[10]. There have been several interpretations of this process, which is a mandatory AQIS live export requirement (Doyle, 1992), including:

- The working of animals within yards on a fairly regular basis, including drafting, drenching and weighing (Mitchell, 1988);
- Activities that 'train animals to eat and drink from troughs and accustom them to being handled' (Doyle, 1992); and
- A process to enable feral goats to adapt to new circumstances and conditions (Hawkins, undated).

Hawkins has expressed concern about the ill-defined nature of 'domestication' and emphasises that it is an *active* process enabling goats to adapt rather than a *passive* process of confinement (Hawkins, undated).

> *The purpose of domestication is to allow feral goats, and particularly those recently harvested from unmanaged production systems, to actively adapt to the new circumstances and conditions associated with the live export process.*

b. The stages and location of the domestication process

There remains some uncertainty with aspects of the domestication process, prompting both Hawkins (undated) and Brightling (2001) to suggest that minimum standards for the domestication of feral goats are urgently needed.

There is general acceptance of the need for a two stage process, particularly following the capture of unmanaged goat populations. Within the AQIS protocol, goats are required to undergo a domestication period prior to export, including a period in an approved domestication premises followed immediately by a further period in a registered pre-embarkation premises (Doyle, 1992). In order to accustom feral goats to normal farming practices, it has generally been recommended that domestication is undertaken in the region where goats are captured (McDonald, 1998; Brightling, 2001).

There is general adoption of the domestication process among industry. According to Nickels[8] and relevant to live goat exports from Western Australia, unmanaged feral goats are generally

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result of fighting, bruising and injury caused by rough capture techniques and poor handling facilities, chronic illthrift and stress-related infection.

held 'on-hand' for several weeks in the locality where they had been captured[8]. In many cases, animals are contained in paddocks with continued access to browse. Subsequently, they are trucked to a holding depot, within reasonable proximity of the port of loading, for 5-7 days prior to loading on-ship.

> *It is generally recommended that goats remain within the region of capture for a significant adjustment period before trucking to the pre-embarkation feedlot.*

c. The duration of the domestication process

In broad terms, there is agreement concerning the overall length of the domestication process. Brightling (2001) suggests 'at least two weeks domestication is needed for feral goats to overcome the stress of capture and transportation and become accustomed to eating and drinking from troughs and to being handled'. This recommendation is in general agreement with both an earlier industry suggestion of 3 weeks (Mitchell, 1988) and the current AQIS requirement for a 21 day domestication program (including a minimum of 16 days in an approved domestication premises followed immediately by 5 days in a registered pre-embarkation premises) (Doyle, 1992).

The first stage of domestication: on-farm preparation of wild-caught goats from unmanaged populations

Although not stated in the AQIS protocol, it is assumed that this stage relates only to unmanaged goat populations. At this point, there is no quantitative information concerning the optimum duration of the initial period of domestication. Although a total of 16 days is suggested in the AQIS protocol, this issue has never been formally tested. According to Nickels[8], the latter feedlotting period is the more critical in terms of effective adaptation to live export. Furthermore, the value of the first stage of domestication is heavily influenced by the quality of management during this period.

The optimal duration of the first stage of domestication remain uncertain. However, it is clear that there should be a high quality of management during this period.

The second state of domestication: feedlotting

The second stage of feedlotting is undertaken for all goats destined for export, and is generally conducted near the port of loading and after the animals have left the region-of-origin. It will be considered later.

A1.4 During feedlotting

A1.4.1 Transport from the property-of-origin to the feedlot

Johnson (2001) describes best-practice relating to transportation of goats prior to live export.

A1.4.1.1 Prior to loading

- Ensure a minimum of 12 hours rest with food and water after mustering and prior to transport. On journeys of greater than 8 hours, this rest period should be at least 24 hours
- Avoid travelling in cold, rainy weather unless the crate is covered

Because goats are particularly susceptible to cold stress, Mitchell (1988) suggests that goats (and particularly feral goats) should be moved from pastoral areas to southern (export) points during warmer months only.

A1.4.1.2 During loading

- Avoid the use of prods electric and the use of trained dogs should be kept to a minimum
- Use well-designed crates and loading ramps and load animals at correct density
- Segregate where practical into lines of bucks, nannies and small animals

A1.4.1.3 During transport

- Aim to reach the destination by the quickest, least stressful means

There may be a need to mandate maximum periods of transport without feed or water, based on experiences where goats are routinely held in trucks for greater than 24 hours prior to loading at the ports of Port Hedland and Broome[8].

> *Detailed attention to management is needed, both prior to and during transport, to safeguard the welfare of goats intended for live export.*

> *Because goats are particularly susceptible to cold stress, particular care must be taken prior to and during transport to minimise the possibility of chilling.*

A1.4.2 Best practice during feedlotting

Johnson (2001) has summarised best-practice during feedlotting, based on experiences from Western Australia, including:

- Excluding old bucks (8 tooth or older) and very thin goats (low body score 1) from export
- Drafting bucks into age/size groups, and removing aggressive, dominant bucks to a separate area
- Identifying and separating non-feeders, or shy feeders, for closer attention
- Maintaining feedlot hygiene to minimise the spread of infectious disease agents
- Ensuring feed conforms to nutritional requirements of goats and that feed and water remain free of faecal contamination
- Ensuring that the domestication period is short and results in a reduced alarm response, reduced flight distance, acceptance of contact/handling by people and appropriate adaptation to pellet diets

> *Detailed attention to management is needed, both prior to and during transport, to safeguard the welfare of goats intended for live export.*

Based on comments from a number of attendees at the industry meeting on 11 February 2003, the prophylactic use of oral anti-microbial agents (that is, antimicrobials given as a preventative in apparently healthy animals) is widespread within the live goat export trade, particularly during feedlotting and on-ship. The use of antimicrobials in this manner is of significant concern for several reasons:

- There is ongoing concern about the use of antimicrobial agents in food producing animals, and its potential effect on human health. Of particular concern is the potential for antibiotic resistant bacteria in food-producing animals to be transferred to people (Barton, 1998). Resistance is more likely to develop when antibiotics are used at less-than-recommended doses, as might occur during oral medication in a feedlot situation.
- Based on advice at the industry meeting, antibiotics are generally being used in the face of problems with hygiene and/or management. It is reasonable to argue that sustainable improvement is only achievable if these fundamental problems are addressed.

- When antibiotics are used in this manner during feedlotting and on-ship, the treatment is likely to result in a delay in the onset of problems, with morbidity and mortality coinciding with the withdrawal of these products. Outbreaks of salmonellosis during sheep feedlotting are known to coincide with the withdrawal of antibiotics following an outbreak of pinkeye (More, 2002b).

It is imperative that oral antimicrobial agents are not used prophylactically in this industry.

> *Oral antimicrobial agents must not be used prophylactically (as a preventive measure to apparently-healthy animals) unless prescribed by a veterinarian.*

A part of a rigorous investigation of feral goats during live export from Australia, Hawkins (undated) investigated the effect of feedlotting on later performance during live export. Relevant findings from this work include:

- *A strong and significant linear relationship between mortality risk and duration of the domestication period.* When the domestication period increased beyond 10 days, there was a sharp and consistent increase in mortalities. These mortality increases were closely associated with increased shedding of salmonellae and coccidia, and increased losses from these two conditions. On the other hand, if domestication was very short (less than 5 days), although there was low acceptance of pellet rations during feedlotting, performance during the subsequent voyage was not impaired
- *Evidence of weight loss following entry to feedlots, particularly among young animals (those with temporary dentition).* However, young animals recover quickly after loading, with voyage mortality rates being lower than in older animals. Although there is If the domestication period is very short (less than 5 days), there is low acceptance of pellet rations

On the basis of these findings, Hawkins strongly suggests that a total period of 7-10 days in intensive handling facilities should be sufficient to domesticate goats that are suitable for export and accustom them to shipping rations.

> *The feedlotting of goats prior to live export should not continue for greater than 7-10 days.*

No data are currently available regarding mortality rates during the early stages of live goat export, although anecdotal evidence would suggest that these rates can be high. In sheep, an average mortality rate of 0.9 deaths per 10,000 animals during transportation to the feedlot has been reported (Norris et al., 1989). Similarly, during the pre-departure period (arrival at feedlot to loading on-ship), sheep mortality rates of 6.7 and 24.8 deaths per 10,000 animals have been reported, in shed- and paddock-based feedlots respectively (More, 2002a). Combining these figures, the pre-voyage mortality rate (covering the period from time of departure from farm-or-origin to loading on-ship) varies from 0.08% (through shed-based feedlots) to 0.26% (through paddock-based feedlots).

A1.4.3 Health problems associated with feedlotting (and shipping)

A1.4.3.1 General health problems

A range of health problems have been associated with live goat export. Data collected in the early 1990s by Hawkins (undated) and in 2001 by Brightling (2001) both suggest that salmonellosis and inanition were the main causes of death during feedlotting and on-ship. Deaths from inanition tended to diminish during shipping, but were important causes of death during feedlotting in Australia and at the port of destination. In contrast, enteric conditions

(and particularly salmonellosis) were a common cause of death at each stage of live export (Hawkins, undated). Other observed causes of death included pneumonia (particularly during shipping), coccidiosis, enterotoxaemia, phytobezoars and trauma. In trial shipments undertaken in 2001, scabby mouth is less of a problem in goats than sheep, and was rarely observed.

Most of the above-mentioned diseases relating to live export are multifactorial, and occur as a result of the interplay of a range of causal factors (Smith and Sherman, 1994). Similar problems are encountered in sheep during live export (More, 2002b). Stress is an important causal factor in most of these conditions, and there is general acceptance of the role of management (on-farm, during feedlotting and on-ship) as contributors to these conditions. Although some aspects of these conditions remain uncertain, best-practice in terms of management (as listed above) will assist with disease control.

> *Appropriate animal selection, adequate domestication and high standards of management on-farm, during feedlotting and on-ship will assist in reducing health problems during live export.*

A1.4.3.2 Management of non-feeders

In the 2001 trial shipments, non-feeding and other stress-related diseases, including inappetence, dehydration and salmonellosis, were a serious concern in feral goats after arrival at the export feedlot (Brightling, 2001). These problems were particularly acute among young animals with light body weights and limited fat reserves. In addition, and in contrast to live sheep exports, losses of goats during feedlotting were generally as high as subsequent losses at-sea (Brightling, 2001).

Some work has been undertaken investigating the impact of the composition and method of introduction of pellets on the failure of goats to eat during feedlotting. Results from this work, in agreement with similar sheep-related work (Norris and Richards, 1989), suggest that this is not a nutritional problem (Gherardi and Johnson, 1995). Adequate domestication appears to be central to satisfactory management of these stress-related problems. During the 2001 shipments, it is noteworthy that few of the feral goats had undergone a prior domestication program, but had previously grazed large paddocks with little human contact (Brightling, 2001).

> *Non-feeders can present significant problems during feedlotting, particularly among young animals from unmanaged feral goat populations that had not undergone a prior domestication program.*

A1.4.4 Dominance behaviour

Dominance behaviour within buck consignments is a significant problem leading to physical injury during export. The problem has described in detail by Hawkins (undated) and Brightling (2001)., with Brightling indicating that ‘dominance, competition, aggression and rampant sexual activity’ were sustained throughout the voyages-in-question, with smaller animals being relentlessly ridden by larger bucks.

Aggressive behaviour during live export is related to the influence of testosterone on the central nervous system (Hawkins, undated). Aggression is rarely a problem in long-established groups (Keeling and Jensen, 2002), and generally develops in situations of

crowding, following the mixing of mobs or during periods of feed limitation (Hawkins, undated). These latter situations are all features of live export.

Several strategies have been used to manage this problem:

- During the 1990s, work was undertaken to investigate the effect of Vaxstrate® (a product to immunologically reduce the production of testosterone) on dominance behaviour. Although proven effective, it may not be appropriate during live export because aggressive behaviour was not significantly reduced until some weeks after treatment. Immunological castration may also cause difficulties in markets that are sensitive to chemical residues in food and/or hormonal treatment of food animals.
- In recent shipments to the Middle East during the latter half of 2002, exporters have encouraged producers to supply wethers rather than entire bucks. As a consequence, the problem of dominance has been significantly reduced. Although the overseas buyers prefer entire to castrated males, there is an acceptance of the significant difficulties associated with the live export of mature goat bucks from Australia
- Segregation of animals into equivalent age/weight groups is an approach that has been adopted by many exporters[8]. According to AQIS recommendations (Doyle, 1992), and as further emphasised by Brightling (2001), the weight range in each line should be no more than 10 kg. In addition, by maximising pen security for larger bucks, it is possible for the smaller animals to escape.
- In recognition of concerns raised previously, it is preferable to exclude larger, older bucks from live export. This strategy has been adopted during shipments to the Middle East during the latter half of 2002, with exporters excluding larger feral bucks (greater than 45kg) from export, and instead sending these animals for slaughter in Australia.

On balance, the supply of wethers and the exclusion of larger bucks have each assisted in significantly reducing the problem of dominance during live export. Segregation of bucks has reduced but not eliminated the problem of dominance during live export, and there is a need for further work to manage dominance behaviour (Brightling, 2001). In a land-based experiment, Flint and Murray (2001) observed a reduction in combative behaviour when goats were held in environments that seek to mimic a natural and familiar setting for the animal as compared to typical feedlot environments.

> *The supply of wethers and the exclusion of larger bucks have each assisted in significantly reducing the problem of dominance during live export. Segregation will also reduce, but not eliminate, this problem.*

Aggression, often presenting as bulling (the mounting of an animal by a more dominant one), is also an important problem in the cattle feedlot industry (Flint and Murray, 2001). This issue has been addressed in several Canadian studies (Taylor et al., 1997b; Taylor et al., 1997a). The prevalence of bullers (the animals being ridden) in specific pens varied from 0 to 11.2% (average 2.7%), and the peak daily incidence was greatest immediately after entry to the feedlot, declining rapidly thereafter. It is believed that bulling is caused by the mixing and confinement of unfamiliar cattle, prior to the development of a stable social hierarchy (Taylor et al., 1997a). Bullers were at significantly greater risk of sickness and mortality than other steers (Taylor et al., 1997b).

A1.4.5 Nutritional issues

General nutritional issues are considered as part of management on-ship.

A1.5 Management on-ship

A1.5.1 Features of the voyage

Based on work by Hawkins (undated), the voyage mortality rate was variable, by destination and time of year. Nonetheless, higher overall death rates were frequently associated with longer voyages. The voyage length to South East Asia and the Middle East is typically 7-12 and 20-25 days, respectively. In addition, the mortality rate during discharge in the Middle East was higher than those to South East Asia. There was no association between shipment size and death rate.

In general, the risk of mortality during shipping and at discharge was higher among goats during voyages to the Middle East than to South East Asia. There was no association between shipment size and death rate.

A1.5.2 Features of the ship

The stocking density for goats during live export is presented as part of the Australian Livestock Export Standards (ALES) guidelines (LiveCorp, 2001). These densities are equivalent to those of sheep, although exporters are required to ensure that the minimum pen area for goat bucks is increased by 10%. This allowance takes account of the additional space requirements of horned animals, particularly when seeking to access feed and water. During the 2001 trial goat shipments, animals were stocked at much lighter stocking densities than required under ALES, being the extra pen area required under SLEP plus an additional 10% for goats up to 35kg and an additional 25% for animals greater than 35 kg (Brightling, 2001). Although this stocking density may have been lighter than was needed, Brightling (2001) suggests that there is currently insufficient data to assess the appropriate stocking density for goats.

There remains uncertainty about the optimal stocking densities for goats during live export. Nonetheless, goat bucks require a stocking density at least 10% less than sheep of equivalent weight due to the additional space requirements of horned animals.

Due to their general behaviour characteristics, goats appear to be less able than sheep to tolerate areas of low head room. As a consequence, it has been suggested that goats should be held in single rather than double tiered pens[8].

Based on anecdotal evidence, goats travel better in single in comparison to double tiered pens during live export.

A1.5.3 Nutritional issues

Under range conditions and in comparison with sheep, goats choose a diet with higher levels of dietary fibre (Hawkins, undated). Goats are predominantly browsers with a preference for the leaves and shoots of trees and bushes (Rutter, 2002). Further, goats are able to digest low quality fibre more efficiently than sheep (Watson and Norton, 1982, cited in Milton, 2002) because ruminal retention is longer and rumen ammonia levels are maintained at a higher level. Consequently, it is likely that goats require high levels of dietary fibre during live export. This requirement was further supported by anecdotal information and observations suggesting that goats eat roughage in preference to pellets and that the feeding of hay or long-chop chaff would substantially reduce the problem of inanition on-ship (Brightling, 2001).

Dietary fibre is routinely supplemented by some exporters[8]. Furthermore, during the recent trial shipments in 2001, exporters were required to provide at least ten percent of the goat's feed as chaff or hay (Brightling, 2001). Although some detailed goat nutritional information is available (for example Agricultural and Food Research Council, 1998), there are no clear guidelines regarding optimal nutrition during live goat export. Hawkins (undated) suggested that the fibre requirement of goats was in excess of 20% acid digestible fibre. In work by Gherardi and Johnson (1995), it appears that neither the composition of the pellets nor the method of introduction affected the performance of feral goats during lot-feeding. Although shipboard pellets typically have a high fibre content, with 40% or more by weight of hay or straw, the fibre is finely ground and passes rapidly through the rumen. For optimal rumen function, a large particle size is needed, such as long-cut chaff or hay. Brightling (2001) concluded that, while apparently beneficial, further work is needed to confirm the optimum type and amount of roughage to be included in the diet.

Although the optimal type and amount of fibre is uncertain, it is known that goats benefit from increased dietary fibre during live export. The roughage provided must have a large particle size that will not rapidly pass through the rumen.

A1.5.4 Managing dominance behaviour

The problem of dominance behaviour in feral buck consignments has been raised previously. In addition to the earlier recommendations, whilst at-sea Brightling (2001) recommends that bucks more than 35 kg are penned on the ship in secure goat-proof pens. In contrast, goats weighing less than 35 kg should be allowed to move freely between pens, to enable them to escape being ridden by larger, more dominant bucks. Brightling also recommended that with large shipments of feral bucks, secure refuge pens are provided where smaller subordinate goats that are being continuously ridden can recover without molestation.

A1.6 Management post-arrival

Based on work by Hawkins (undated), mortalities continued after goats arrived at the port of destination. For example, feedlot managers frequently observed mortality rates of 5-20% during feedlotting in Malaysia. In a detailed investigation, enteric diseases, respiratory diseases and inanition accounted for most of the deaths in Malaysia. The cause of these conditions was multifactorial but generally related to feedlot management, including problems of water quality and quantity, a sudden change in diet, a lack of segregation and general hygiene.

A number of preventive measures were recommended, including:
- Excluding older bucks from the export process
- Maintaining segregation by age and size
- Identifying and removing aggressive, dominant bucks
- Ensuring feed troughs are constructed to minimise the possibility of faecal contamination
- Ensuring that plentiful high-quality water is available
- Tailoring the pellet mix as closely as possible to the ship-board diet
- Controlling vermin
- Allowing regular access to pasture

Detailed attention to management is needed, after arrival at the port of destination, to safeguard the health and welfare of goats following live export.

Appendix 2: A retrospective investigation of all live goat export voyages since September 2000

A2.1 Introduction

Concern has been raised by government concerning voyage mortality rates during live goat exports. As part of the industry response to these concerns, data analyses were conducted with two main aims:

- To define the temporal patterns of voyage mortality during live goat export; and
- To identify factors contributing to the rate of voyage mortality during live goat export.

The results of these investigations are described here.

A2.2 Materials and methods

This study was conducted by analysing data that is routinely collected and managed by LiveCorp, Sydney. At the end of each voyage, exporters are required to forward a limited amount of voyage data including the vessel name and details, departure dates and ports, destination and days of sailing, number of cattle, sheep and goats loaded, and the voyage mortality rates for each of these species. This database is maintained by Rosanne Ransley of LiveCorp, Sydney.

Data collected between 1995 and 2002 was used to address the first objective. In keeping with a specific request from government, the second objective was addressed using data collected during the last two years, namely during the period 20 September 2000 to 19 October 2002, inclusive. For both of these analyses, standard descriptive and analytical analyses were conducted, and the data were managed using Microsoft Excel 2002 (Microsoft Corporation, Seattle, USA) and analysed using Statistix 7 (Analytical Software, Tallahassee, USA).

A2.3 Results

A2.3.1 Temporal changes in goat voyage mortality rates

A detailed analysis of temporal changes to the goat voyage mortality rate is presented in Table A2.1. Based on data collected since 1995, the number of incident voyages (those with goat voyage mortality greater than 2%) has gradually decreased since 1996. At its worst, during 1996 to 1999, incident voyages generally accounted for greater than 30% of all voyages. This figure has decreased to approximately 20% during 2000 and 2001, and to approximately 10% in 2002. This improvement has been stronger during short- as compared with long-haul voyages. Incident voyages accounted for 7.7% and 12.5% of short- and long-haul voyages during 2002.

There has been a gradual decrease in the proportion of incident voyages (those where the goat voyage mortality rate exceeded 2%) in recent years. During 2002, the goat voyage mortality rate exceeded 2% on 9.1% of 55 goat voyages from Australia. The improvement in mortality has been stronger during short- as compared with long-haul voyages.

It is also important to note that significant numbers of goats are exported from air each year, accounting for between 11.1% (in 2002) and 57.2% (in 2000) of goats exported live from Australia during the period 1998 to 2002. Goats are exported live from airports in Perth, Adelaide, Melbourne, Sydney and Brisbane. Mortality data relating to the air freighting of goats are not available.

There has been a steady improvement in goat voyage mortality rates in recent years. Incident voyages (those where the goat voyage mortality rate exceeded 2%) accounted for 9.5% of all voyages during 2002.

A2.3.2 Factors contributing to increased voyage mortality

Between 20 September 2000 and 19 October 2002, there were 140 live export voyages which carried at least some goats. A total of 173,875 goats were carried on these voyages, with an average consignment of 1,242 goats (range 2 to 21,000, standard deviation 2,544). As illustrated in Figure A2.1, the main ports of loading (based on number of goats loaded) were Fremantle, Broome, Darwin, Adelaide and Geraldton. Malaysia was the main destination of these shipments, accounting for 46.4% of live goat consignments (Figure A2.2).

Of the 140 voyages in question, 33 (23.6%) carried less than 300 goats. The following analyses all specifically relate to the 107 voyages between 20 September 2000 and 19 October 2002 that carried 300 goats or more.

During the period of interest, the average voyage mortality rate was 1.63% (range 0 to 9.72%, standard deviation 2.06%). This distribution is substantially right skewed (Figure A2.3), with the mortality rate remaining below 1.0% during 54 (50.5%) voyages, and exceeding 2% on 21 (19.6%) voyages (Figure A2.3). On the 65 short-haul voyages (that is, voyages to southeast Asia), the average voyage mortality was 1.27%, with 8 (12.3%) of voyages exceeding a 2% voyage mortality (Figure A2.4). On the 42 long-haul voyages (that is, voyages to all destinations including the Middle East and Mauritius), the average voyage mortality was 2.19%, with 13 (30.1%) of voyages exceeding a 2% voyage mortality (Figure A2.5).

Between 20SEP00 and 19OCT02, there were 107 live export voyages which carried 300 goats or more. Although the average voyage mortality rate was 1.63%, the mortality rate remained below 1.0% during 54 (50.5% of these voyages. The voyage mortality rate exceeded 2% on 21 (19.6%) of voyages.

In order to identify factors associated with high voyage mortalities, a detailed comparison was undertaken of voyages with high (equal to or greater than 2%) and low (less than 2%) mortality rates, after excluding voyages where less than 300 goats were loaded (Table A2.2). A total of 107 voyages were included in this analysis. Data were available for analysis relating to the source of the goats (the port of loading) and management on-ship (number of goats and other animals loaded, percentage of livestock that were goats, sheep and cattle voyage mortality rates, length of voyage and port of unloading). In addition, pen configuration was examined for 53 of the 107 voyages with available data. No data were available in this database with respect to management on-farm or during feedlotting.

Analyses were conducted to identify factors associated with high voyage mortality. A total of 107 voyages, including all voyages between September 2000 and October 2002 with greater than 300 goats, were included in this analysis.

As illustrated in Table A2.2, the only factors in this database significantly associated with voyage mortality included:

- length of voyage (P = 0.04; median 9 days on low mortality voyages versus 14 days on high mortality voyages), and
- port of unloading (P = 0.02; 66.3% of low mortality voyages unloaded in southeast Asia compared to 38.1% of high mortality voyages).

Although pen configuration may have played a role in voyage mortality, the association was not significant (P = 0.29). High mortality voyages were more common when goats were held in double (21.2% of the 33 voyages with this configuration) as compared with single-tiered pens (10% of 20 voyages).

> *In this period of interest, the voyage mortality rate was significantly associated with length of voyage and port of unloading.*

Voyage length and port of unloading are clearly related, with voyages to southeast Asia taking an average of 8.1 (median 8, range 5-16) days and voyages to all other destinations (ports in the Persian Gulf and Red Sea, Mauritius) an average of 21.8 (median 23, range 11-31) days. There was no significant difference in the average daily mortality rate on voyages to these two different regions, (P = 0.93), with the average daily mortality rate on voyages to southeast Asia being 1.64 deaths per 1000 goat-days at-risk (median 0.88, range 0 to 14.1) in comparison with 1.15 (median 0.66, range 0 to 5.6) during voyages to other ports. To further investigate this issue, it is important to determine whether the higher voyage mortality rate to non-southeast Asian ports are entirely a result of the longer voyage length or due to other reasons. These daily rates are not significantly different (P = 0.93). Therefore, although the overall mortality rate was higher during voyages to the Middle East and Mauritius in comparison to southeast Asia, the average daily mortality rate tended to be lower. Logically, therefore, the higher risk posed by the long-haul ports is due entirely to the extended duration of these voyages.

> *Voyage mortality rates tended to be higher on long-haul voyages to non-southeast Asian ports. During these voyages, the increased mortality rates occurred as a direct result of increased voyage length, and was not associated with an increased daily mortality rate.*

A2.4 Discussion

A2.4.1 General comments

The validity of these analyses is closely related to the accuracy of the LiveCorp database. As stated previously, the database represents a compilation of data based on information provided by each exporter at the end of each voyage. Although most of the data are likely to be accurate, this cannot be corroborated. Because exporters face the possibility of harsh punitive action when the voyage mortality rate exceeds 2%, this figure may be underreported on occasions. The subsequent potential bias, known epidemiologically as differential misclassification, can either exaggerate or underestimate an effect (Rothman and Greenland, 1998). Consequently, care must be taken when interpreting these results.

> *The voyage mortality rate may be underreported in some situations. Because data accuracy is uncertain, care must be taken when interpreting the results of this analysis.*

A2.4.2 Temporal pattern of voyage mortality rates

There has been some improvement in mortality rates during live goat export, particularly in recent years. Between 1996 and 1999, incident voyages (those where the goat voyage mortality rate exceeded 2%) were very common, accounting for 30-60% of all voyages. Incident voyages became common during 2000-2001 (with 21.1-23.3% of voyages exceeding 2% mortality) and there has been a further improvement during 2002 (with 9.1% of voyages exceeding 2% mortality). According to Bob Nickels[13], this improvement is mainly as a consequence of the decreasing average age of goats available for export by sea. In recent times, most exported goats have been young, weighing 22-30 kg. For comparison, during the period September 2000 to October 2002 the sheep voyage mortality rate exceeded 2% and the cattle voyage mortality rate exceeded 1% on 11.3% and 1.5% of voyages, respectively.

> *The recent improvement in goat voyage mortality rate is mainly a consequence of the decreasing average age of goats available for export by sea.*

A2.4.3 Factors contributing to increased voyage mortality

The LiveCorp database is not comprehensive, and does not include information about all known risk factors relating to mortalities during live goat export. Risk factors of interest to this analysis, but not covered in the existing database, include aspects of information about the source of animals in each consignment, the method(s) of on-farm preparation, feedlotting practices and management on-ship. Although it may have been possible to access these data using other methods, including a mail-based questionnaire, based on previous experience in this and other similar industries we were concerned with the completeness and validity of these additional data. To illustrate and assuming that exporters would have been willing to assist, it is likely that they would not have been able to provide accurate data concerning the on-farm preparation of a number of different lines of goats on a voyage several years previous. Similarly, exporters may be reluctance to provide information about stocking densities during each voyage, particularly if the vessel is stocked at or above Australian Livestock Export Standards. Due to the nature of the trade, there are no alternative sources for most of these data. As a consequence of these broad concerns, we elected not to gather additional information for the current analysis.

> *The LiveCorp database does not include information about all the risk factors known to be associated with increased voyage mortality. Accurate information about these additional variables is not readily-available.*

The results clearly identify length of voyage and port of unloading as two key risk factors for high voyage mortality during live goat export. These factors are related, with southeast Asia being the sole destination of short-haul voyages. As indicated in the results, there is no significant difference between short- and long-haul voyages in terms of daily mortality rate. Therefore, the increased voyage length entirely accounts for the increased mortality risk associated with long-haul voyages. Because voyage length is unlikely to significantly change over time, the management of mortality risk on long-haul voyages will depend on manipulation of other variables such as the selection of goats suitable for export. Because farmed feral goats perform significantly better during live export than unmanaged feral goats, the risks associated with long-haul voyages would be substantially reduced with the exclusion of the latter animals from this sector of the trade.

[13] Bob Nickels, Department of Agriculture Western Australia (phone conversation 18FEB03)

As a direct result of voyage length, long-haul voyages are inherently riskier than short-haul voyages. With attention to other factors, including the selection of goats suitable for export, these risks can be substantially reduced.

Based on background information (presented elsewhere), there are a range of other factors associated with mortality risk during live goat export. A number of these factors were included in this analysis, including source of animal and aspects of management on-ship. The sample size is relatively small, and therefore the statistical power of this analysis (the ability to detect statistical differences if present) will be relatively low. Given this fact, and also problems relating to data quality, it is not surprising that significant difference were not found with many of these other factors. These results do not devalue their importance, as suggested from other sources.

Table A2.1 Relative importance of live goat export by sea and air, and goat voyage mortality rates during live export by sea, during 1995 to 2002

Year and destination	% of goats, exported live from Australia, that were exported		Number of voyages		Voyages with => 300 goats			
					Voyage mortality rate		Voyage mortality exceeding 2%	
	By sea	By air	Total	Carrying => 300 goats	Mean	Median	Number	%
2002[1]								
Total	88.7	11.3	64	55	1.24	0.92	5	9.1
Long-haul			-	16	1.42	1.49	2	12.5
Short-haul			-	39	1.17	0.55	3	7.7
2001[2]								
Total	71.6	28.4	79	60	1.69	1.05	14	23.3
Long-haul			-	30	2.28	1.52	10	33.3
Short-haul			-	30	1.10	0.81	4	13.3
2000								
Total	42.8	57.2	40	19	1.91	0.92	4	21.1
Long-haul			-	7	2.83	1.88	2	28.6
Short-haul			-	12	1.37	0.61	2	16.7
1999								
Total	68.1	31.9	26	14	2.22	1.41	5	35.7
Long-haul			-	3	3.44	2.00	1	33.3
Short-haul			-	11	1.89	1.31	4	36.4
1998								
Total	81.4	18.6	27	18	3.35	1.84	8	44.4
Long-haul			-	7	2.05	1.95	3	42.9
Short-haul			-	11	4.18	1.67	5	45.5
1997								
Total	n/a	n/a	35	26	2.16	1.91	11	42.3
Long-haul			-	9	2.25	2.10	5	55.6
Short-haul			-	17	2.19	1.66	6	35.3
1996								
Total	n/a	n/a	24	19	1.95	1.44	7	36.8

Long-haul			-	10	2.59	2.38	6	60.0
Short-haul			-	9	1.24	1.40	1	11.1
1995[3]								
Total	n/a	n/a	5	5	1.09	1.33	0	0
Long-haul			-	2	0.67	0.67	0	0
Short-haul			-	3	1.37	1.35	0	0

1 All voyages up until 08DEC02
2 Mortality data from one long-haul voyage is not available
3 All voyages from 22AUG95

Table A2.2. A comparison of low and high mortality voyages, in terms of putative risk factors for voyage mortality. Voyages loading less than 300 goats have been excluded from these analyses. If goats were loaded at two ports, only the main port of loading (where the majority of the goats were loaded) is considered in these analyses

Variable	Low mortality voyages[a] (n = 86)			High mortality voyages[b] (n = 21)			*P* value
	Mean	Median	%	Mean	Median	%	
1. Source of goats							
Goats were loaded from a southern port[c]			57.0			71.4	0.23[d]
Goats were loaded in either Portland or Adelaide			17.4			23.8	0.54[d]
2. Management on-ship							
Number of goats loaded	1,402	1,028		2,306	985		0.80[e]
Total DSE[f] carried	4,217	2,069		5,700	4,515		0.72[e]
Goats as proportion of total DSE[f]	0.155	0.034		0.207	0.069		0.99[e]
Voyages where sheep mortality exceeded 2%			3.1			0.0	1.0[g]
Voyages where cattle mortality exceeded 1%			0.0			0.0	-[h]
Length of voyage	12.8	9.0		16.2	14.0		0.04c
Goats were unloaded in southeast Asia[i]			66.3			38.1	0.02h

a Voyage mortality rate less than 2%
b Voyage mortality rate at least 2%
c That is, from ports below 26^{o} south (Geraldton, Fremantle, Adelaide or Portland)
d Using the Chi-square test
e Using the Kruskal-Wallis test for non-normally distributed, continuous data
f Dry-sheep-equivalents (with 10 sheep or goats equivalent to 1 head of cattle)
g Using the Fishers Exact Test
h Could not be calculated
i That is, in Brunei, Indonesia and/or Malaysia

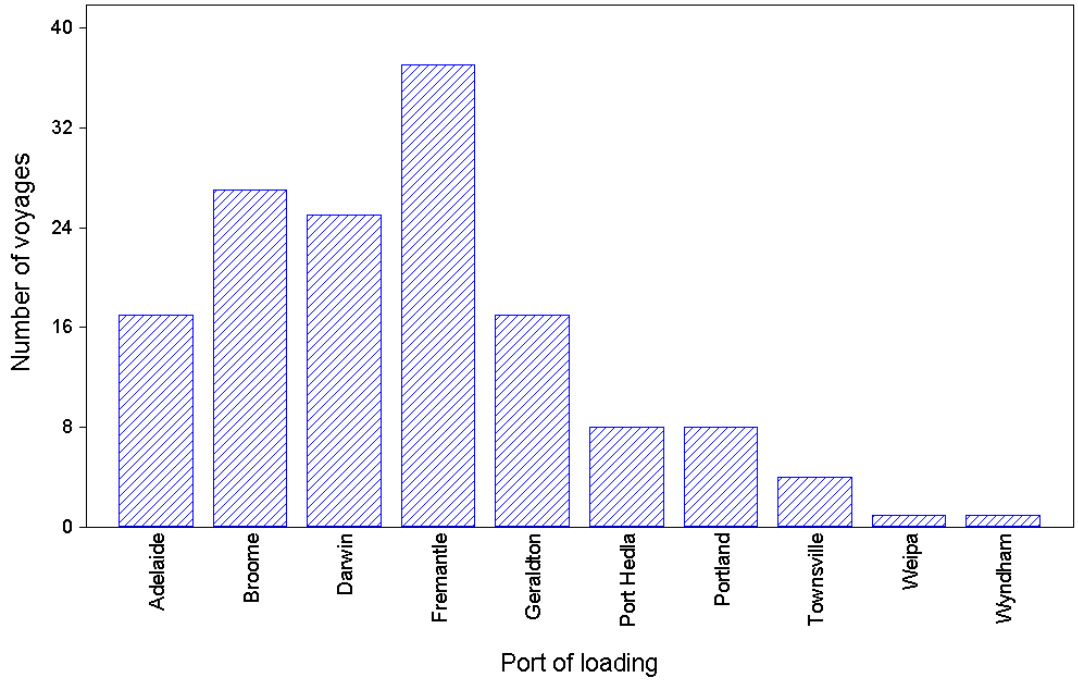

Figure A2.1. The ports where goats were loaded by number of voyages. There were five voyages with two ports of loading, four Adelaide-Fremantle and one Portland-Fremantle.

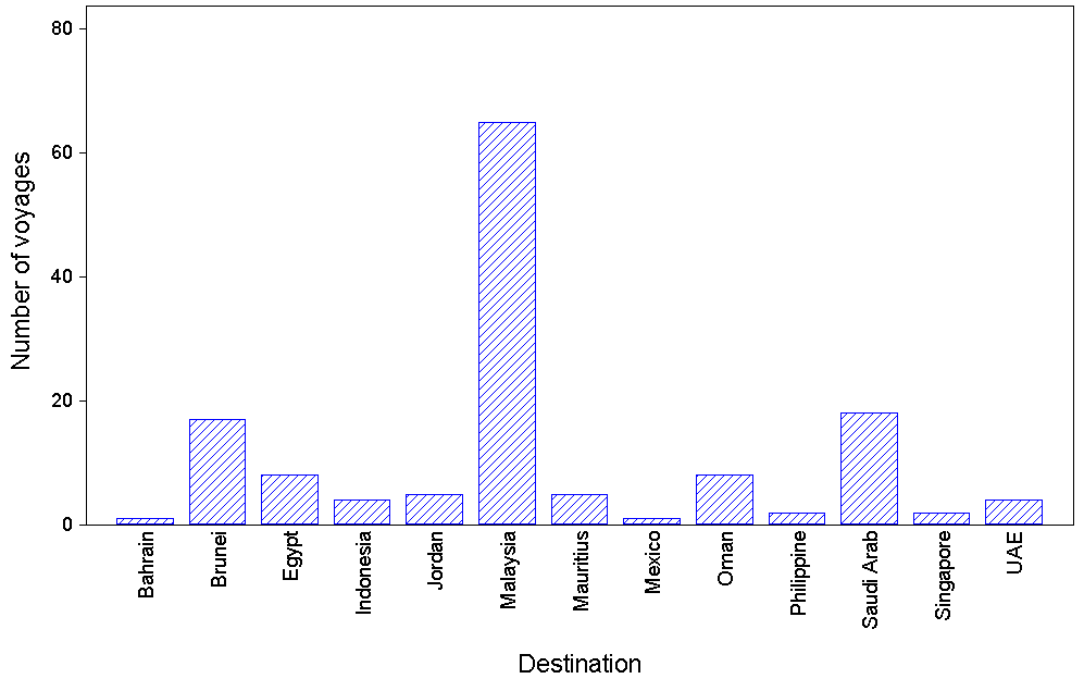

Figure A2.2. The country of destination by number of voyages.

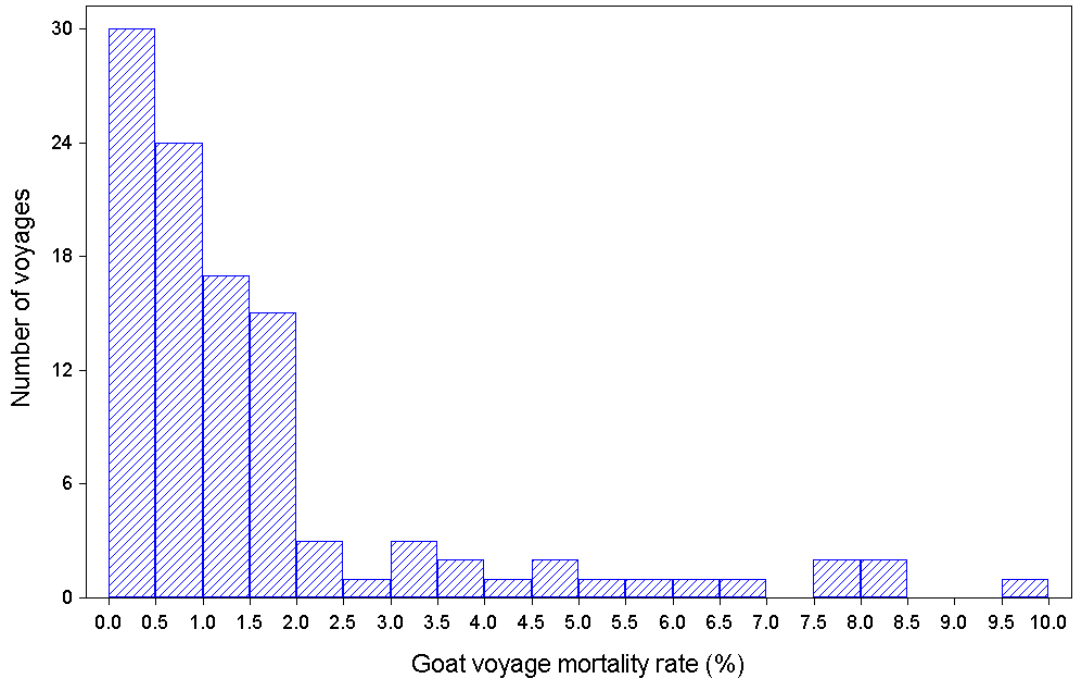

Figure A2.3. The number of voyages by voyage mortality rate (%). A total of 76 (54.3%) voyages achieved less than 1.0% mortality rate, whereas 23 (16.4%) voyages exceeded a voyage mortality rate of 2.0%

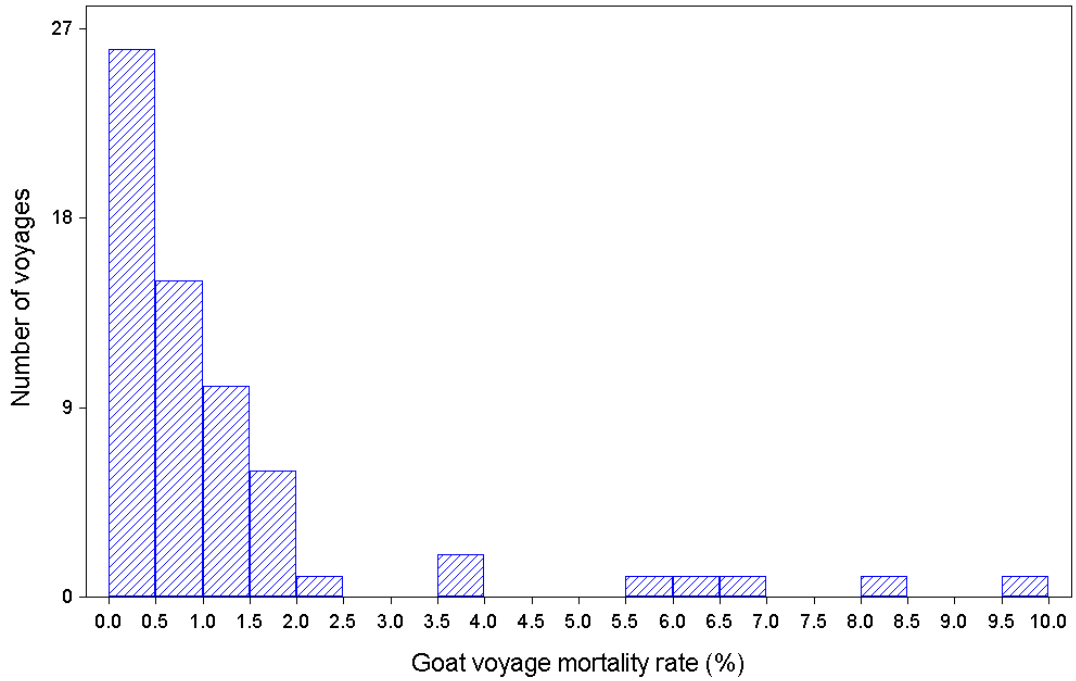

Figure A2.4. The number of short-haul voyages by voyage mortality rate (%). This figure only includes the 65 short-haul voyages between 20 September 2000 and 19 October 2002 that carried at least 300 goats. A total of 41 (63.1%) voyages achieved less than 1.0% mortality rate, whereas 8 (12.3%) voyages exceeded a voyage mortality rate of 2.0%

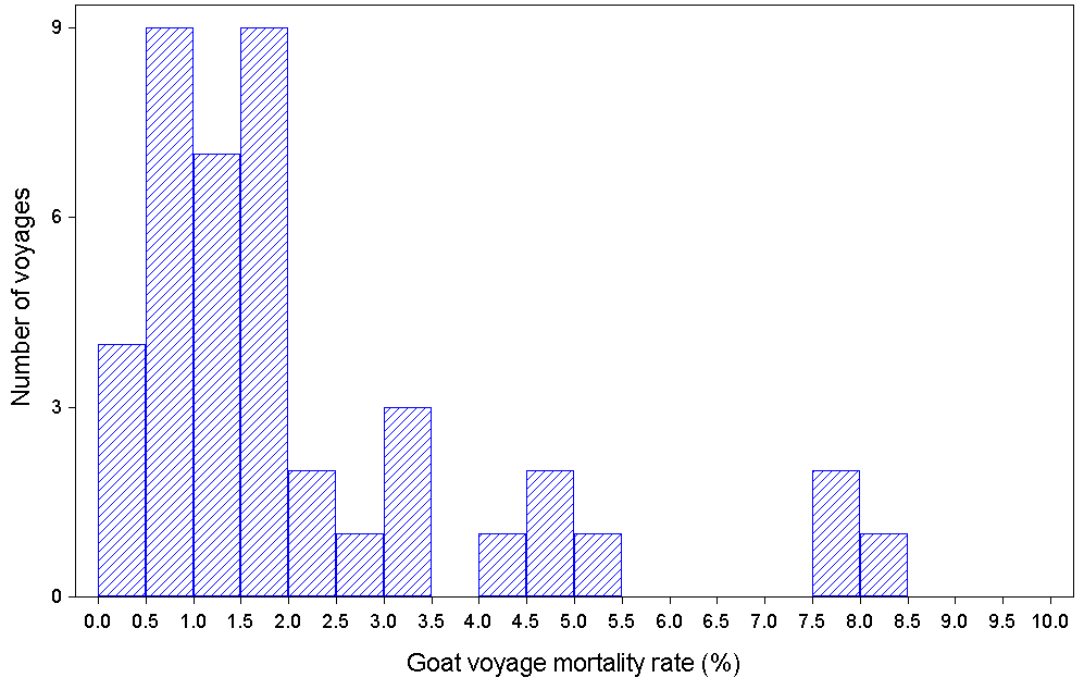

Figure A2.5. The number of long-haul voyages by voyage mortality rate (%). This figure only includes the 42 long-haul voyages between 20 September 2000 and 19 October 2002 that carried at least 300 goats. A total of 13 (31.0%) voyages achieved less than 1.0% mortality rate, whereas 13 (31.0%) voyages exceeded a voyage mortality rate of 2.0%

Appendix 3a: Goat risk assessment template (for voyages of 10 days duration or more)

Vessel and voyage number	
Loading port and date	
Destination	
Voyage duration (days)	
Number of goats in shipment	

		Yes	No
1	Captured feral goats in the shipment		
	Prior to I January 2005		
	From 1 January 2005		
2	Bucks of feral origin with full mouth		
3	Female goats for slaughter		
4	Goats < 22 kg		
5	Goats drafted by weight, with a weight range in each group < 10 kg		
6	Hay and/or chaff > 200 gm / head / day whilst on the ship		
7	On ship in single tier pens		
8	Experienced shipboard stockperson or veterinarian		
9	Cold stress risk considered		

Comment:

Appendix 3b: Goat risk assessment template (for voyages of less than 10 days duration)

Vessel and voyage number	
Loading port and date	
Destination	
Voyage duration (days)	
Number of goats in shipment	

		Yes	No
1	Captured feral goats in the shipment		
2	If captured ferals, is domestication adequate		
3	Bucks of feral origin with full mouth		
4	Female goats for slaughter		
5	Goats < 22 kg		
6	Goats drafted by weight, with a weight range in each group < 10 kg		
7	Hay and/or chaff > 200 gm / head / day whilst on the ship		
8	On ship in single tier pens		
9	Experienced shipboard stockperson or veterinarian		
10	Cold stress risk considered		

Comment: