



*Animal welfare for a better world*

# How technologies can improve the welfare of transported livestock

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# Worldwide live export of agricultural animals

Species	Number exported per year (million)		Proportional increase
	1961	2013	
Chickens	0.08	1.6	20 x
Pigs	2.6	38.6	15 x
Sheep	6.5	16.4	2.5 x
Cattle	4.9	11.0	2.2 x





# The quality of the transport is in the hands of the operator





# Key livestock transport issues

- better loading and unloading facilities
- stocking densities
- suitable floors and bedding
- provision of food and water during the journey
- noise and vibration
- sufficient ventilation
  - accumulation of heat from the livestock
  - humidity and ammonia from excreta



# Loading



Loading in Lombok, Indonesia

1931

Courtesy of Tropenmuseum Royal  
Tropical Institute



Loading in Fremantle, 2005

# Loading in Port Perak, Surabaya, Indonesia



Courtesy of World  
Animal Protection



# Live export from Australia



MV Ocean Drover  
([www.dieselduck.net](http://www.dieselduck.net))

# Live export stages (21-86 days)

	<u>Days</u>
• Mustering	0.5-1
• Holding in yards	0.5-1
• Trucking to assembly depot	1-2
• <i>Assembly depot</i>	1-7
• Trucking to port	0.1
• Enter ship	0.1
• <i>On ship</i>	7-25
• <i>Discharge to truck</i>	0.1
• Hold at feedlot	10-50
• Truck to abattoir	0.1
• Unload and hold in lairage	0.5
• Slaughter	0.05



# Feedlot preparation



# Loading onto a ship



# Loading ramps

- 15-20° maximum
- Use bedding or batons to allow animals to grip
- Minimise slip by handling gently



# Slip minimisation, ship entry



# National standards

- Australian Maritime Safety Authority  
Marine Orders Part 43
- Specifies pen size, deck loading capacity, rail strength and spacing, passageway width, ceiling height
- Based on 'best practice'

# Heat stress

- Temperature/humidity
- Ventilation rate
- Emergency wetting
- Heat Stress Risk Management Model





# Processing the information

- Algorithms to predict developing problems
- On board alarms for high temperatures, humidity and ammonia
- Stability monitoring

News

## Cattle euthanised after truck rolled on highway

13th Oct 2016



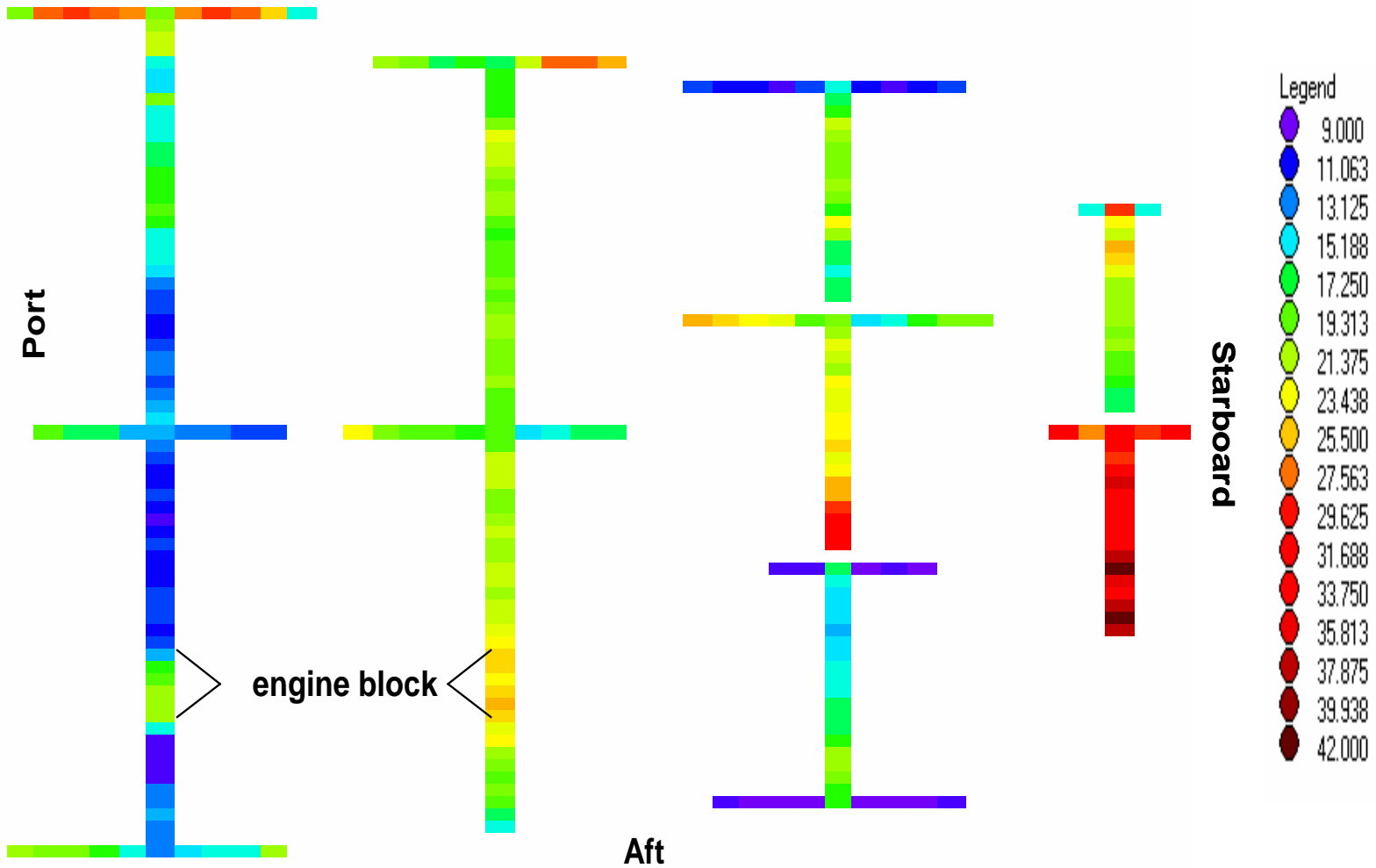
# Heat Stress Risk Management Model

## Uses:

- Weather at destination and on route
- Acclimatisation
- Coat and condition
- Ventilation characteristics of ships

# Ammonia accumulation on ships

Fore

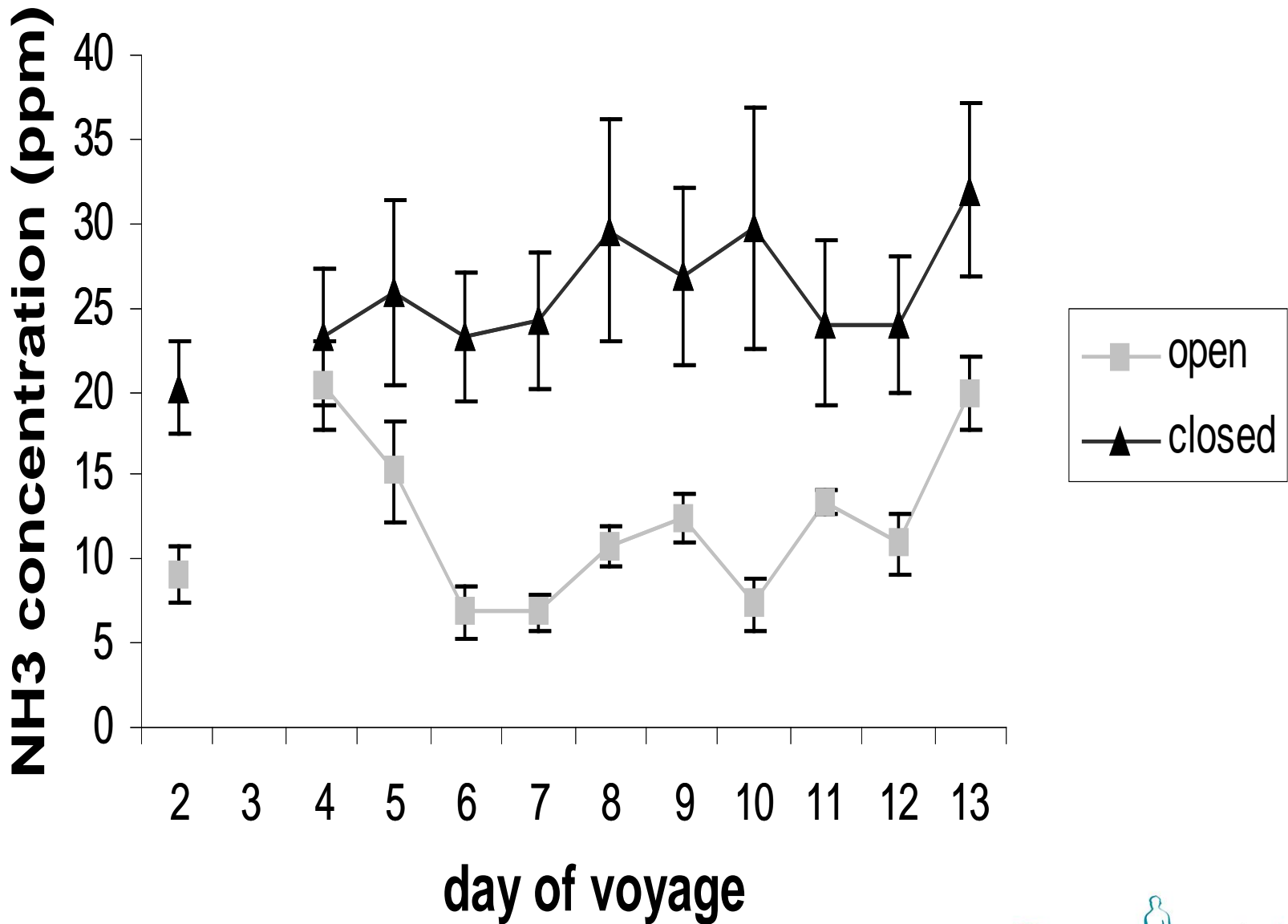


Deck 9 (open)

Deck 6 (open)

Deck 5 (closed):  
fore, mid & aft

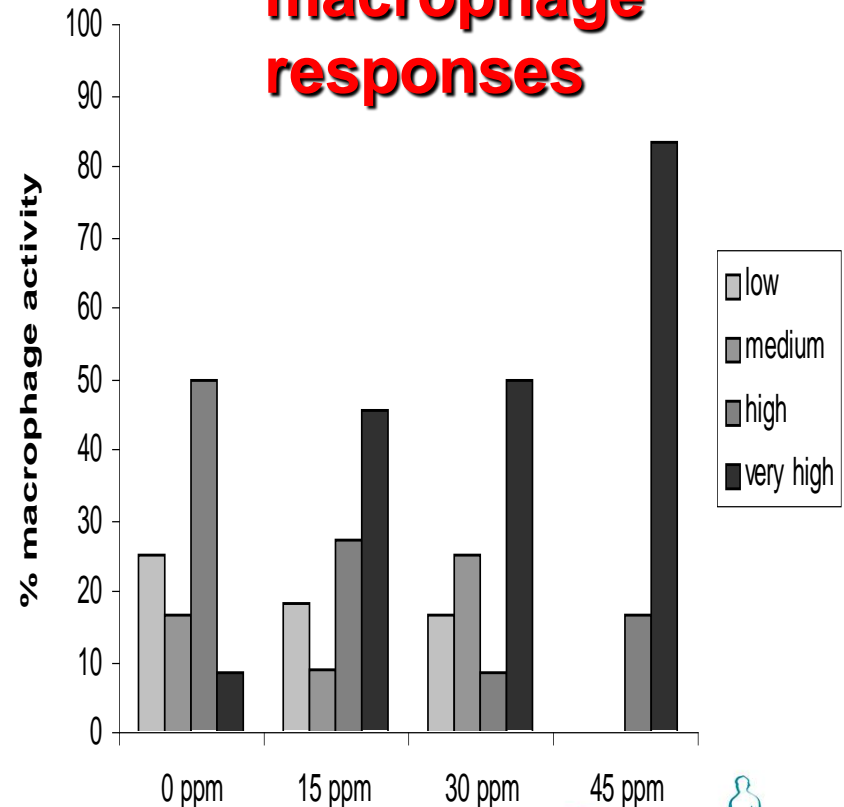
Deck 1 (closed):  
fore & aft



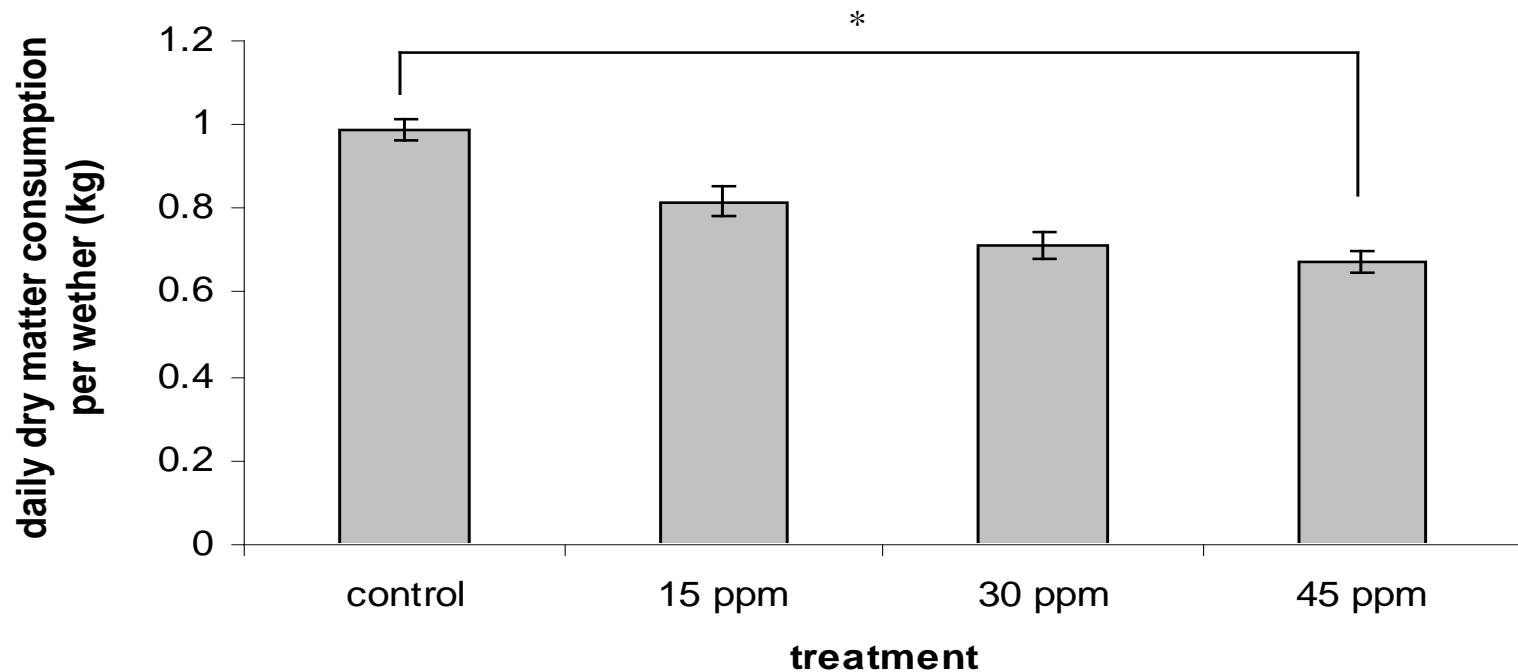
# Effects of ammonia on ships

- Mucosal secretions:
  - nose, eyes, throat
  - Increased macrophage activity
- Reduced feed intake and weight loss

## Cattle macrophage responses



# Sheep feed consumption in different ammonia concentrations



# Potential solutions

- Increase ventilation rate on closed decks
- Wash pens to remove excreta



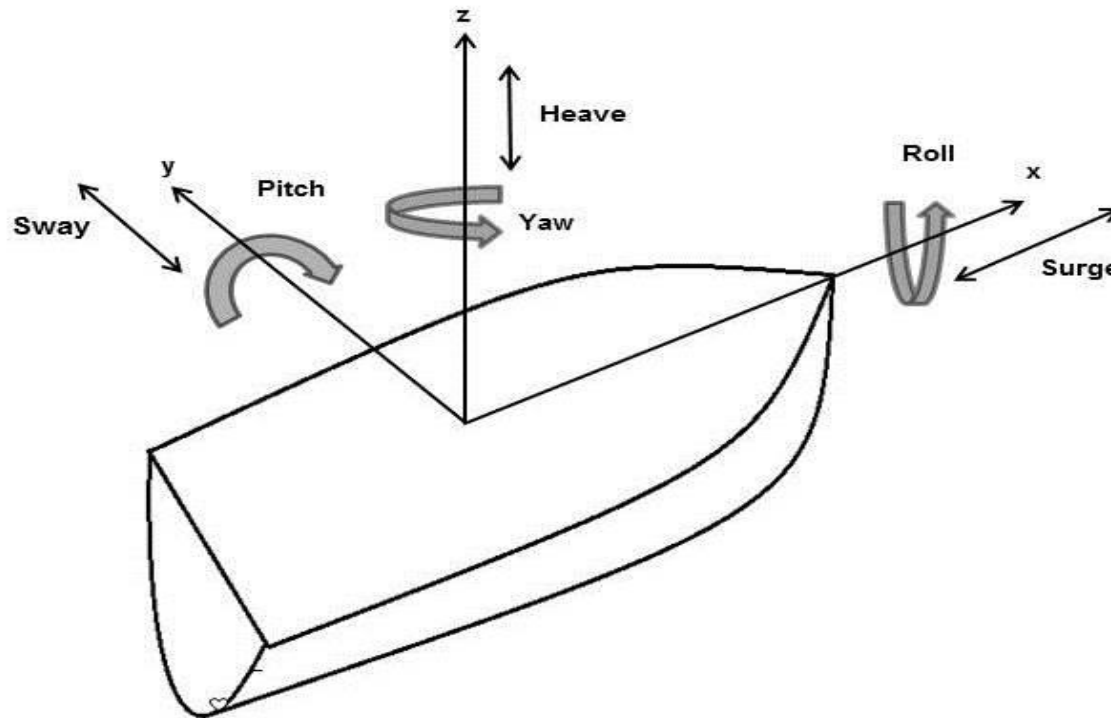


- Add gypsum to diet
- Reduce protein in ration
- Provide bedding to absorb excreta



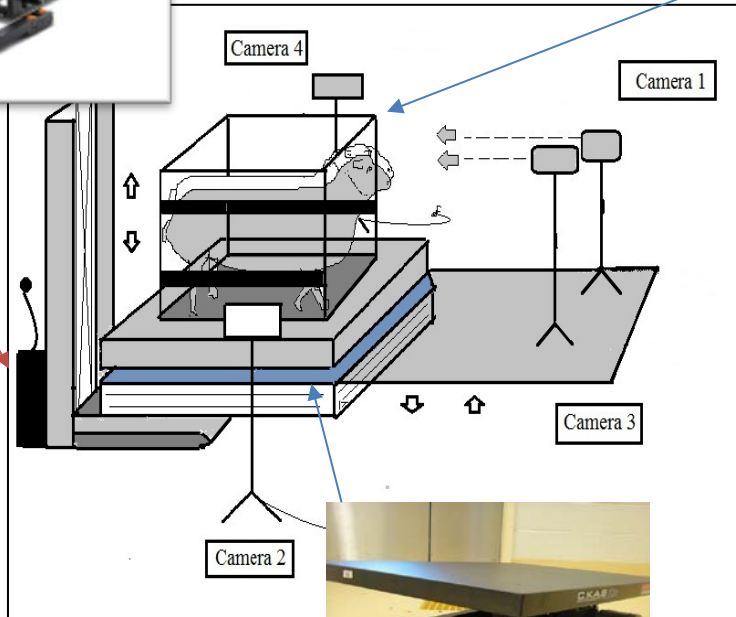
# Do livestock get seasick?

## Main ship movements



Source: Ibrahim RA, Grace IM. Modeling of Ship Roll Dynamics and Its Coupling with Heave and Pitch. *Mathematical Problems in Engineering* 2010:32.

# Effects of ship movement on sheep behavior and physiology



# Effects of movement on stress

Behavior, s/30 min	Roll	Heave	Pitch	Control
Looking at companion	152	309	193	140
Head under/above	1.2	2.3	1.2	1.0
Leaning on crate	169	408	190	131
Lying	574	212	743	910
Ruminating	809	166	839	941
Number of steps/30 min	2.3	2.0	1.6	1.5
Heart rate, bpm	84	84	81	79



# Conclusion

In simulated ship transport,  
Roll and Heave  
stress the sheep

# Conclusions

Antiemetic reduces the amount of balance correction by sheep during roll motion

Therefore sheep potentially experience seasickness as a result of the rolling motion of the ship

# Potential solutions

1. Stabilise the ship against roll

Bilge keel

Stabiliser fins

Antiroll tanks

But reduce speed and increase fuel use



2. Include antiemetic in feed  
But high cost and feed intake variable



3. Reroute to avoid high seas

# Provision of feed and water



Source: Navarro, Gallo and Phillips





# Air transport

Rapid growth  
in Australia.  
Mainly cattle



Source: Avalon Airport:  
Victoria's Live Animal  
Freight Centre  
(business case)

# Conclusions

- Worldwide long distance transport of livestock is increasing
- Much is in developing countries where advanced technologies are not available
- The greatest concerns - heat stress, ammonia, inappetence, seasickness – are now better understood
- This should lead to improvements in the welfare of livestock transported long distances





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# Thank you

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