Effectsof the thermal micro-environment on breeder pigson 72 hour export journeysunder summer conditions

M. A. Mitchell, P.J. Kettlewell, M. Villaroel-Robinson, P. Barreiro, M. Farish and E. Harper

Background

- Long distance journeys are a matter of concern in relation to the welfare of the transported animals.

- The vehicle thermal micro-environment is a potential major source of stress and reduced welfare in all transported animals.

- A combination of extended journey durations (e.g. export journeys) and exposure of animals to hostile thermal environments may constitute an important welfare concern.

Experimentalapproach

- 7 experimental journeys, lasting 3 days, over the same route
- Day 1: Edinburgh – Fougeres (France) – lairage
- Day 2: 24 hours rest in lairage – feed and water (Control Post)
- Day 3: Fougeres – Humilladero (Southern Spain) - slaughterhouse

Experimentalmeasures

- **Ambient temperaturesRH**
  - **At origin and destination**
  - **External on truck in transit**
  - **Throughout truck in transit**

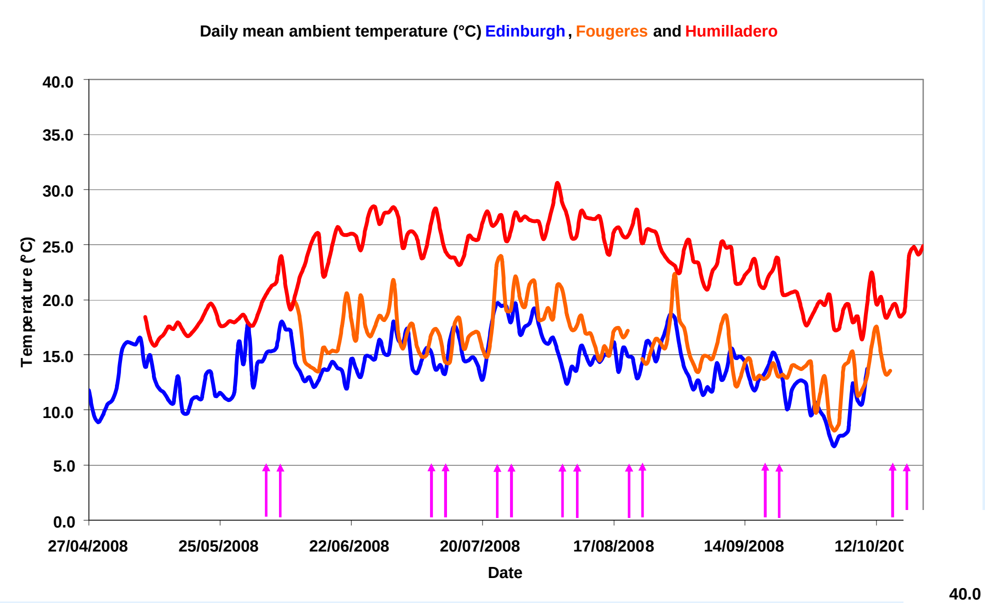
- **Derive enthalpy**

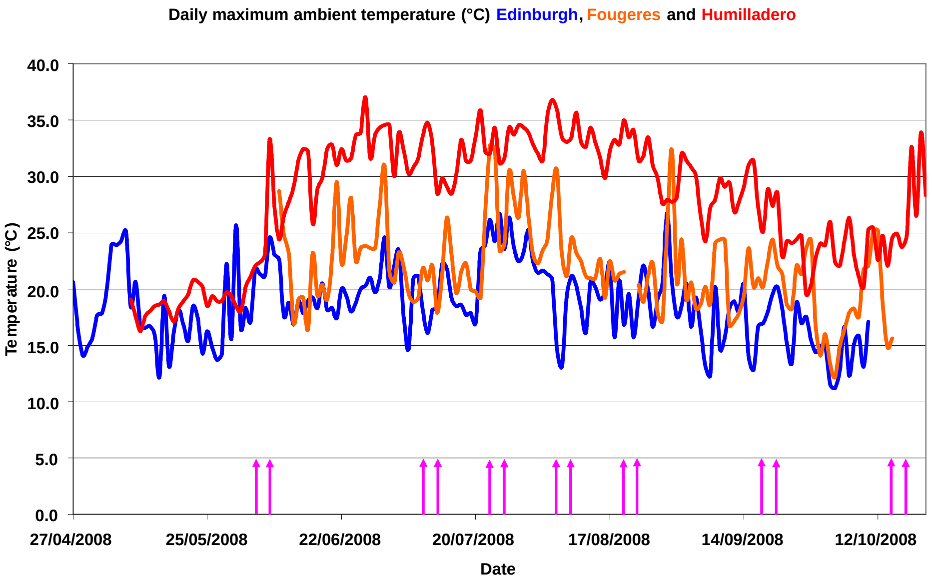
- **Derive Apparent Equivalent Temperature**

AnimalProcedures /measures

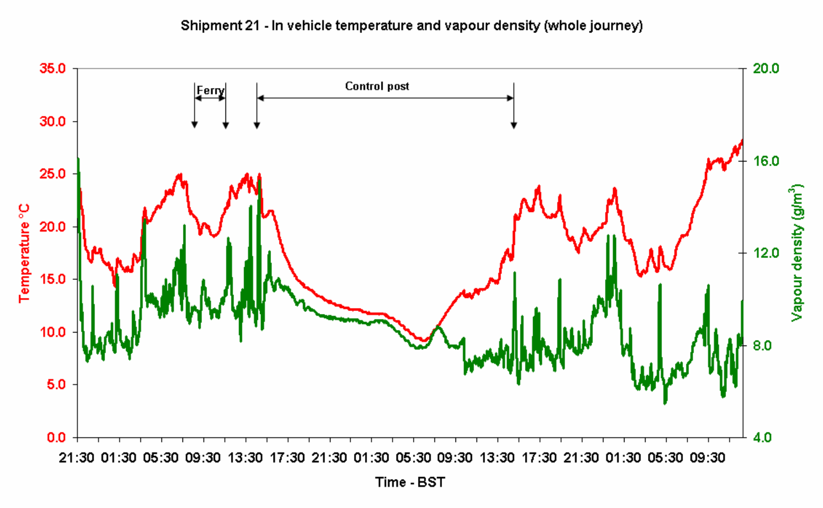
- Rectal temperature
- Surface temperature
- DBT data logger (loggerimplant only)
- RFID chipinjection (identificationand BT)
- Behaviouralanalysis and recording
- Body weight

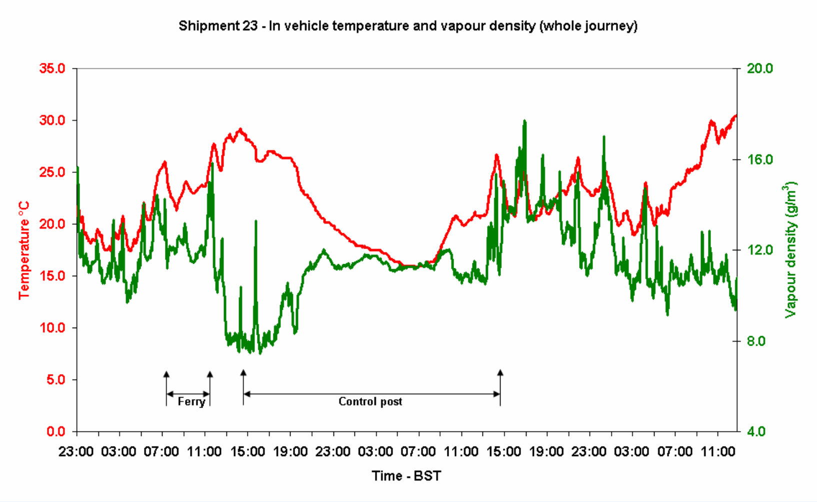
Dailytemperatures

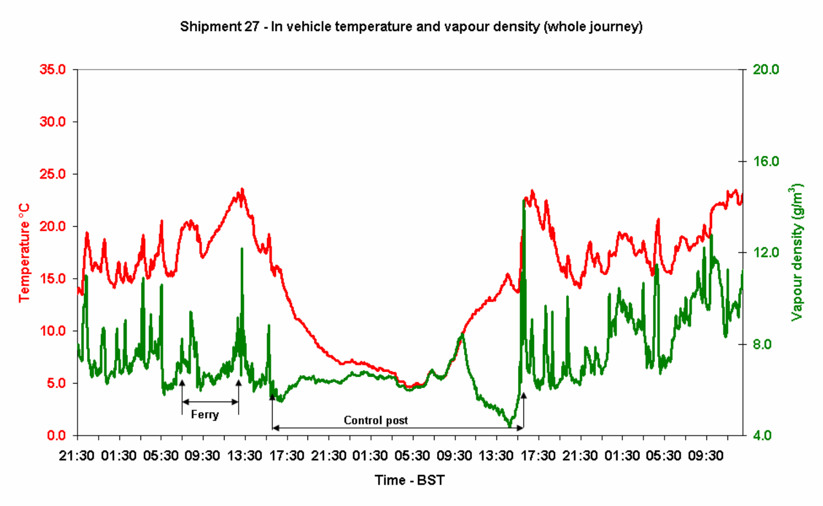


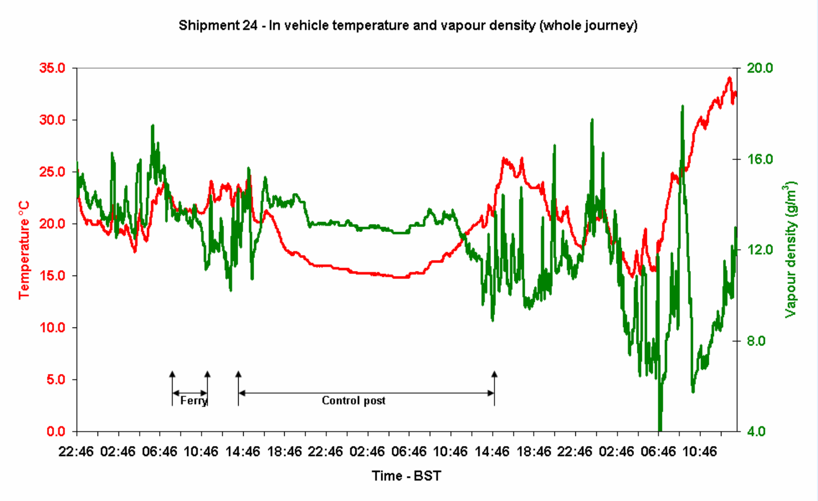


Internaltruck temperatures

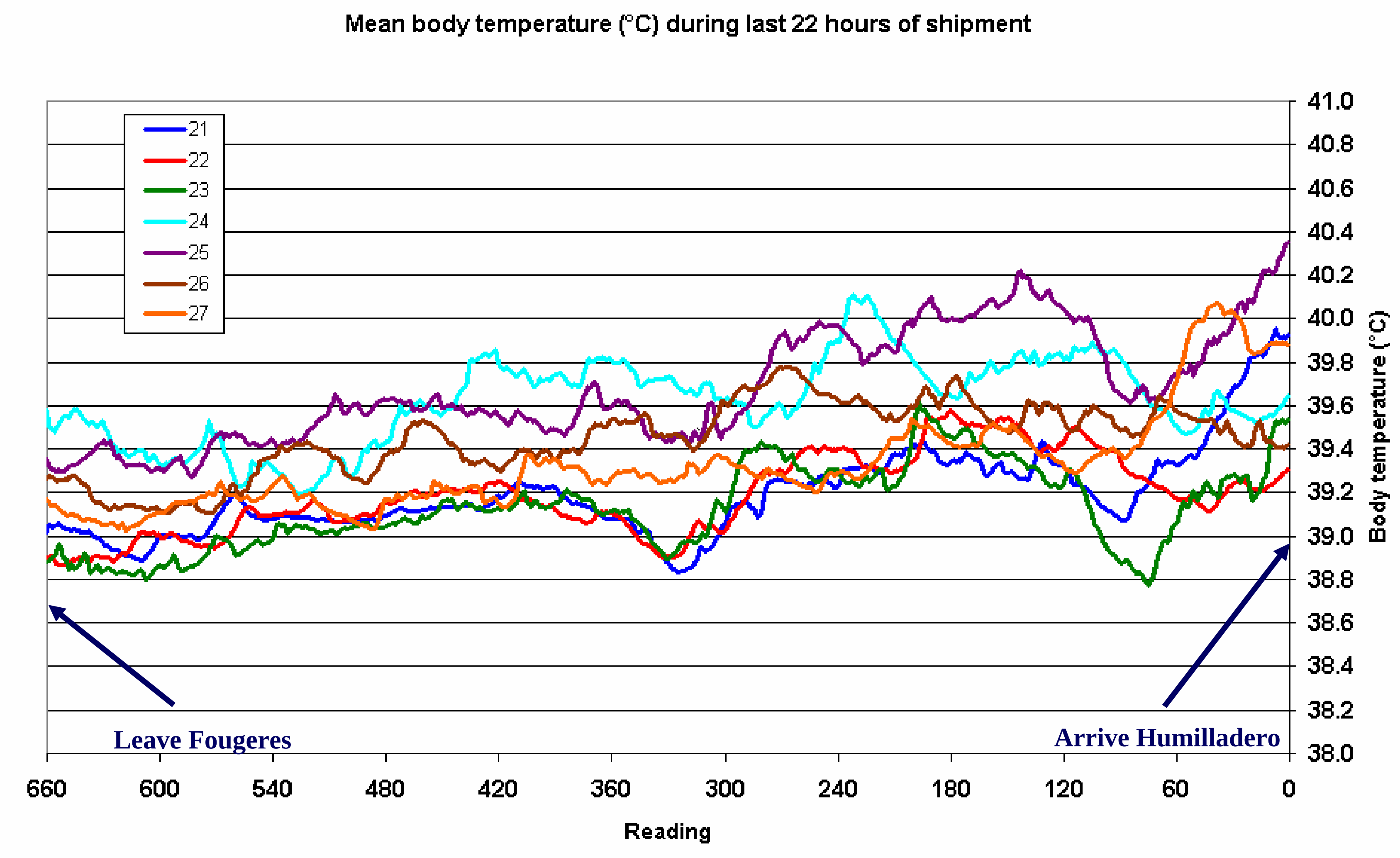




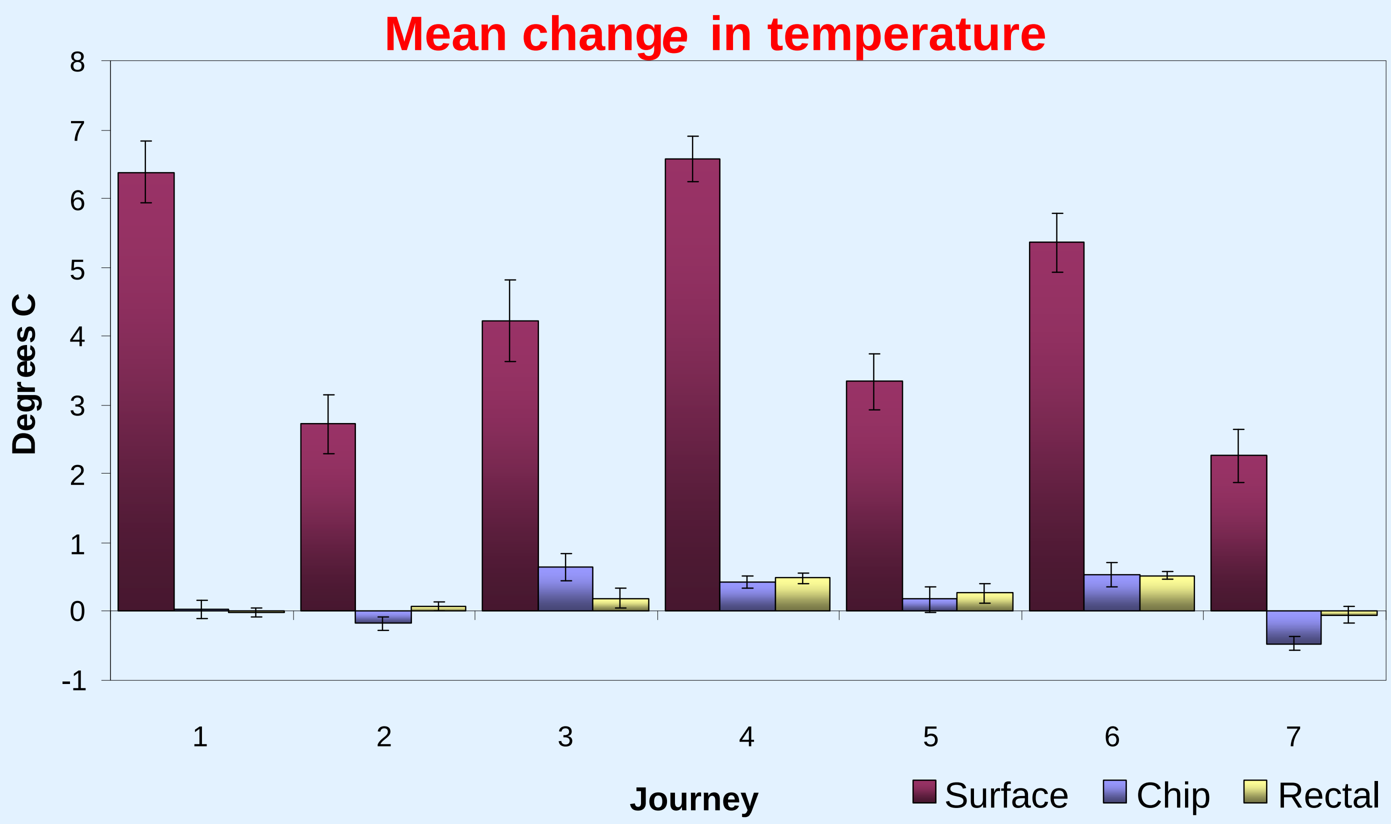




Meandeep bodytemperatures (last22 hours)



Changein bodytemperatures



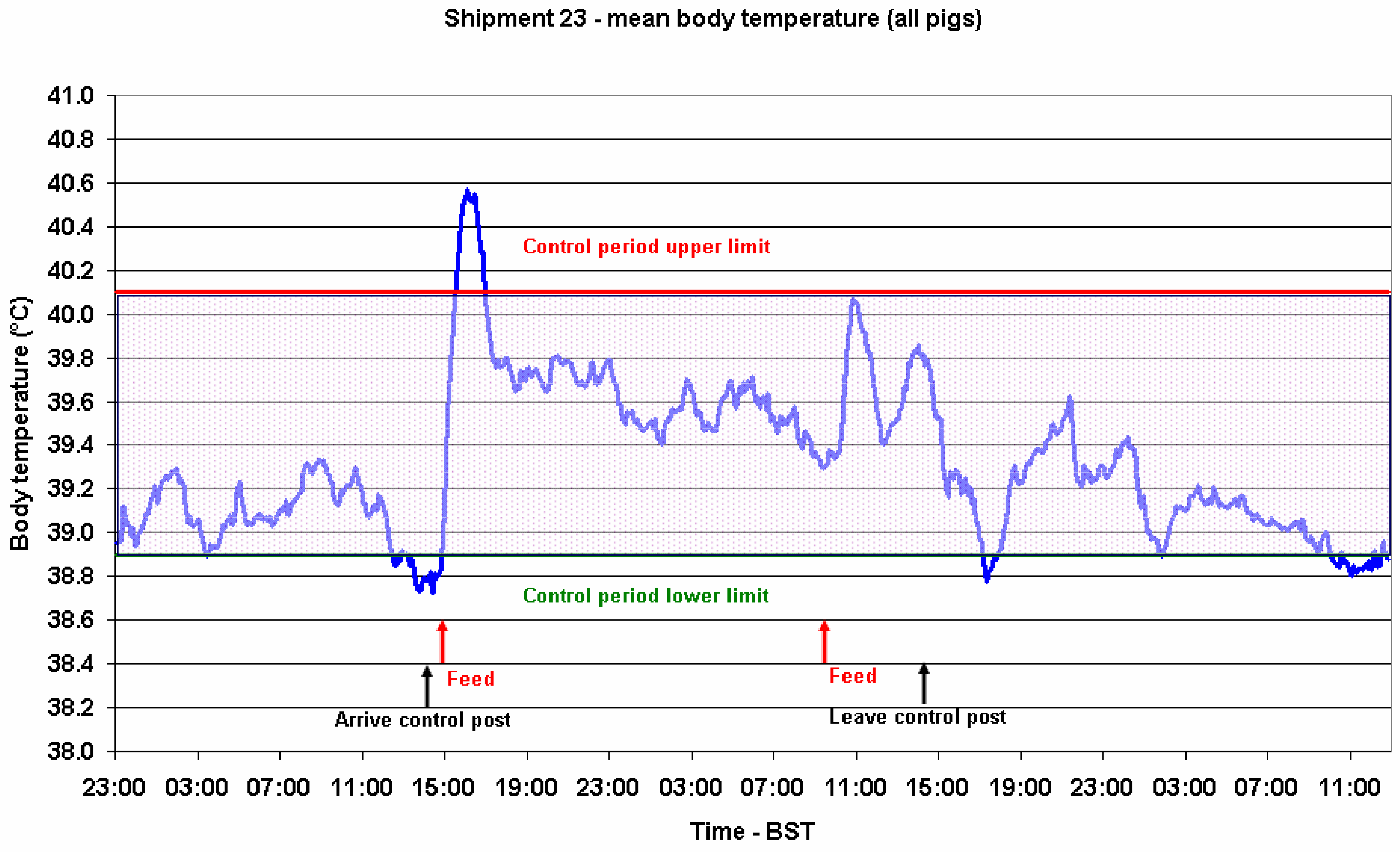
Meanbody temperature – whole journey

Deep body temperature – whole journey							
	Shipment						
	21	22	23	24	25	26	27
Mean	39.5	39.3	39.3	39.6	39.7	39.2	39.5
SD	0.3	0.2	0.3	0.3	0.3	0.3	0.3
Maximum	40.2	39.8	40.6	40.3	40.4	39.8	40.2
Minimum	38.7	38.7	38.7	39.0	39.0	38.7	38.8
Range	1.5	1.2	1.8	1.3	1.4	1.1	1.3
Median	39.4	39.3	39.3	39.7	39.7	39.1	39.4

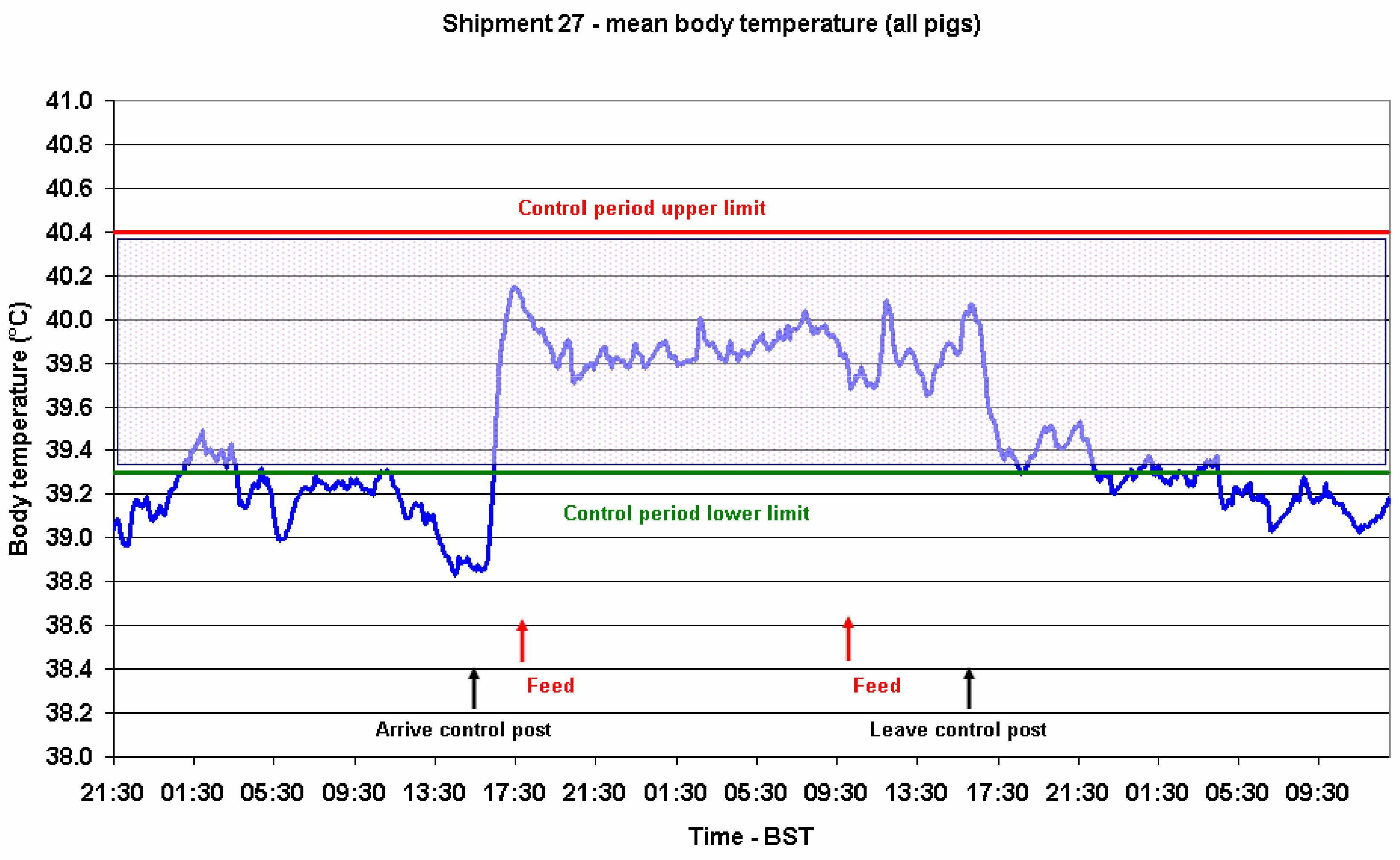
Meanbody temperature – last22 hours

Deep body temperature – final 22 hours of journey							
	Shipment						
	21	22	23	24	25	26	27
Mean	39.2	39.2	39.1	39.6	39.7	39.4	39.3
SD	0.2	0.2	0.2	0.2	0.3	0.2	0.2
Maximum	40.0	39.6	39.6	40.1	40.3	39.8	40.1
Minimum	38.8	38.9	38.8	39.2	39.3	39.1	39.0
Range	1.1	0.7	0.9	0.9	1.1	0.7	1.0
Median	39.1	39.2	39.1	39.6	39.6	39.5	39.3

Meanbody temperature – controland intransit



Meanbody temperature – controland intransit



Dynamicanalyses of temperature data

- **The "Temperature derivative"** is calculated by the method of Savitzky-Golay (smoothing one-dimensional, tabulated data and also for computing numerical derivatives). The fundamental idea is to Fits a different polynomial to the data surrounding each data point. The smoothed points are computed by replacing each data point with the value of its fitted polynomial. Numerical derivatives come from computing the derivative of each fitted polynomial at each data point. In our case a window of 21 points is used with a five order polynomial.

- **Phase space for temperature**. A phase space (Willard Gibbs in 1901) is a space in which all possible states of a system are represented with each possible state of the system corresponding to one unique point in the phase space. A sketch of the phase portrait may give qualitative information about the dynamics of the system. In our case, this has been applied for temperature and its corresponding gradient.

Dynamicanalysis (environment)

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Dynamicanalysis (environment)

		Ship_21	Ship_22	Ship_23	Ship_24	Ship_25	Ship_26	Ship_27	F
Avg T	Bef.	14.4	15.3	14.8	17.0	14.8	13.9	11.8	24.0
	Ext.	14.5	18.9	21.5	19.7	18.7	13.5	12.2	114.7
	E Ist22	15.3	20.9	22.3	21.3	20.2	14.7	14.1	146.3
	Int.	18.2	20.4	23.0	21.8	20.2	16.6	15.1	99.73
Avg RH	Bef.								
	Ext.	76.74	76.42	71.10	72.59	72.86	70.83	-	0.60
	E Ist22	68.94	70.11	71.81	59.89	62.18	67.67	-	0.90
	Int.								
AvgTap	Bef.	33.9	35.1	34.0	40.1	35.9	34.0	30.0	6.57
	Ext.	31.9	43.2	47.5	47.2	45.7	31.2	-	19.1
	E Ist22	31.1	44.1	49.5	44.6	46.7	32.2	-	10.1
	Int.	34.5	41.6	44.9	43.9	40.5	31.6	30.4	52.12
T>30	Bef.	0	0	0	0	0		0	-
N	Ext.	5.3	82.8	208.5	162.6	164.0	0.0	0.0	24.0
	E Ist22	5.3	70.2	115.3	161.8	160.2	0.0	0.0	40.8
	Int.	0.0	0.0	101.5	164.3	148.8	33.7	0.0	767.8
dT/dt> 5-03	Bef.	0	0	0	0	0		0	-
N	Ext.	29.8	50.8	68.8	43.2	51.8	55.7	7.0	0.8
	E Ist22	11.8	25.8	23.3	21.4	29	38	3	0.8
	Int.	3.0	6.3	24.0	4.5	9.8	5.7	7.8	4.96

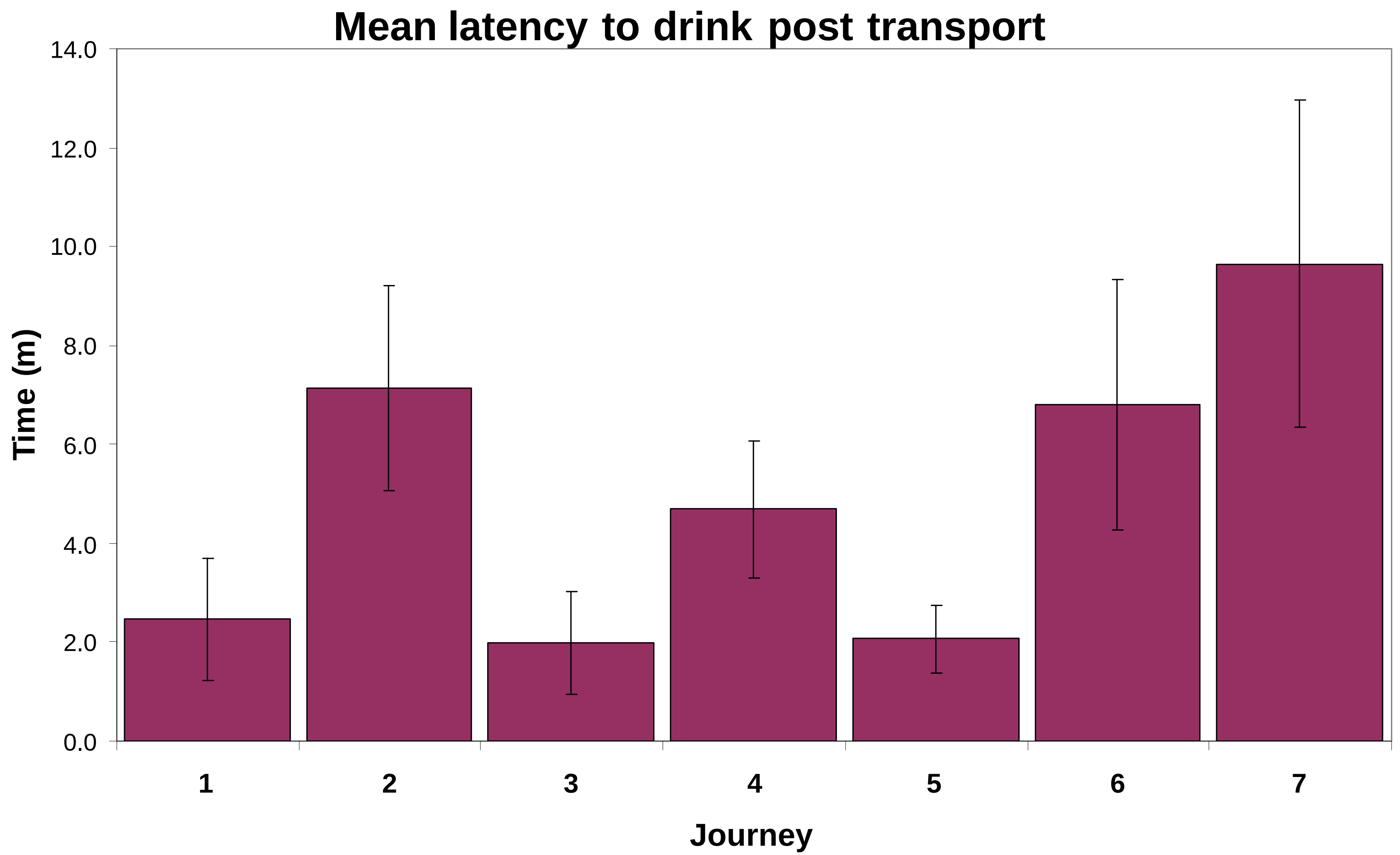
Dynamicanalysis (DBT)

Dynamicanalysis (Environment &DBT)

Dynamicanalysis (Environment &DBT)

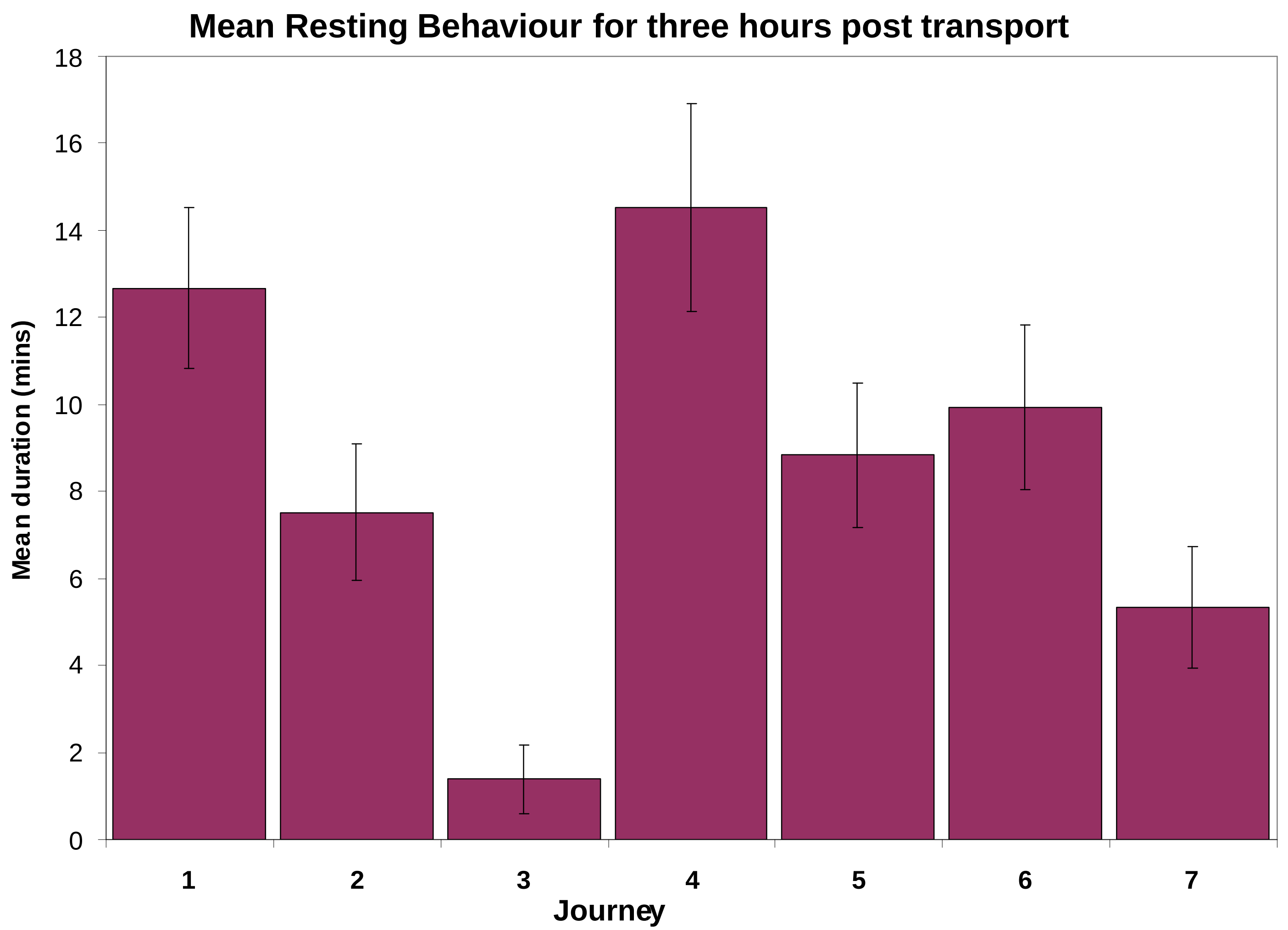
Behaviouralrecording

DrinkingBehaviour



DrinkingBehaviour

RestingBehaviour



SUMMARYand CONCLUSIONS

- **The journeys covered a typical range of thermal conditions and transport micro-environments for Southern Europe.**
- **A number of physiological and behavioural measures and analyses were correlated with the vehicle thermal micro-environment**
- **On none of the journeys was severe thermal stress identified**

SUMMARYand CONCLUSIONS

- The deep body temperature did not exhibit any major excursions outside the normal ranges recorded in the home pen
- The only exceptions correlated with feeding and arousal during lairage
- Journeys that were scored highly on elevated temperatures and enthalpy were associated with increases in both physiological and behavioural indices of stress

SUMMARYand CONCLUSIONS

- Thus journeys3 and 4 (5?) may have been associatedwith some degree of thermal stress (not severe)

- These journeyshad periodswhen the conditionswere in the upper ranges for temperature currentlyprescribed in the regulation

SUMMARYand CONCLUSIONS

- **Integration of the physiological data and dynamic temperature analysis with the behavioural data suggest that we should:-**

Limit duration of exposure to thermal integral above 30°C to180 minutes (3h)

Limit thermal gradient to < 5 x 10^{-3} °C/s

SUMMARYand CONCLUSIONS

- **It is proposed that this approach can provide the sound scientific basis for the prescription of thermal limits for transportation of livestock**

SAC

Success through Knowledge