Thermal stress in livestock during transportation: Continuousrecording of deep body temperature

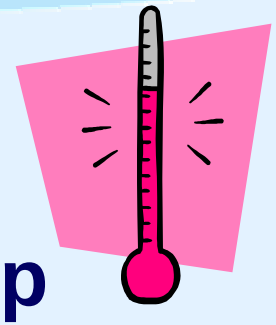
M. A. Mitchell, P.J. Kettlewell, M. Villarroel-Robinson, M. Farish and E. Harper

Background

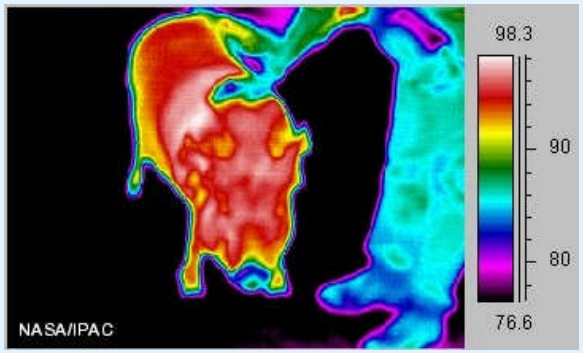
- **Commercial animal transportation is a matter of public and political concern in relation to the welfare of the transported animals.**

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

Background



- **Measurement and monitoring of the deep body temperature will provide insight in to the degree of physiological or thermal stress imposed in transit and the animals' capacity for adaptive responses**



ContinuousRemote Monitoring

- **Continuousmonitoring**
  - **Acute responses, rapid responses, correlation with events of short duration and longer term responses**
- **Point Sampling**
  - **Longer term responses, long recording periods, growth and development**

ContinuousRemote Monitoring

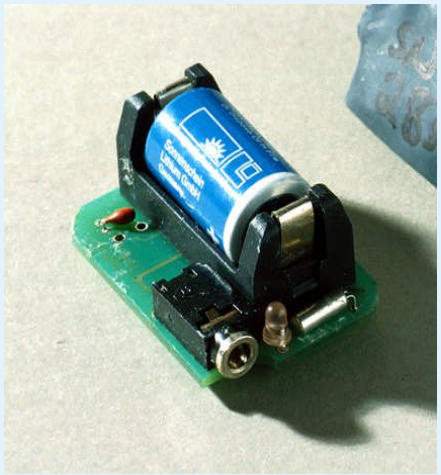
- Normal behaviours
- Free movement
- Inaccessibleor hostileenvironments
- Minimal human influenceor threat
- Protectionof equipment

ContinuousRemote Monitoring

- **Telemetry**

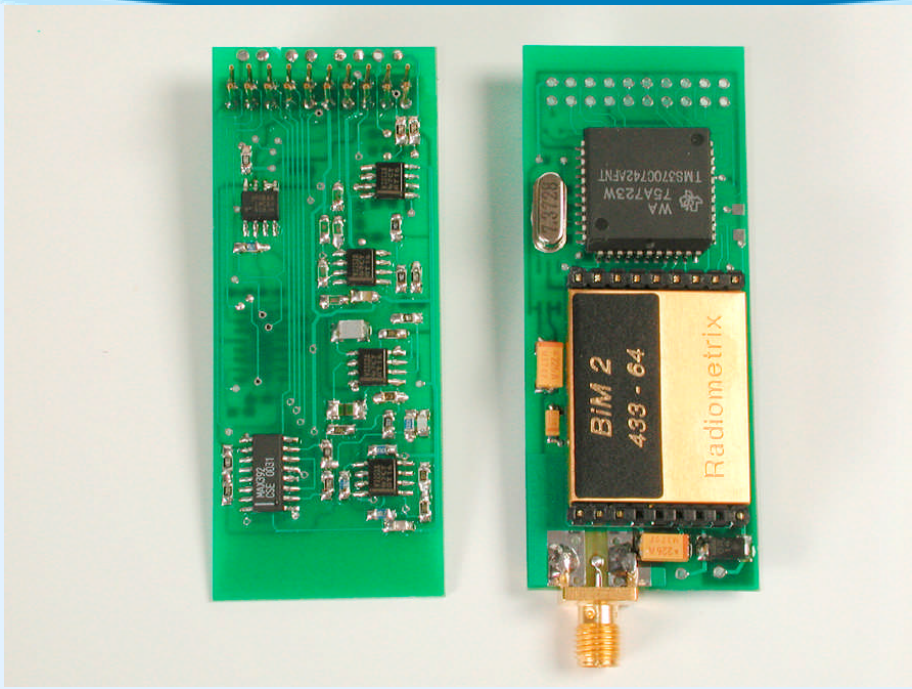
Telemetry

- **Data logging**



Surgical implantation or surface mounted

Telemetrypackage

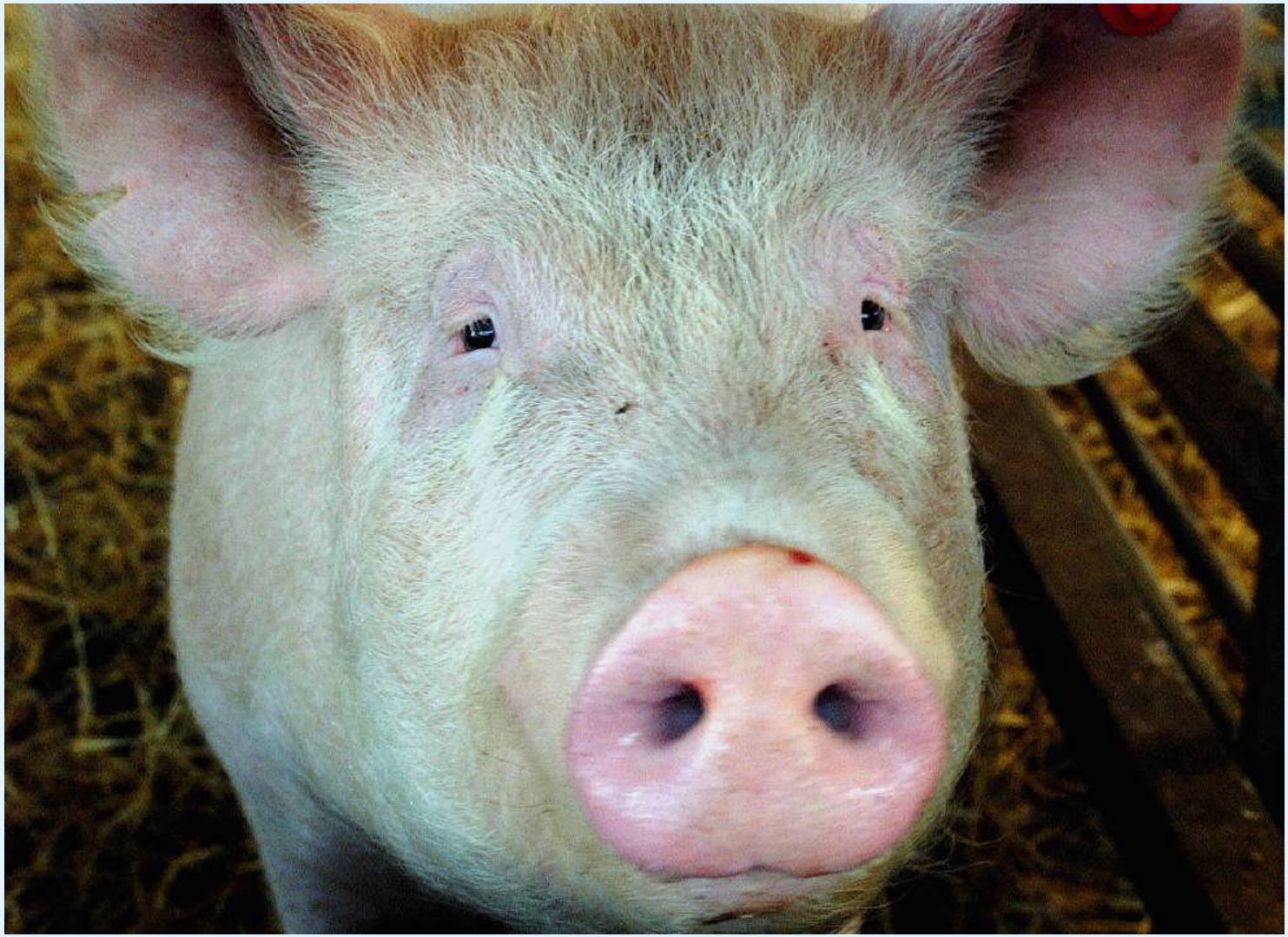


- Multi-channel
- Bi-directional
- Interactive
- Time multiplexed
- Digital+ waveform
- Micro-controller(TMS370C742)
- BIM418Ftr ansceivermodule - 433 MHz

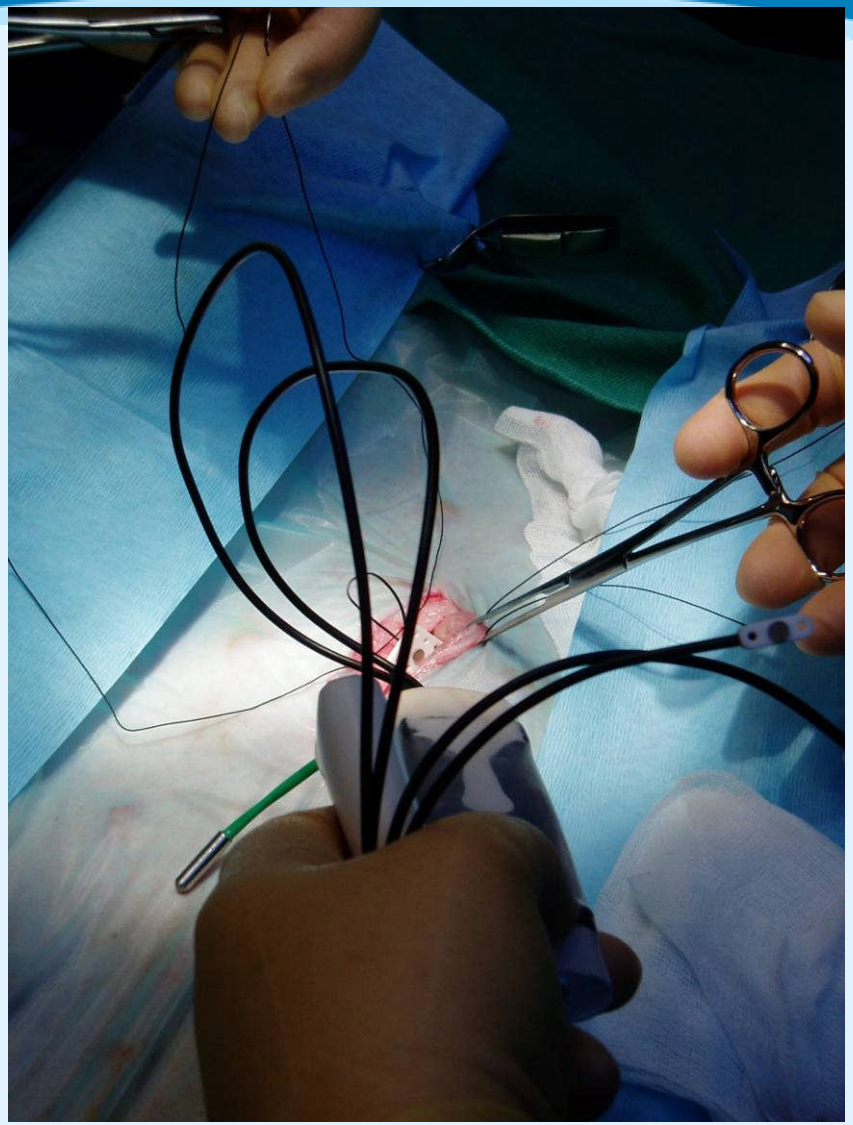
Telemetrypackage

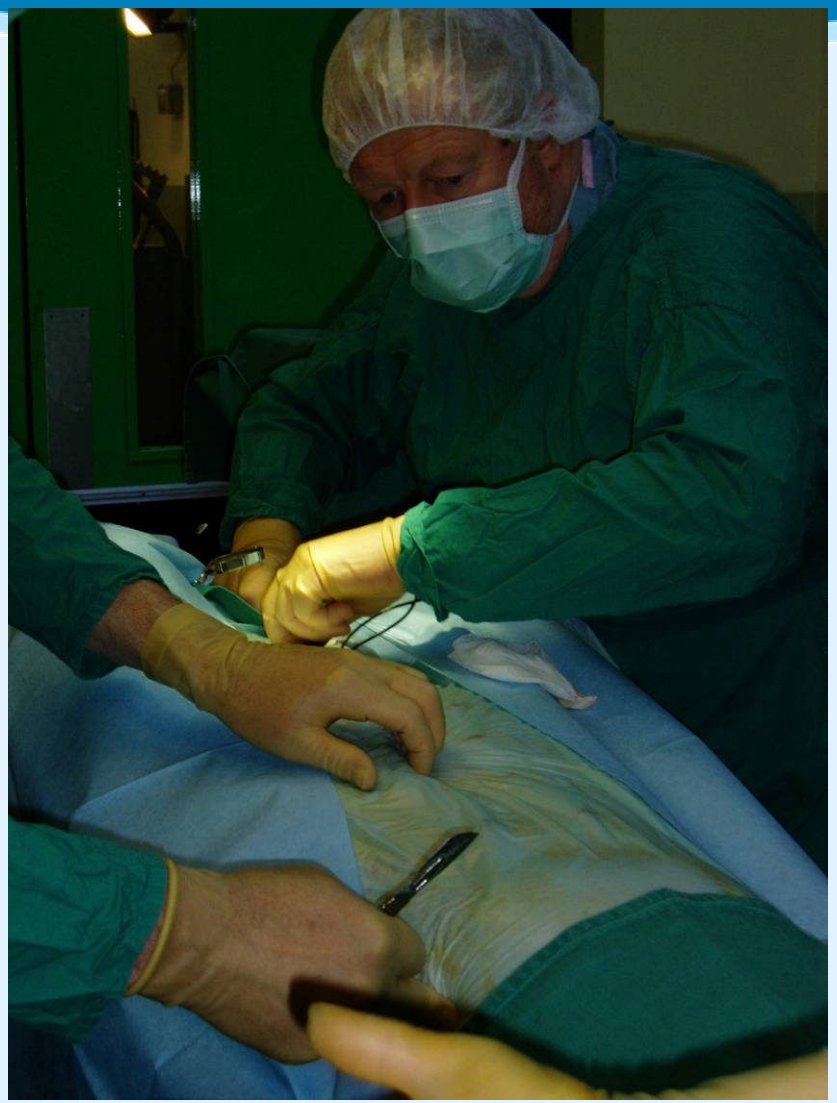
Large mammal Tx

PigTelemetry



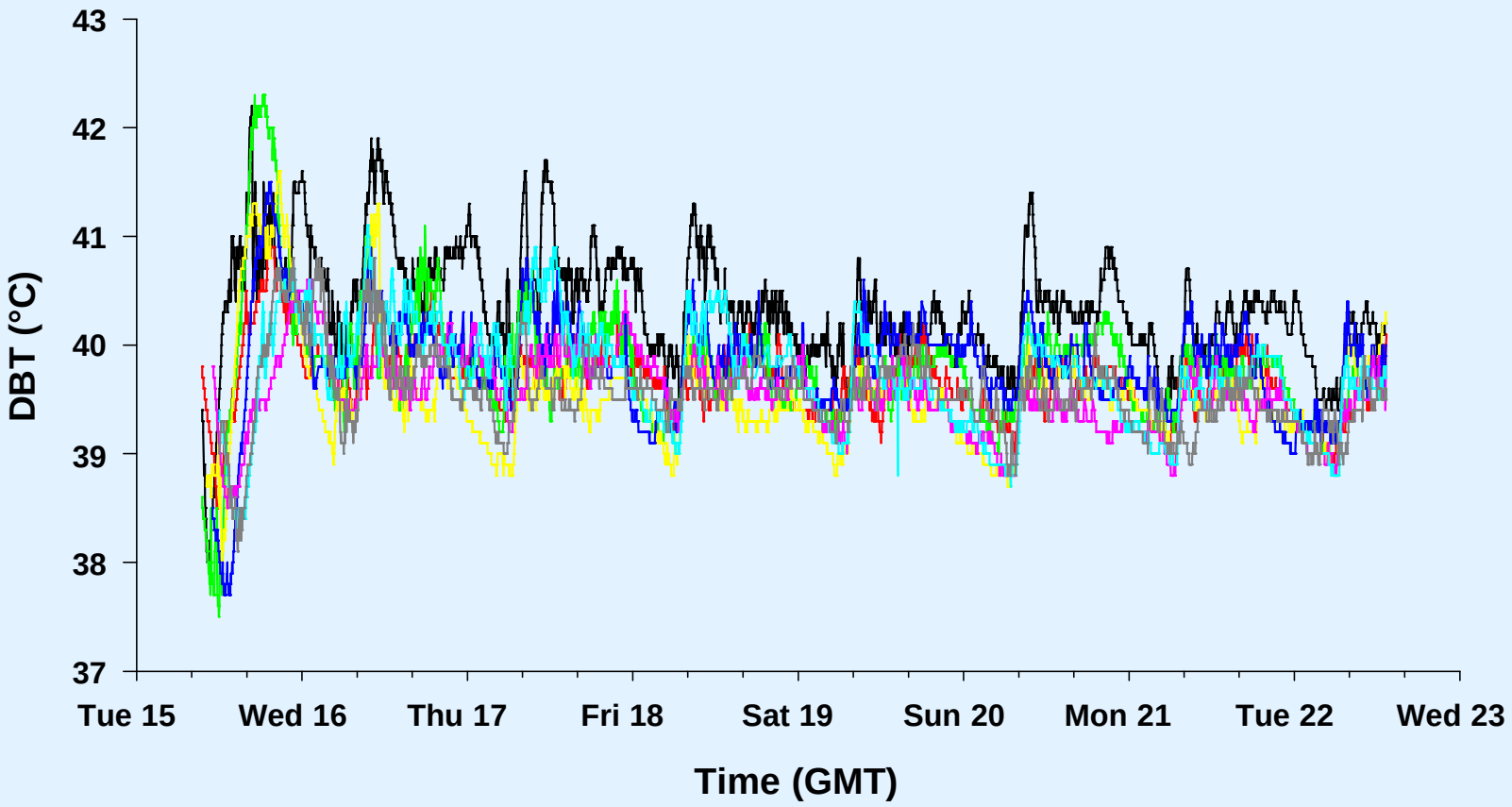
Telemetryimplant surgery



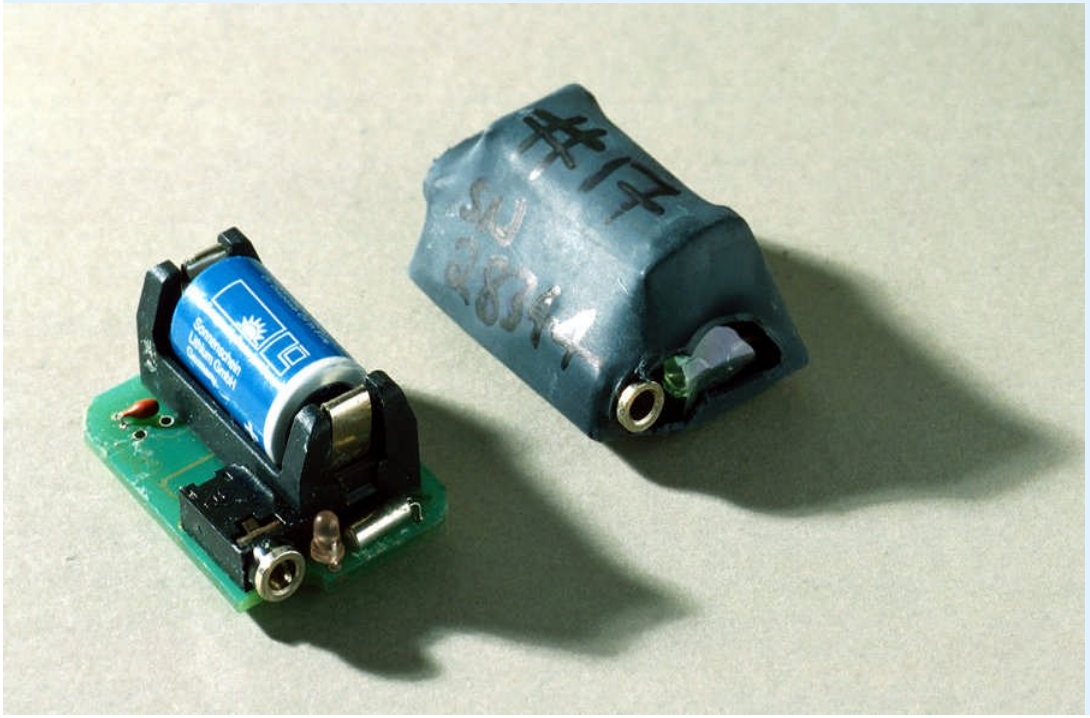


Telemetryimplant surgery

PIG – DBT – DIURNAL RHYTHM

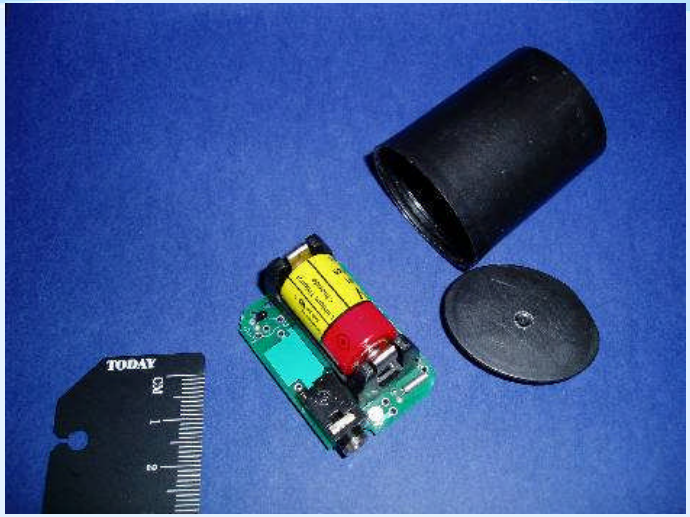


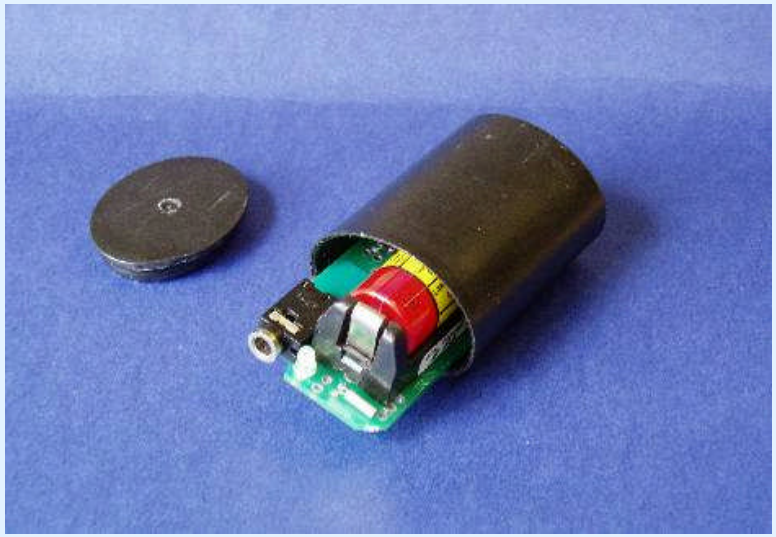
Physiologicaldata logging

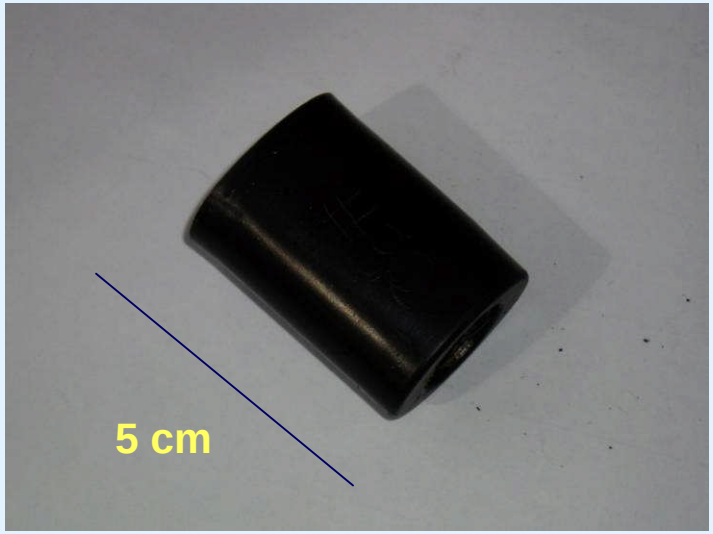


- Memory 16,000 readings
- Logging interval 1 sec to 4.5 hours
- Temp. range -30º to +50ºC
- Accuracy ± 0.2ºC
- Resolution 0.25ºC
- Battery life ≈ 2 years

Body temperaturedata logging

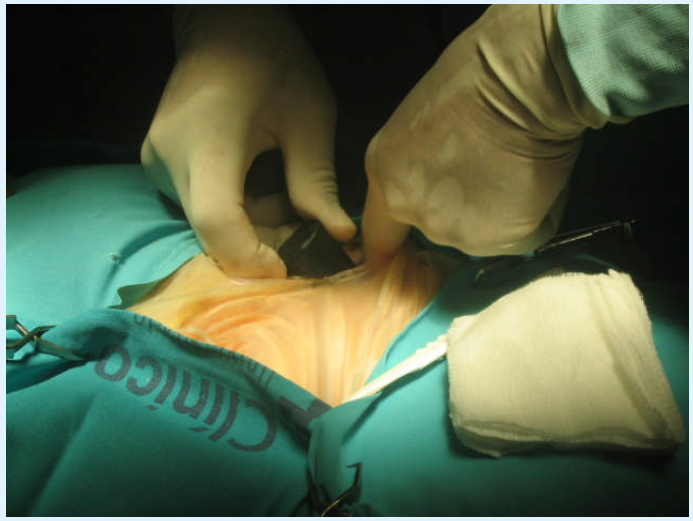


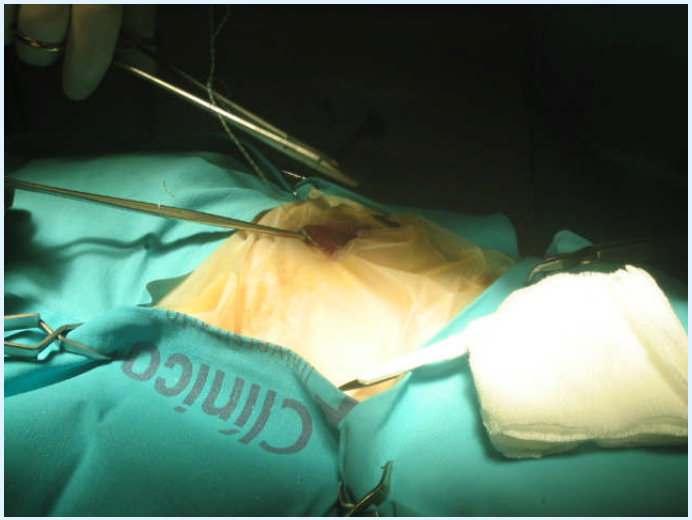




Lambdata logging

Physiologicaldata loggingin lambs

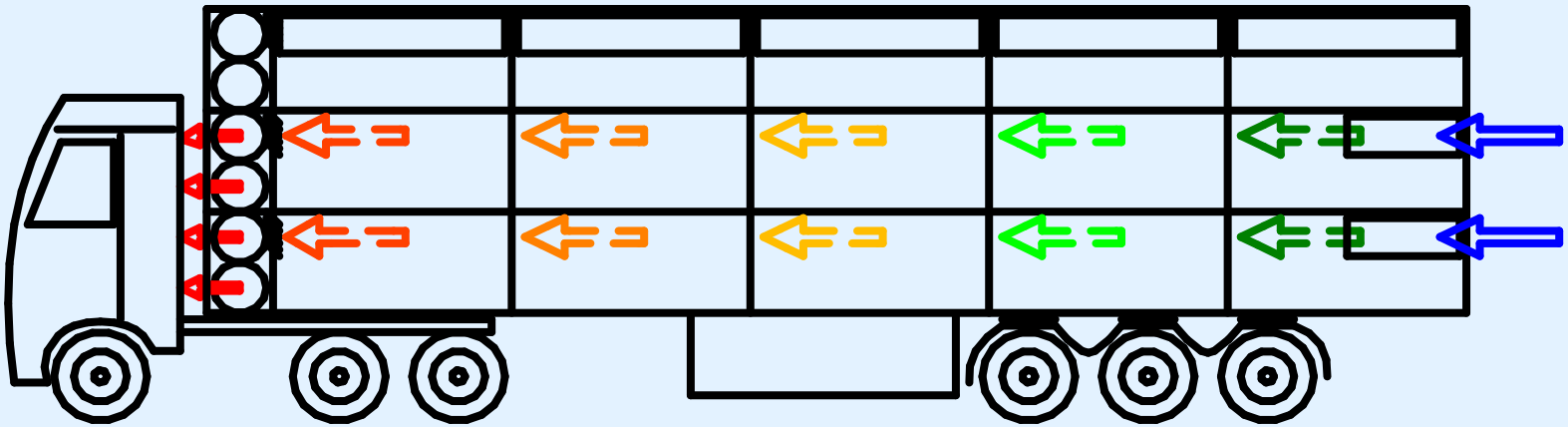




Studiesof “hotweather transport”

Studies were undertaken to investigate the deep body temperature responses of pigs and lambs to hot weather transportation in Spain in mid-summer

Experimentalvehicle (Spain)



Experimentaljourneys – Spain (transportof pigsand lambs)

Experimentaljourneys

Methods:-

- 8 hour journeys using “Experimental commercial vehicle”
  - – 45 minute mid-journey break
- commercial space allowances
- natural ventilation

Experimentaljourneys

Environmentalmeasurements

- ambient and within container – temperature and relative humidity
- solar radiation
- heat and moisture production measurements (mechanical ventilation)

Experimentaljourneys

Physiologicalmeasurements

- Radio-telemetry – deep body temperature (pigs)
- Data logging – deep body temperature (lambs)

Journeyand animaldetails for transportstudies

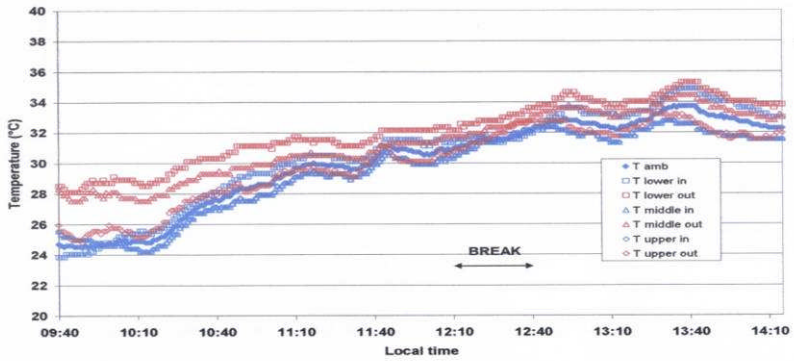
Journey	Species	Average liveweight (kg)	Total number transported
1	Pigs	102	176
2	Lambs	22	600
3	Pigs	106	178
4	Lambs	22	600
5	Pigs	121	53
6	Pigs	103	60

Journeyconditions

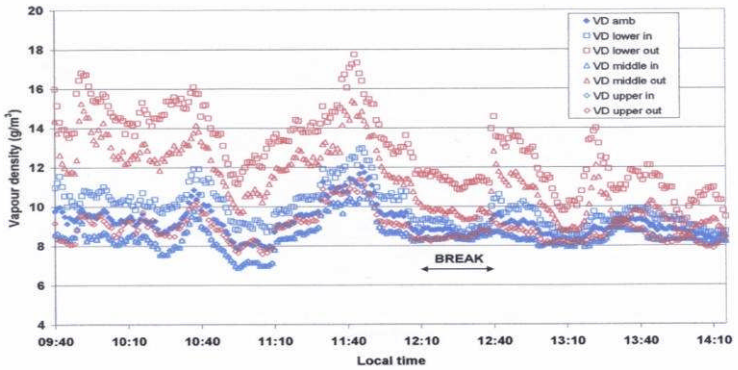
Journey	Species	Mean temp (ºC)	Max temp (ºC)	Mean VD (gm^{-3})	Max VD (gm^{-3})
1	Pigs	30.0	35.3	9.2	14.5
2	Lambs	31.4	37.9	10.4	17.0
3	Pigs	22.6	28.7	13.4	19.0
4	Lambs	19.8	23.6	9.3	10.8
5	Pigs	19.5	22.3	5.7	6.8
6	Pigs	23.1	26.9	6.7	7.9

Experimentaljourneys

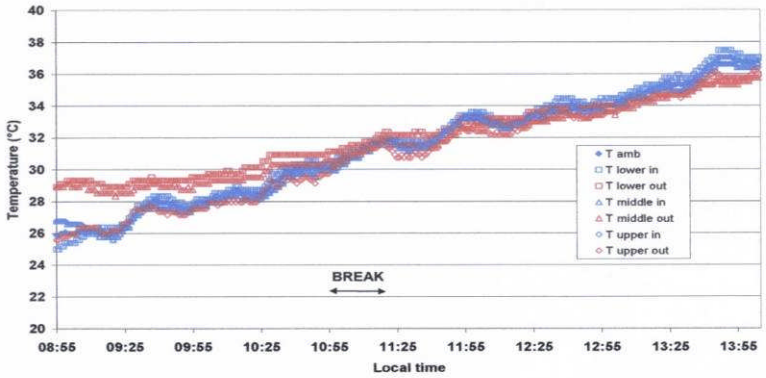
Temporal distribution of temperatures during journey 1 (pigs)



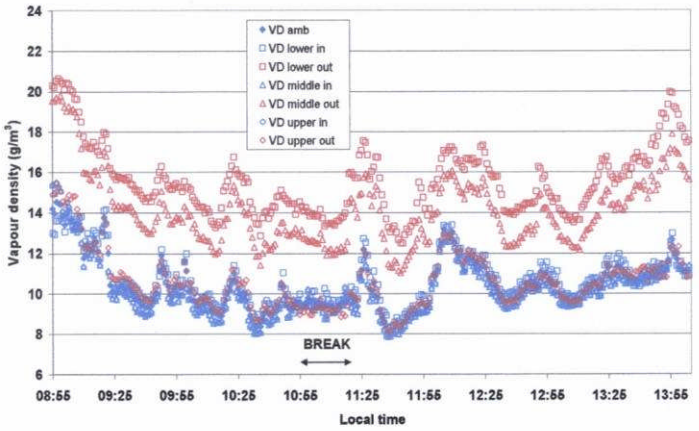
Temporal distribution of water vapour density during journey 1 (pigs)



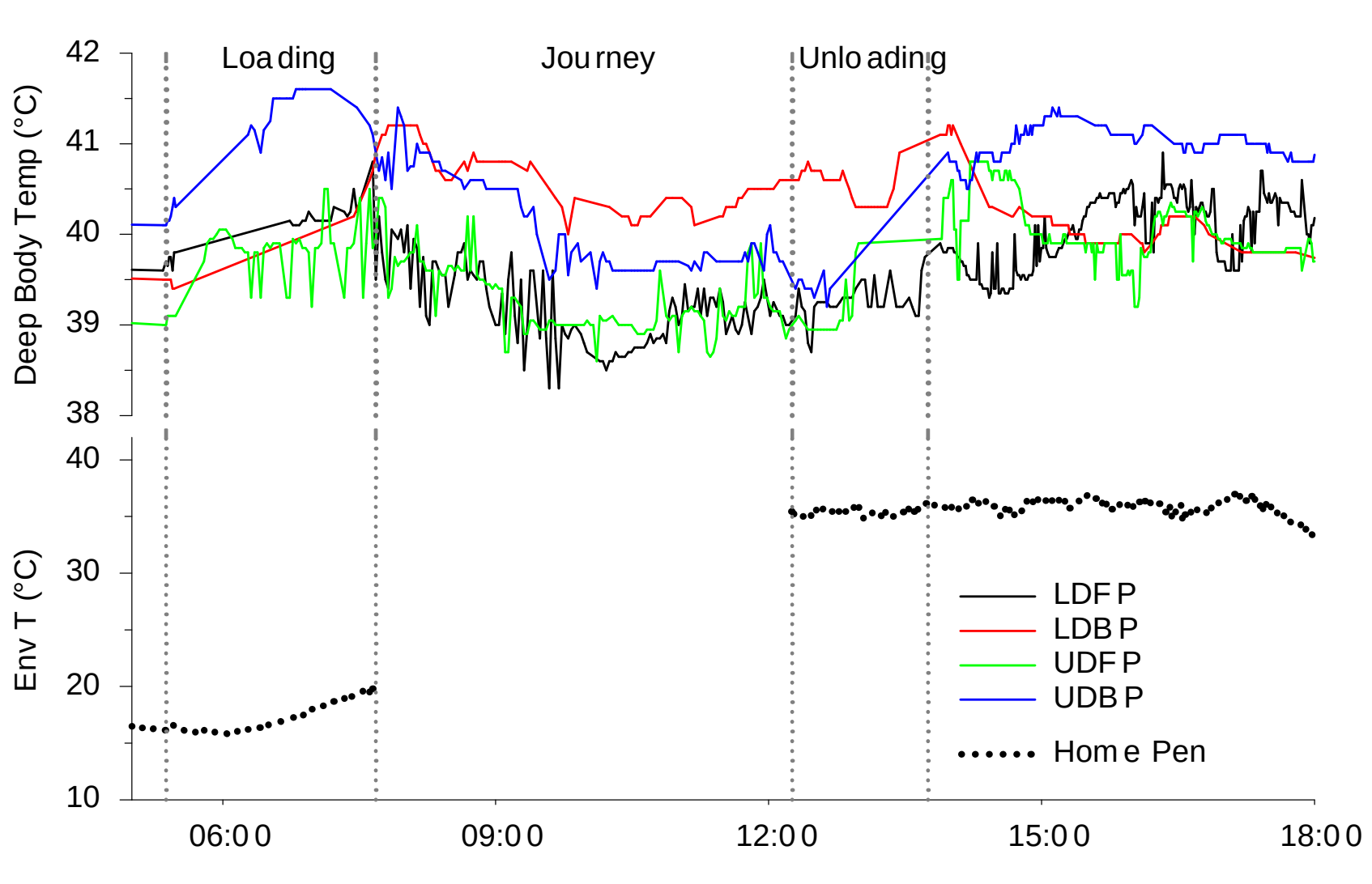
Temporal distribution of temperature during journey 2 (lambs)



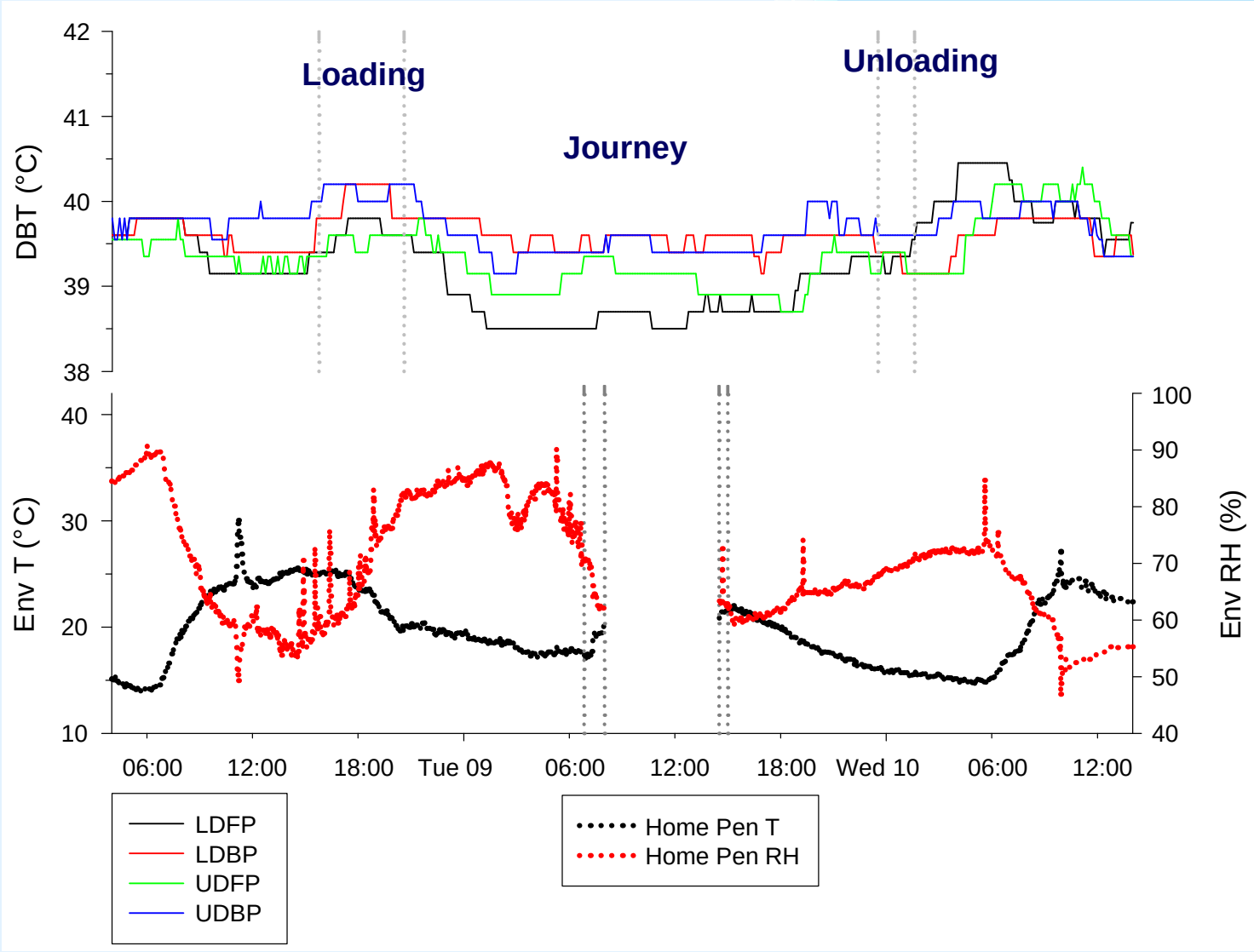
Temporal distribution of water vapour density during journey 2 (lambs)



PIGS(DBT Journey1)



LAMBS(DBT Journey4)



Effectsof transportationon deep body temperature

Journey	Species	Control DBT (ºC)	"In transit DBT (ºC)	Change (ºC)	Stat sign
1	Pigs	40.4 ± 0.4	39.9 ± 0.5	- 0.5	$p < 0.05$
2	Lambs	39.9 ± 0.2	39.3 ± 0.4	- 0.6	$p < 0.002$
All pig journeys	Pigs	39.8 ± 0.4	39.5 ± 0.5	-0.3	$p < 0.05$
All pig journeys	Lambs	39.8 ± 0.3	39.3 ± 0.4	-0.5	$p < 0.001$

Radio-telemetryand datalogging

Implant Surgery Session	Operational Units	Total Readings	Total Drop-out	Efficiency (%)
1	8	38,856	6,359	84
2	6	10,800	0	100
3	8	20,314	3,992	80
4	8	14,399	1	100
5	8	97,163	16,653	83
6	7	12,600	903	93
7	8	113,895	6,314	95
Total	53	308,027	34,222	89

Summary(1)

- **Both radio-telemetry and data logging are appropriate methods for the continuous monitoring of deep body temperature in livestock (during transportation).**
- **The efficiency of data capture for both methods is high.**
- **Both methods provide valuable and important information that can be incorporated in to physiological stress response modelling.**

Summary(2)

- **Body temperature responses form an important component of physiological models that may be used to develop guidelines and legislation relating to the welfare of animals in transit.**

- **The current study importantly illustrates that in adapted animals heat stress in transit does not occur under conditions that would induce severe heat stress in non-adapted animals.**

- **Continuous monitoring of physiological variables during stress may assist in improving animal welfare in practical and commercial setting**

ADAS

SAC

AATA

A GLOBAL INDUSTRY

CASA DE GANADEROS
DESDE 1218

University of Zaragoza

defra
Department for Environment Food and Rural Affairs

Escuela Técnica Superior de Ingenieros Agrónomos
UNIVERSIDAD POLITÉCNICA DE MADRID

University of Madrid

ROSLIN INSTITUTE

SILSOE RESEARCH INSTITUTE


THANK YOU FOR YOUR
ATTENTION !