

Urban Search and Rescue Operations in Tropical Climates

Matt Brearley¹, Ian Norton^{1,2}, Daryl Rush³, Mick Hutton⁴,
Steve Smith³, Hector Fuentes⁵

¹ National Critical Care and Trauma Response Centre

² World Health Organisation

³ Queensland Fire and Emergency Services

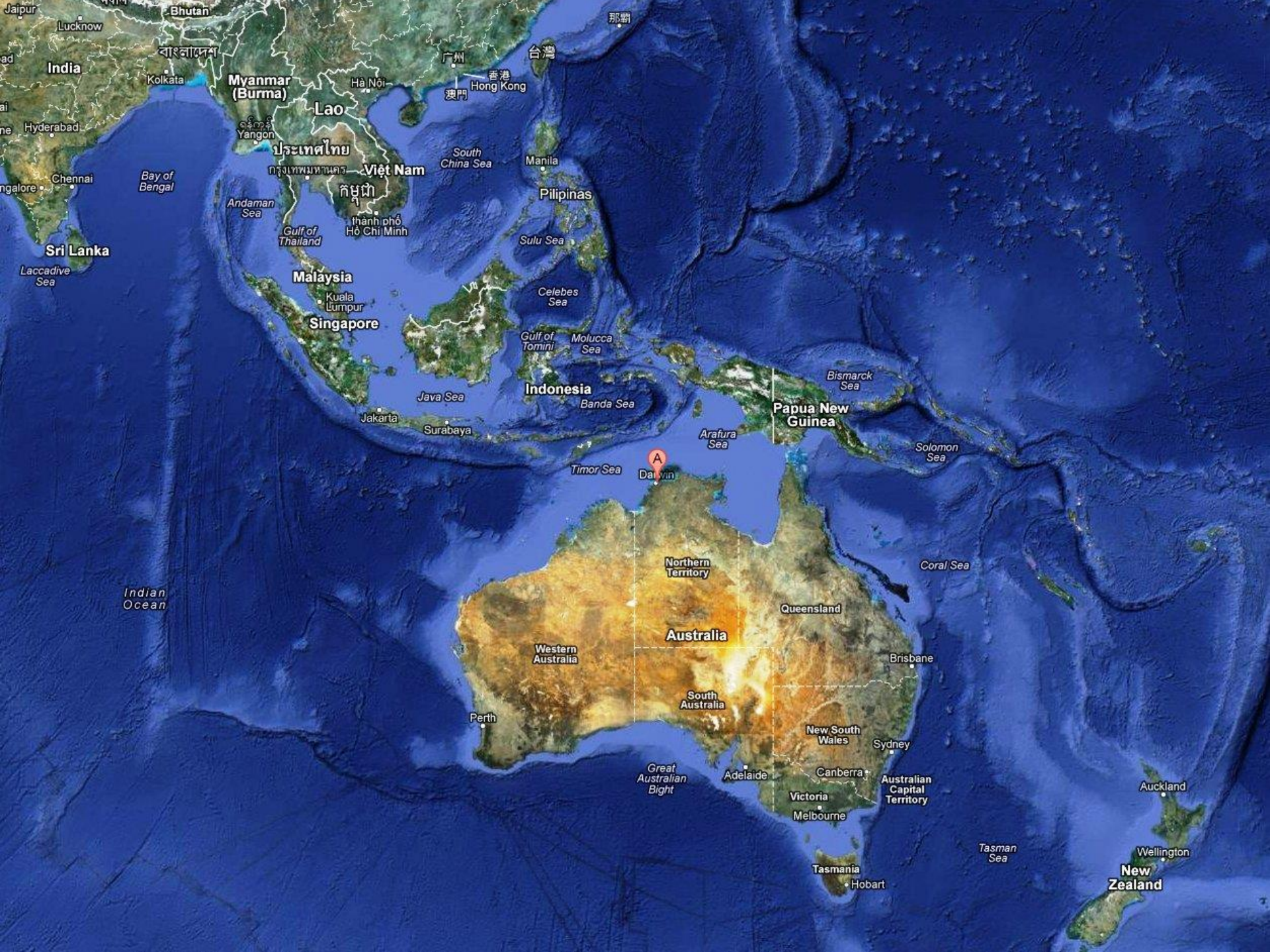
⁴ Northern Territory Fire and Rescue Service

⁵ Princess Alexandra Hospital



NATIONAL CRITICAL
CARE AND TRAUMA
RESPONSE CENTRE



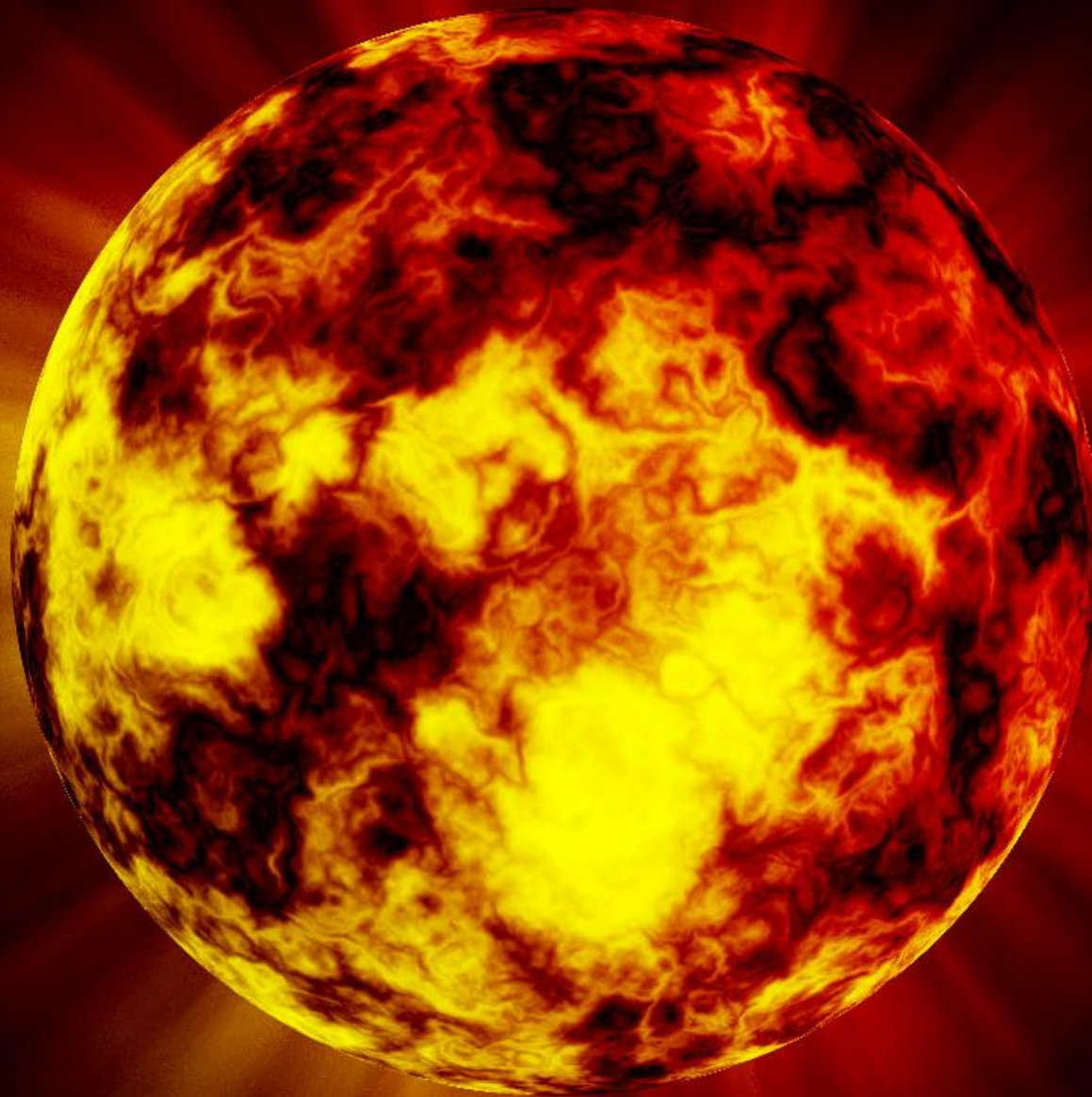




**NATIONAL CRITICAL CARE
AND TRAUMA RESPONSE CENTRE**



**NATIONAL CRITICAL CARE
AND TRAUMA RESPONSE CENTRE**



**NATIONAL CRITICAL CARE
AND TRAUMA RESPONSE CENTRE**

**LOOK UP.
STAY
ALIVE.**



Dropbears are a very real danger to all Australians. Almost one in ten Australians has been attacked by a Dropbear, and the rate is even higher for foreign visitors. Don't become another statistic. Always beware low branches and doorframes. *Look up. Stay alive.*



**Department of Dangerous
Fauna Management**

When Good Koalas Go Bad



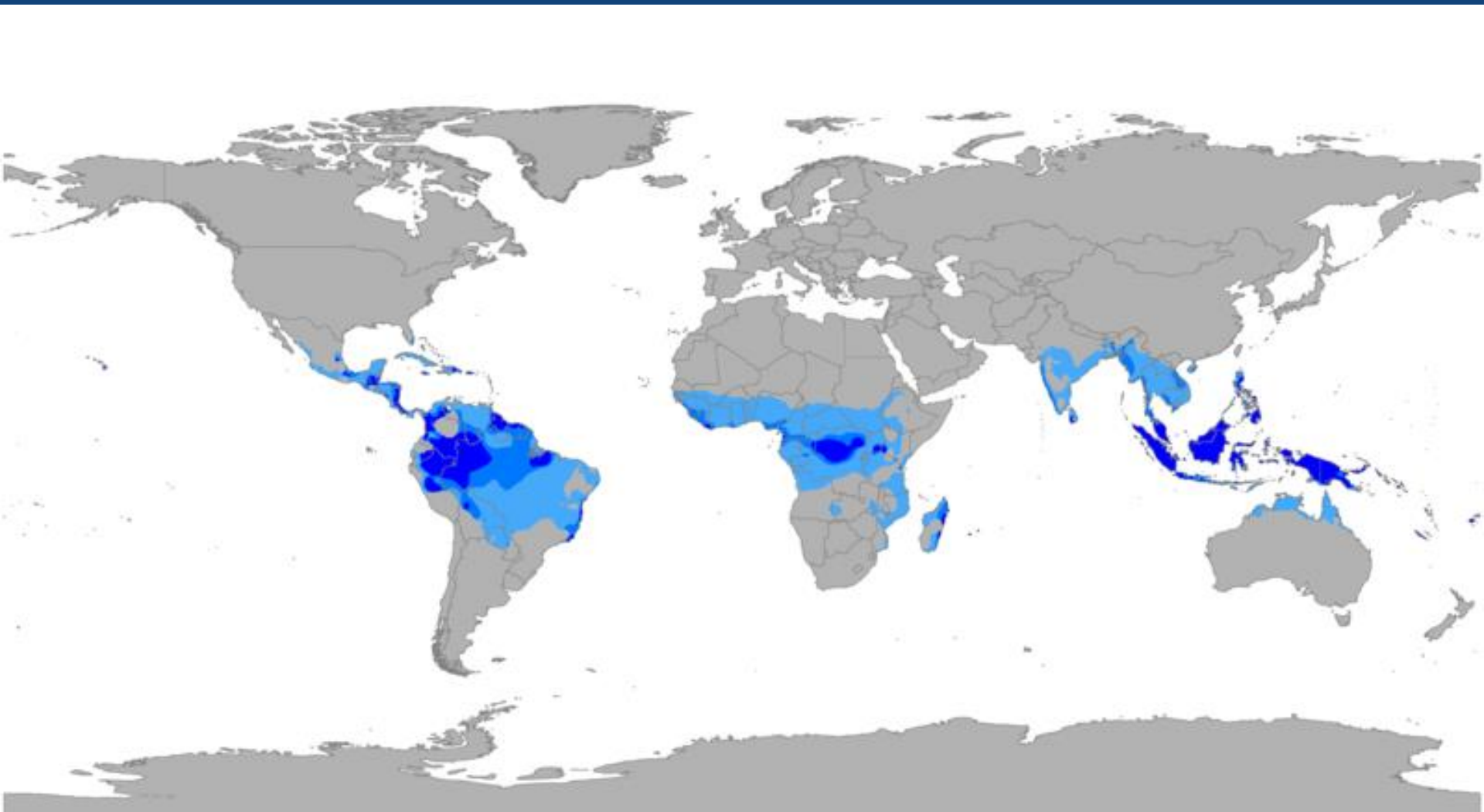
**NATIONAL CRITICAL CARE
AND TRAUMA RESPONSE CENTRE**

When Good Crocodiles Go Bad



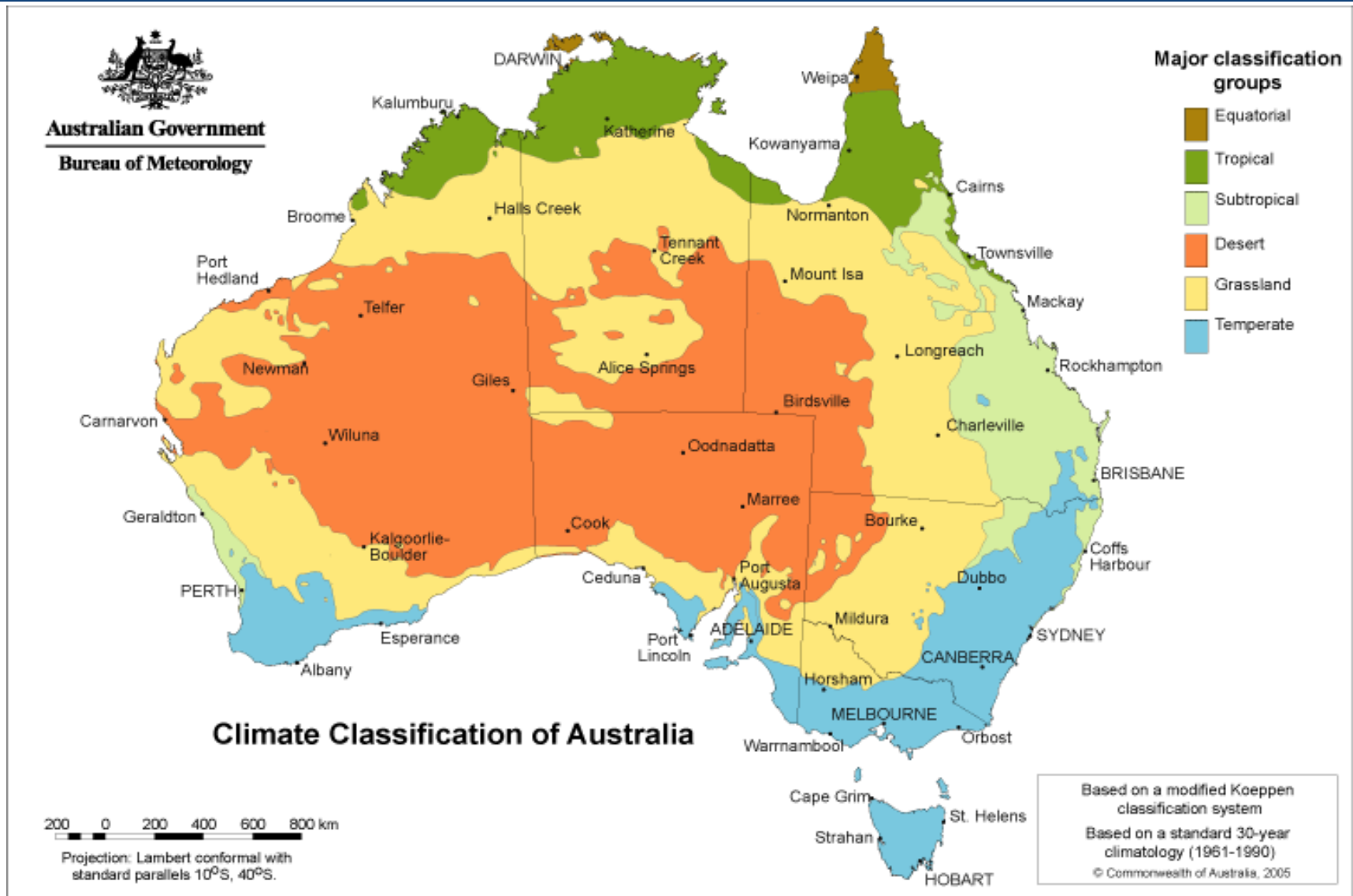
**NATIONAL CRITICAL CARE
AND TRAUMA RESPONSE CENTRE**

Tropical Climates



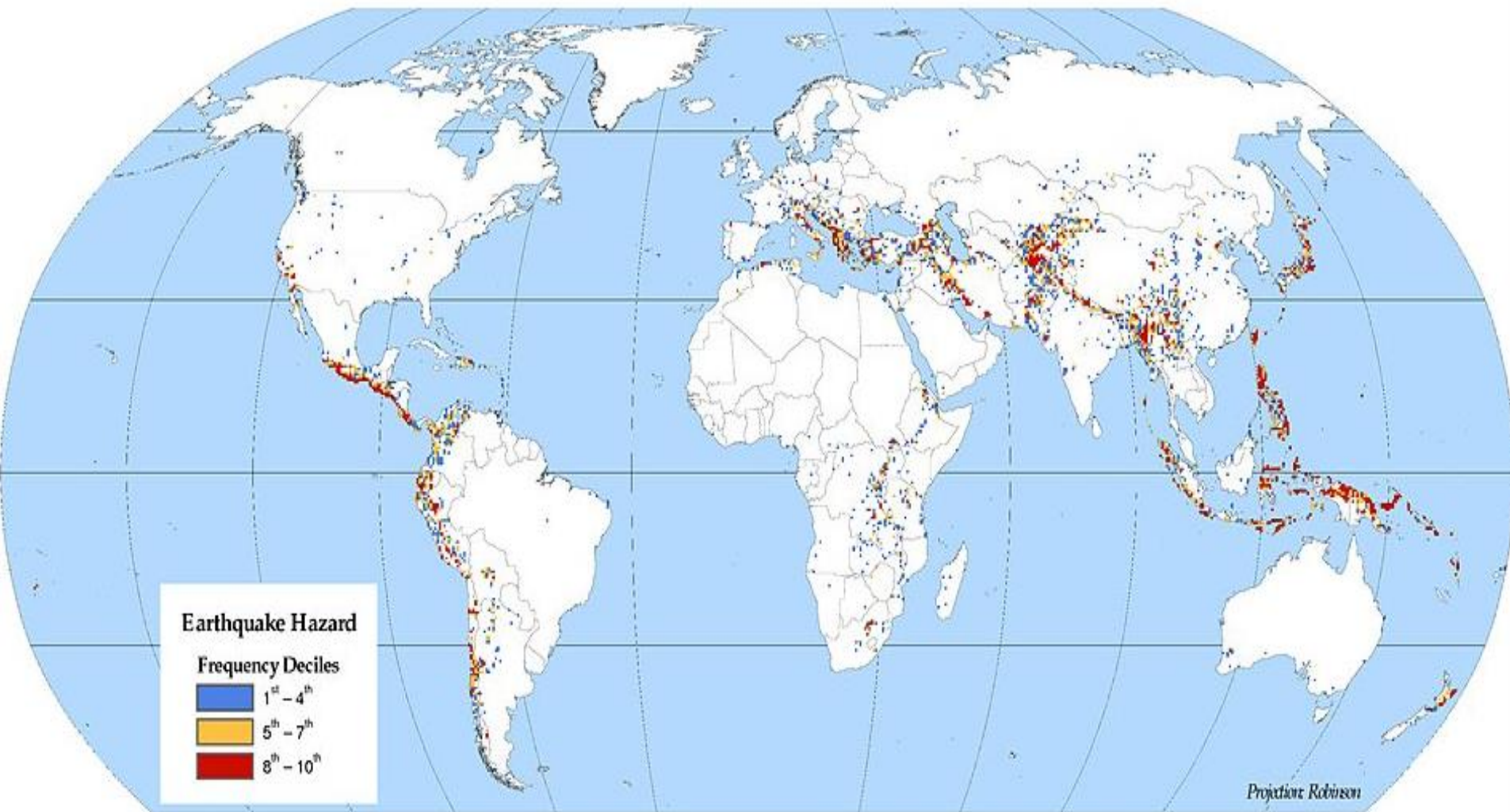
**NATIONAL CRITICAL CARE
AND TRAUMA RESPONSE CENTRE**

Tropical Climates



**NATIONAL CRITICAL CARE
AND TRAUMA RESPONSE CENTRE**

Earthquake Hazard Distribution



Dilley, Maxx, Chen, Deichmann, Lemer-Lam, Arnold (2005). World Bank Report.



**NATIONAL CRITICAL CARE
AND TRAUMA RESPONSE CENTRE**

Participants

Variable	Heat Acclimatised	Non Heat Acclimatised
n	8	8
Age (yrs)	37.9	41.3
Body Mass (kg)	86.2	98.1
Height (m)	1.79	1.83
Body Mass Index	26.9	29.2



Methodology

- QLD team arrive Darwin 1200
- Briefing @ 1250
- 2 groups of mixed NHA and HA formed
- Start @ 1320
- Both teams work initial shift
- Rotate thereafter, working ~14.5 hours
- Physiological and perceptual monitoring
- Initial Shift 34.0°C/48% RH
- Overall 29.4°C/72% RH



Monitoring Equipment



NATIONAL CRITICAL CARE
AND TRAUMA RESPONSE CENTRE

Simulated Earthquake



NATIONAL CRITICAL CARE
AND TRAUMA RESPONSE CENTRE

Simulated Earthquake



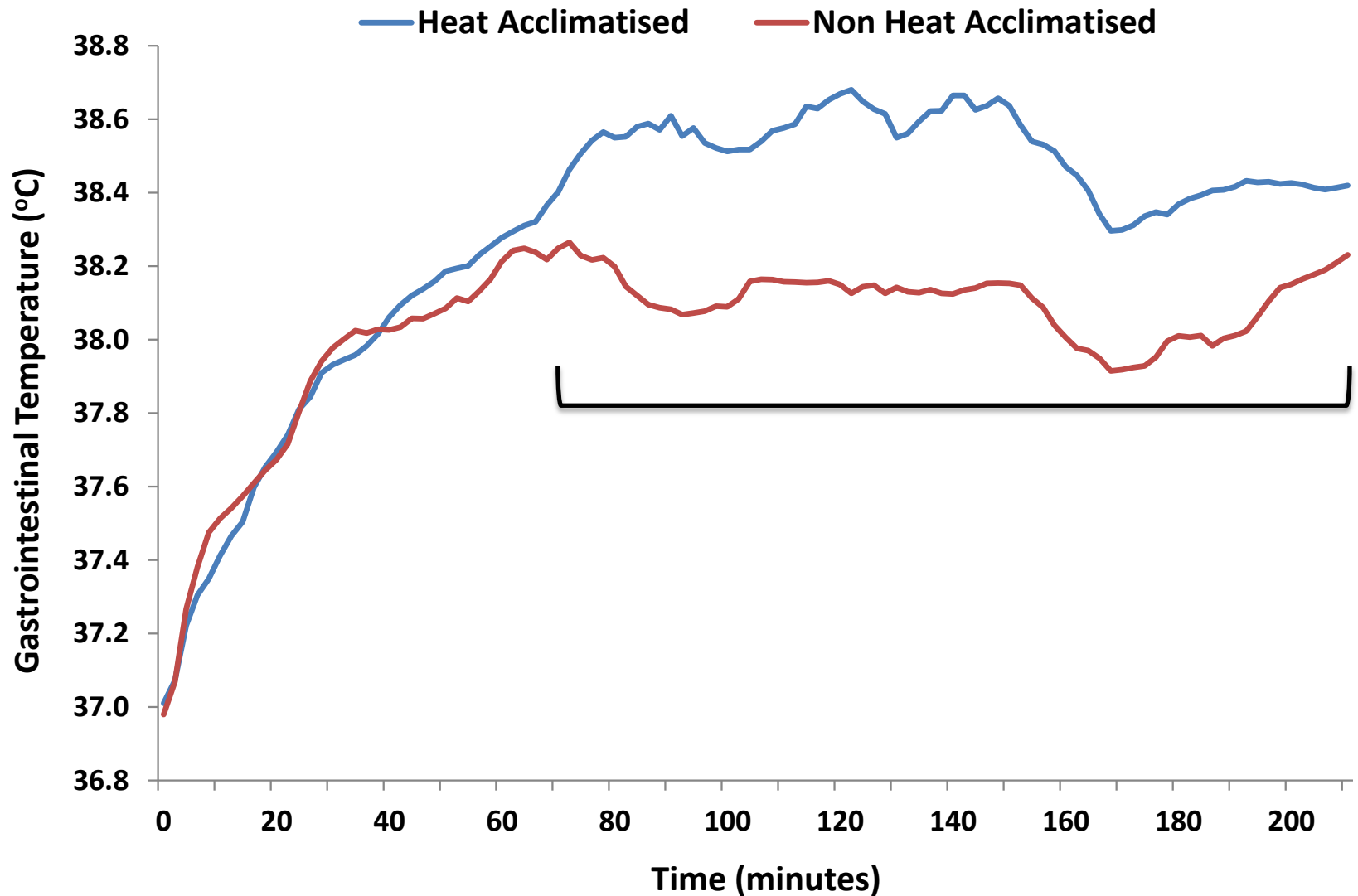
NATIONAL CRITICAL CARE
AND TRAUMA RESPONSE CENTRE

Initial Shift

Variable	Heat Acclimatised	Non Heat Acclimatised
Pre USG	1.014	1.010
Mean T_{gi} ($^{\circ}\text{C}$)	38.33	38.06
Heart Rate ($\text{b}\cdot\text{min}^{-1}$)	130.5	129.6
Respiratory Rate ($\text{r}\cdot\text{min}^{-1}$)	25.6	27.2
Exceeded ISO9886	8	7
$T_{gi} > 39.0^{\circ}\text{C}$	4	2



Initial Shift



Initial Shift

Variable	HA	NHA
Sweat Loss (L)	5.3	4.7
Fluid Consumption (L)	4.5	4.3
Sweat Rate (L.h ⁻¹)	0.98	0.84
Sweat Rate (mL.h ⁻¹ .kg BM ⁻¹)	11.0	8.8
Dehydration (%)	0.8	0.5



Sleeping Quarters



NATIONAL CRITICAL CARE
AND TRAUMA RESPONSE CENTRE

Presentations to the Medical Team

Hours	Acute T _{gi} /HR	N	H	V
9.5*	37.3 / 104	■	■	
9.5	37.8 / 131	■	■	
9.6*	38.2 / 101	■	■	
13.5	37.2 / 96	■	■	■
18.0	37.4 / 117	■	■	
20.7	38.2 / 132	■	■	
21.3	37.4 / 125	■	■	

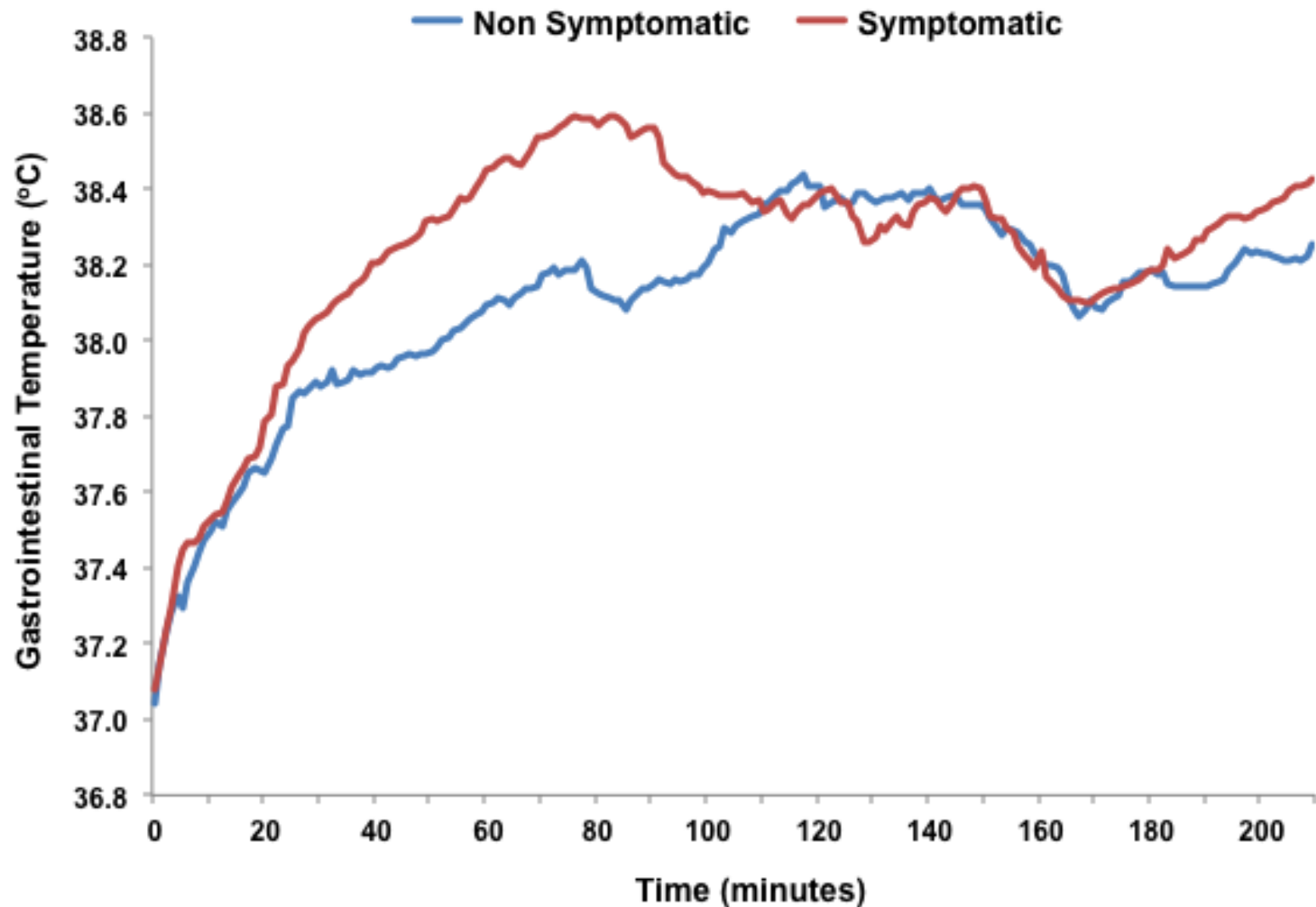


Presentations to the Medical Team

Hours	Acute T _{gi} /HR	N	H	V	Prev. 2h T _{gi} /HR
9.5*	37.3 / 104	■	■		37.5 / 114
9.5	37.8 / 131	■	■		37.3 / 113
9.6*	38.2 / 101	■	■		38.0 / 121
13.5	37.2 / 96	■	■	■	Sleeping
18.0	37.4 / 117	■	■		37.3 / 96
20.7	38.2 / 132	■	■		37.4 / 130
21.3	37.4 / 125	■	■		37.3 / 113



Illness



Solutions

- **Annual heat awareness and management training**
- **Year round physical training to induce/maintain heat acclimatisation**
- **Establish rehab sector with monitoring**
 - **Robust body mass scales**
 - **Fans**
 - **Hydration**



Rehab Sector – Low Resource Setting



**NATIONAL CRITICAL CARE
AND TRAUMA RESPONSE CENTRE**

Resting in the Shade



NATIONAL CRITICAL CARE
AND TRAUMA RESPONSE CENTRE

Rehab Sector – High Resource Setting



**NATIONAL CRITICAL CARE
AND TRAUMA RESPONSE CENTRE**

Rehabilitation Sector



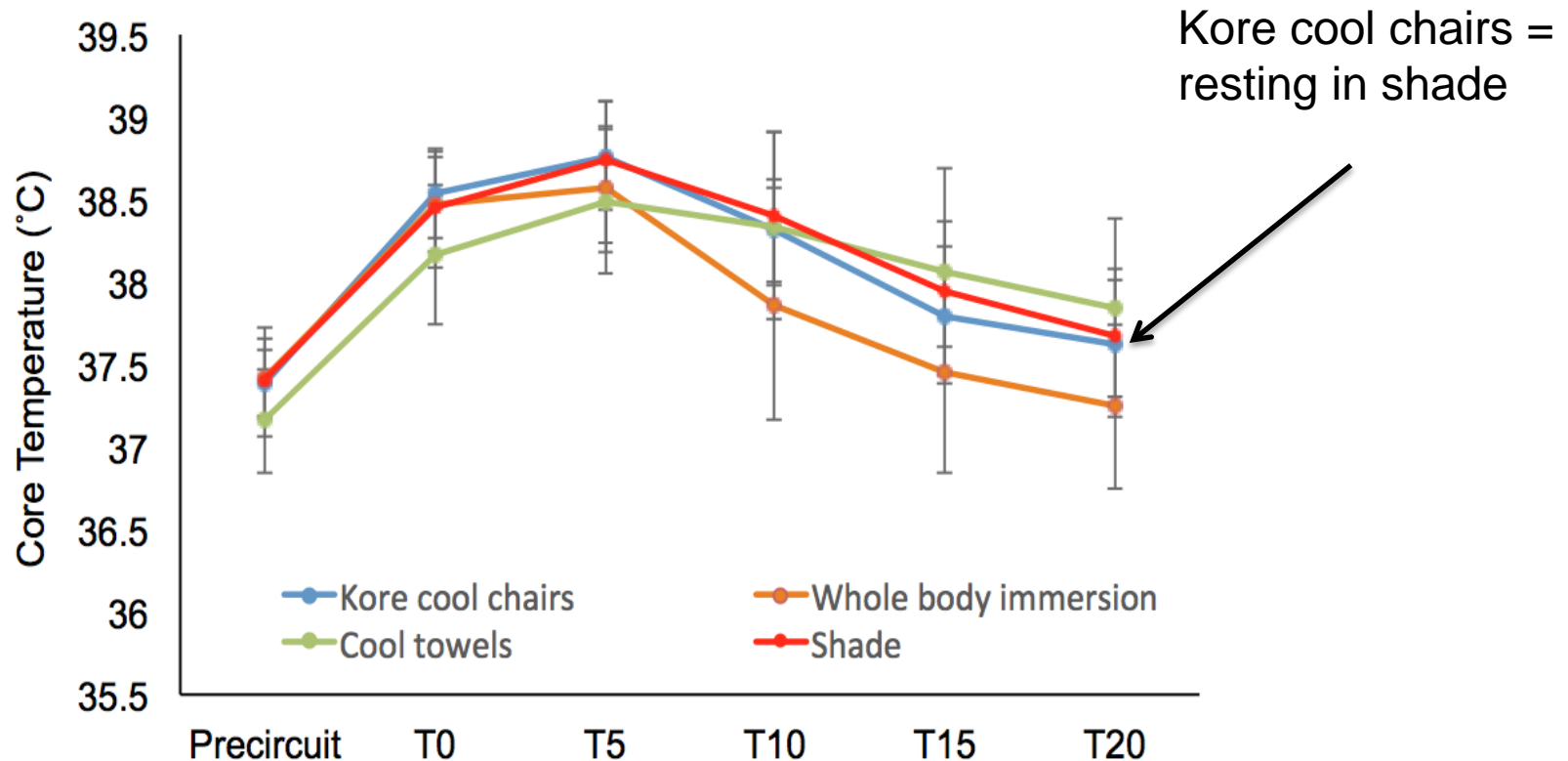
**NATIONAL CRITICAL CARE
AND TRAUMA RESPONSE CENTRE**

Rehabilitation Sector



**NATIONAL CRITICAL CARE
AND TRAUMA RESPONSE CENTRE**

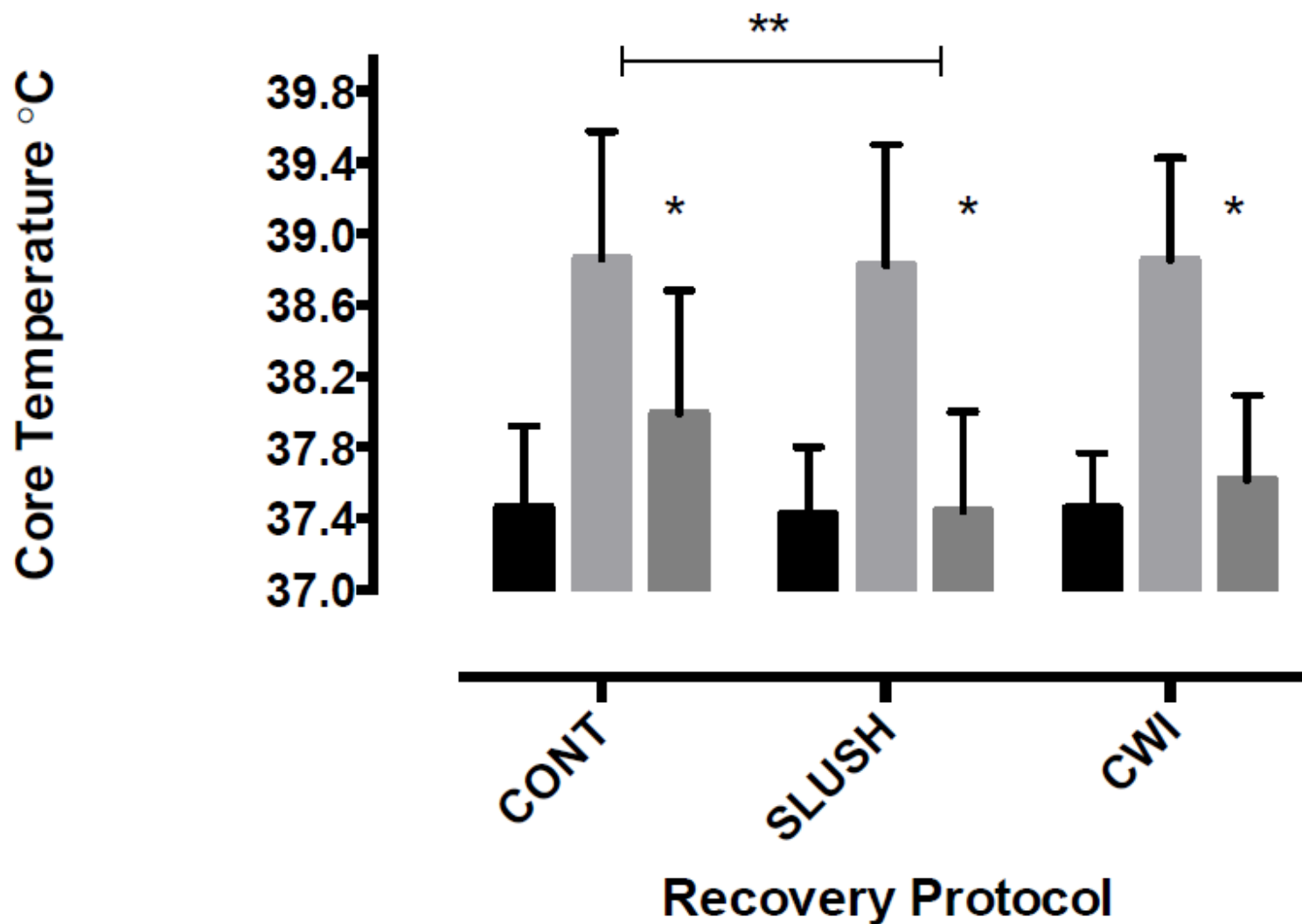
Darwin – Hot/Humid



- Order of cooling effect:

Whole body immersion → Kore cool chairs → shade → cool towels

Rehabilitation Sector



Walker, Driller, Brearley, Argus, Rattray. Applied Physiology, Metabolism and Nutrition. In Press.



NATIONAL CRITICAL CARE
AND TRAUMA RESPONSE CENTRE

Take Home Message

- **USAR teams can be prepared for, and managed in tropical conditions to maximise operational capability**
- **Preparation – education and physical training**
- **Management – removal of excess body heat via evidence based strategies**



Acknowledgements

- **Trauma and Disaster Management (TRADIM) Research Funding**
- **The commitment of NTFRS and QFES firefighters and management to the project**
- **Daryl Rush**
- **Research team**



Questions



Matt Brearley PhD
Research Manager, NCCTRC

+61420889399

matt.brearley@nt.gov.au

Twitter: DrMattBrearley



**NATIONAL CRITICAL CARE
AND TRAUMA RESPONSE CENTRE**