Genetic Evaluation:
Productivity, Efficiency and Profitability

Colin Byrne, Sarah Blumer and Andrew Thompson

Murdoch UNIVERSITY

awi Australian Wool Innovation Limited

GOVERNMENT OF WESTERN AUSTRALIA
Department of Primary Industries and Regional Development

Background

- Income and costs per hectare are the drivers of livestock profitability.

- Systems used to calculate $/ha in blood line comparisons are flawed

- Based on live weight and the increase in energy requirements for heavier animals
  - lower stocking rate and profits for heavier genotypes
  - factors other than live weight can influence stocking rate

Murdoch UNIVERSITY

Background

- Genotypes and sires differ in their ability to convert feed into energy reserves (fat) and lean tissue
  - storing and then mobilising fat tissue is 3 to 4 times as efficient as recycling lean
- Adult ewes with a higher proportion of body fat
  - require less feed (0.8 MJ/d per ½ CS)
  - lose less weight (30 g/d per ½ CS)

#GEPEP - project objectives

- Measure differences between sire groups
  - growth and production
  - feed intake and liveweight change
  - body composition
  - feed and liveweight efficiency
- Evaluate potential effects of sire on profit per head and per hectare
- Identify proxies for feed intake and body composition

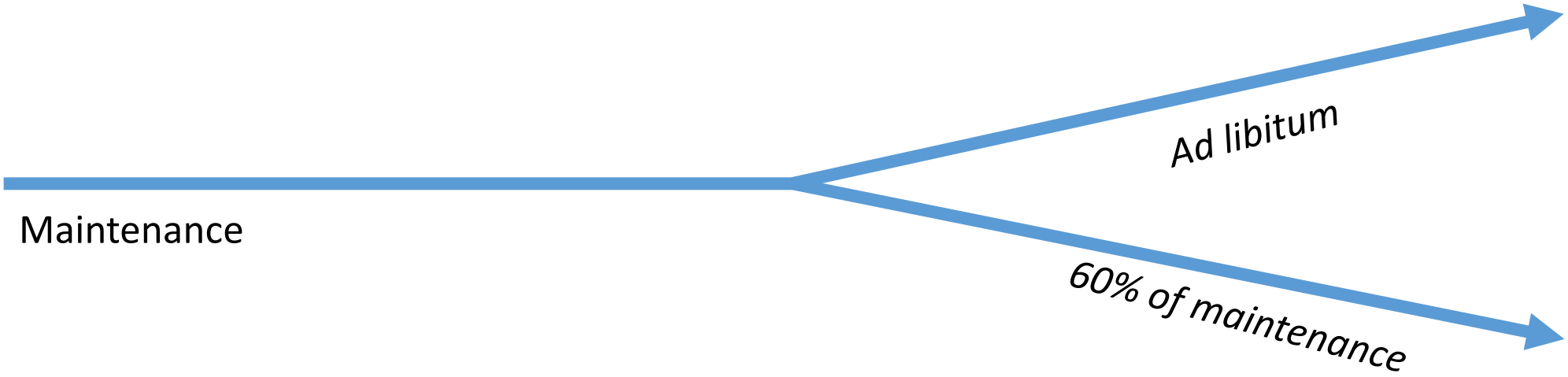
Methodology

- MLP wether progeny
  - Pingelly site
  - 2016 and 2017 drop

- 4 cohorts, n = 640 progeny (min n = 15 / sire)
- 2019/2020 - testing 15 sires in each - link sires between years

Murdoch UNIVERSITY

Methodology



Day 0

DEXA scan

- Fat %
- Whole body energy

Blood sample

Deuterium injection

Day 35

DEXA scan

- Fat %
- Whole body energy

Blood sample

Deuterium injection

Day 70

DEXA scan

- Fat %
- Whole body energy

Blood sample

Deuterium injection

Murdoch UNIVERSITY

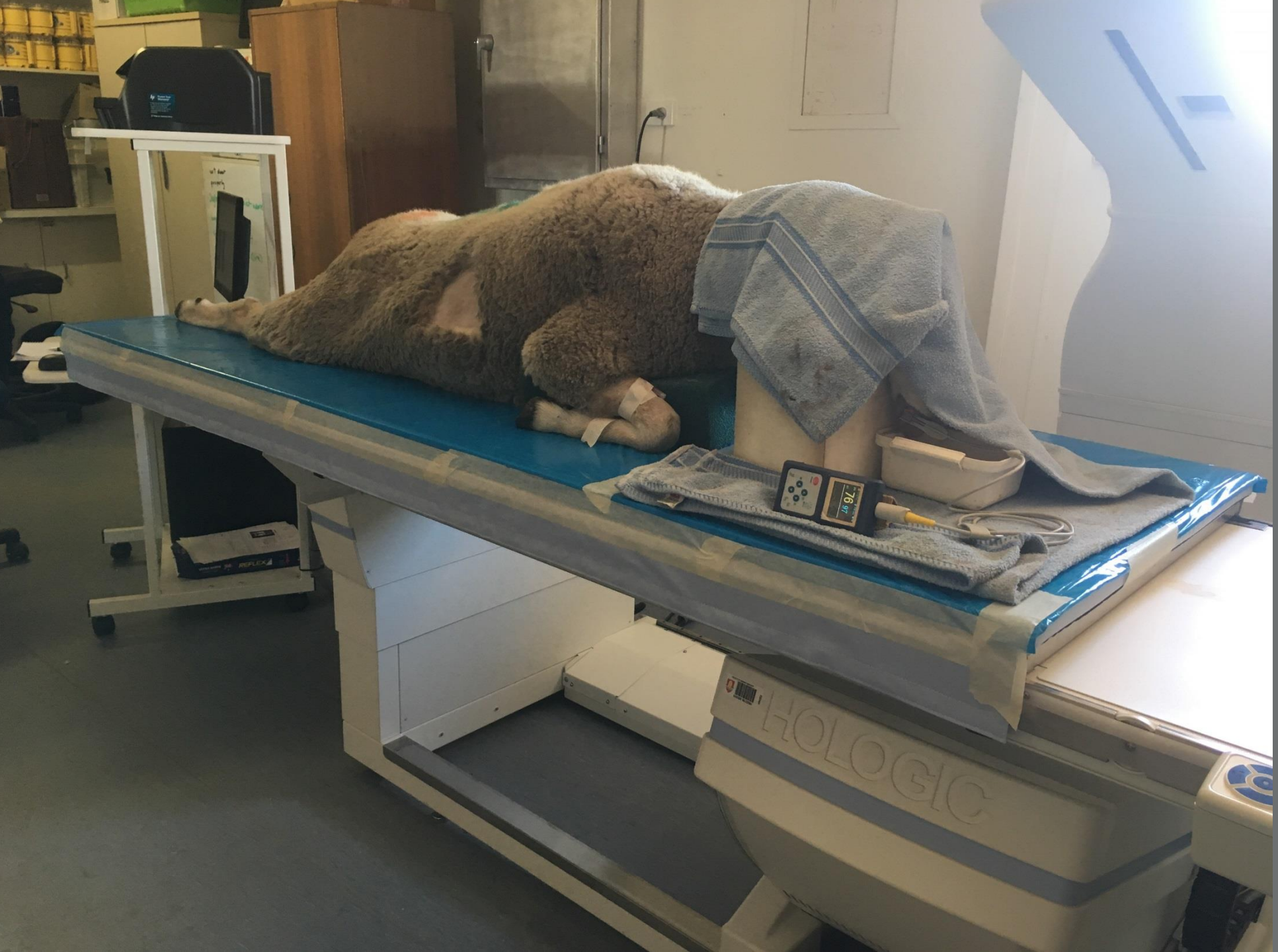
Methodology

- Proxies – roll out to paddock testing
- Feed efficiency – daily measurement of intake, and lwc
  - Composition
  - CO2
  - Sensor data
- Composition – DXA
  - Condition score
  - Industry standard ultrasound
  - Deuterium – heavy water
  - Leptin

Murdoch UNIVERSITY

Murdoch
UNIVERSITY

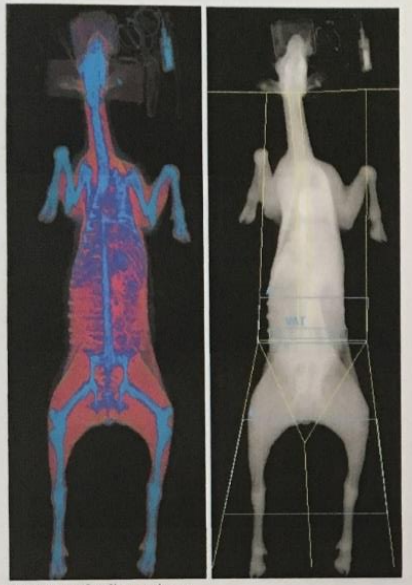
Murdoch
UNIVERSITY


HOLOGIC

Name: pen 142
Patient ID:
DOB:

Sex: Female
Ethnicity: White

Height:
Weight: 48.6 kg
Age:



Images not for diagnostic use

Fat Lean Bone

Total Body % Fat

14.0%

Source: NHANES Classic White Female.

Body Composition Results

Region	Fat Mass (g)	Lean + BMC (g)	Total Mass (g)	% Fat	%Fat Percentile YN	%Fat Percentile AM
L Arm	24	312	336	7.15		
R Arm	43	387	430	9.98		
Trunk	5196	32364	37560	13.8		
L Leg	320	2432	2752	11.6		
R Leg	353	2682	3035	11.6		
Subtotal	5936	38178	44113	13.5		
Head	643	2234	2877	22.4		
Total	**6579**	**40411**	**46990**	**14.0**		
Android (A)	753	6072	6825	11.0		
Gynoid (G)	311	2293	2604	11.9		

Adipose Indices

Measure	Result	Percentile YN	Percentile AM
Total Body % Fat	**14.0**		
Fat Mass/Height² (kg/m²)			
Android/Gynoid Ratio	0.93		
% Fat Trunk/% Fat Legs	1.19		
Trunk/Limb Fat Mass Ratio	7.02		
Est. VAT Mass (g)	83.9		
Est. VAT Volume (cm³)	90.7		
Est. VAT Area (cm²)	17.4		

Lean Indices

Measure	Result	Percentile YN	Percentile AM
Lean/Height² (kg/m²)			
Appen. Lean/Height² (kg/m²)			

Scan Date: 28 February 2018 ID: A0228180A
Scan Type: a Whole Body
Analysis: 28 February 2018 09:52 Version 13.6.0.4
Auto Whole Body Fan Beam

Operator:
Model: Horizon A (S/N 201293)
Comment:

Est. VAT = Estimated Visceral Adipose Tissue
YN = Young Normal
AM = Age Matched

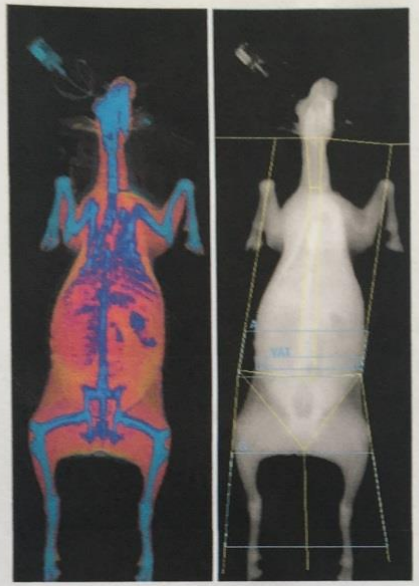
HOLOGIC

TBAR1904

Name: Greeline, 2251
Patient ID:
DOB:

Sex: Female
Ethnicity: White

Height:
Weight: 63.0 kg
Age:



Images not for diagnostic use

Fat Lean Bone

Total Body % Fat

20.7%

Source: NHANES Classic White Female.

Body Composition Results

Region	Fat Mass (g)	Lean + BMC (g)	Total Mass (g)	% Fat	%Fat Percentile YN	%Fat Percentile AM
L Arm	23	294	317	7.28		
R Arm	23	232	255	9.12		
Trunk	11126	40363	51489	21.6		
L Leg	562	3149	3710	15.1		
R Leg	515	3037	3552	14.5		
Subtotal	12249	47074	59323	20.6		
Head	781	2720	3501	22.3		
Total	**13030**	**49794**	**62824**	**20.7**		
Android (A)	2432	8403	10836	22.4		
Gynoid (G)	280	1553	1833	15.3		

Adipose Indices

Measure	Result	Percentile YN	Percentile AM
Total Body % Fat	**20.7**		
Fat Mass/Height² (kg/m²)			
Android/Gynoid Ratio	1.47		
% Fat Trunk/% Fat Legs	1.46		
Trunk/Limb Fat Mass Ratio	9.91		
Est. VAT Mass (g)	529		
Est. VAT Volume (cm³)	572		
Est. VAT Area (cm²)	110		

Lean Indices

Measure	Result	Percentile YN	Percentile AM
Lean/Height² (kg/m²)			
Appen. Lean/Height² (kg/m²)			

Scan Date: 23 February 2018 ID: A0223180D
Scan Type: a Whole Body
Analysis: 23 February 2018 14:53 Version 13.6.0.4
Auto Whole Body Fan Beam

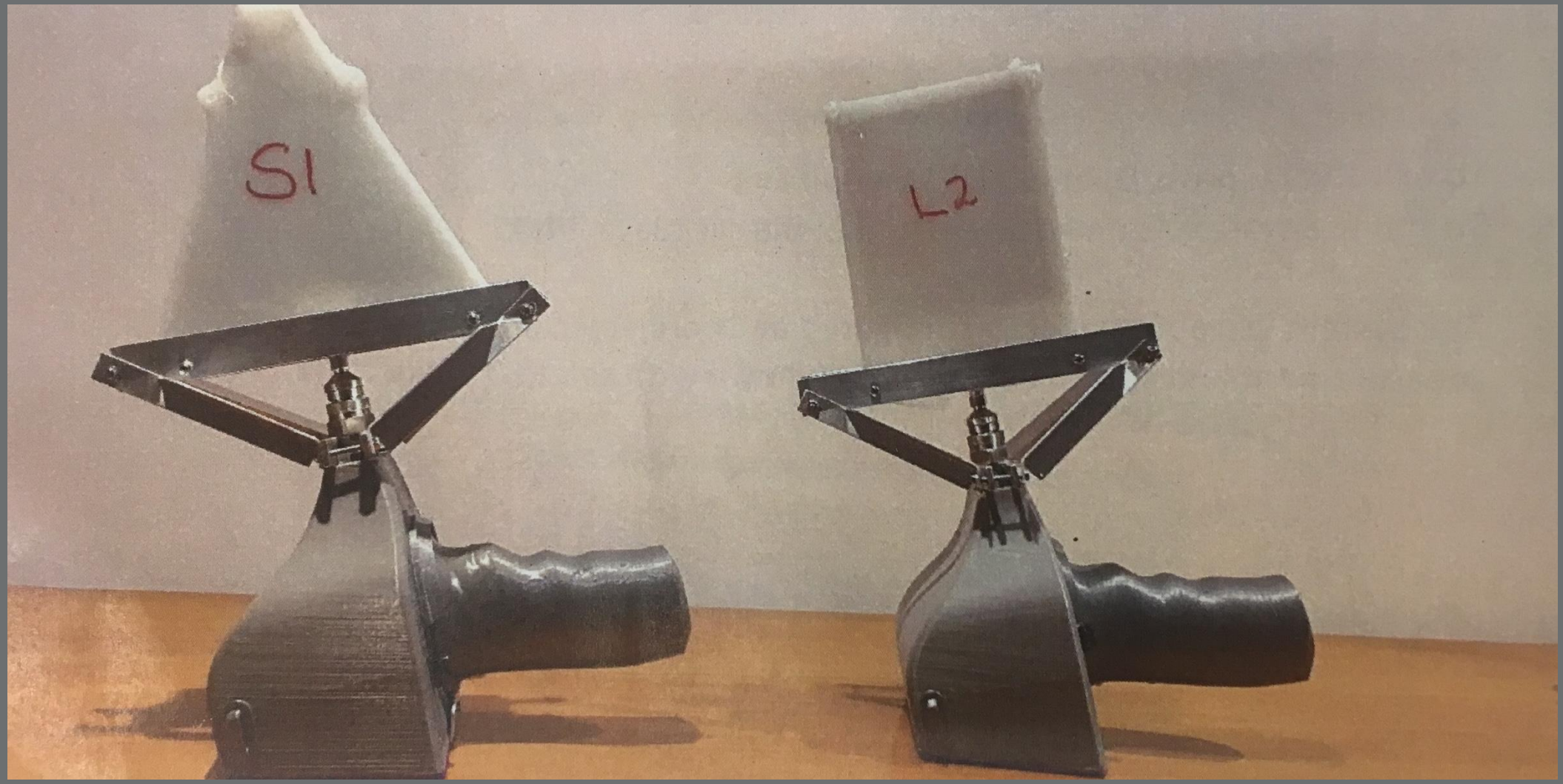
Operator:
Model: Horizon A (S/N 201293)
Comment:

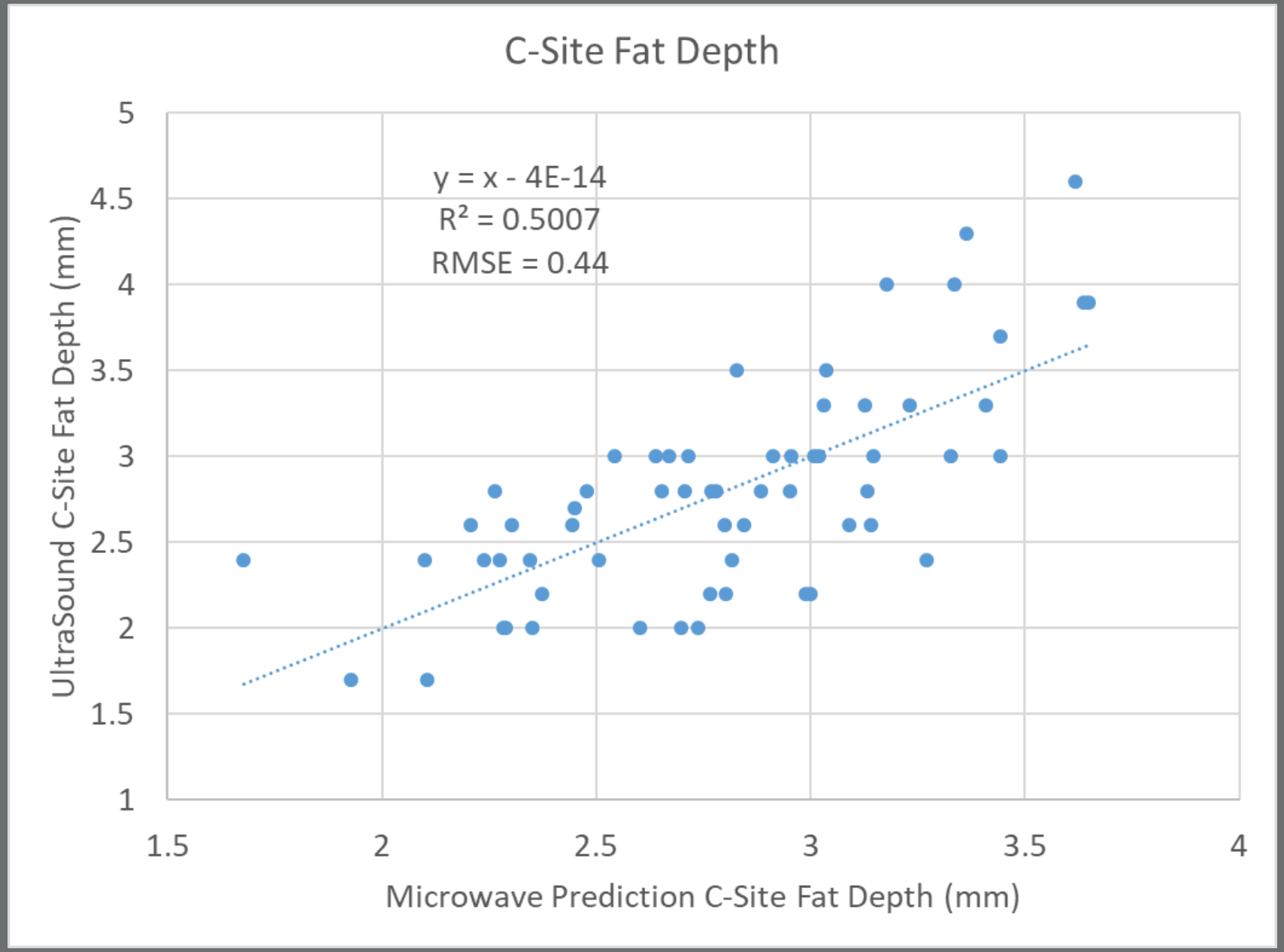
Est. VAT = Estimated Visceral Adipose Tissue
YN = Young Normal
AM = Age Matched

HOLOGIC

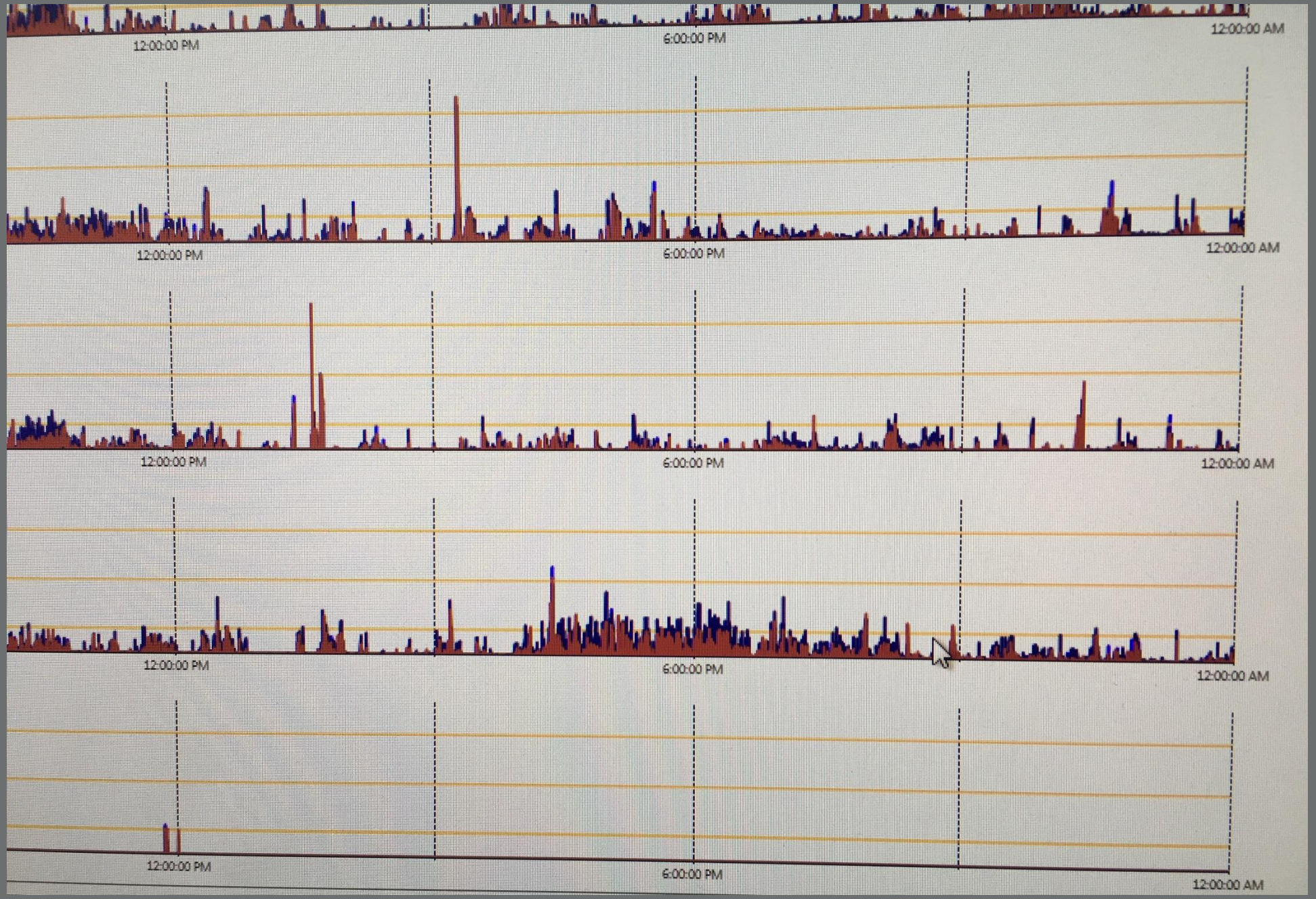
TBAR1904

Murdoch UNIVERSITY


S1
L2


C-Site Fat Depth
y = x - 4E-14
R² = 0.5007
RMSE = 0.44
UltraSound C-Site Fat Depth (mm)
Microwave Prediction C-Site Fat Depth (mm)
5
4.5
4
3.5
3
2.5
2
1.5
1
1.5
2
2.5
3
3.5
4

Murdoch
UNIVERSITY


12:00:00 PM
6:00:00 PM
12:00:00 AM
12:00:00 PM
6:00:00 PM
12:00:00 AM
12:00:00 PM
6:00:00 PM
12:00:00 AM
12:00:00 PM
6:00:00 PM
12:00:00 AM
12:00:00 PM
6:00:00 PM
12:00:00 AM

Genetic Evaluation:
Productivity, Efficiency and Profitability

Colin Byrne, Sarah Blumer and Andrew Thompson

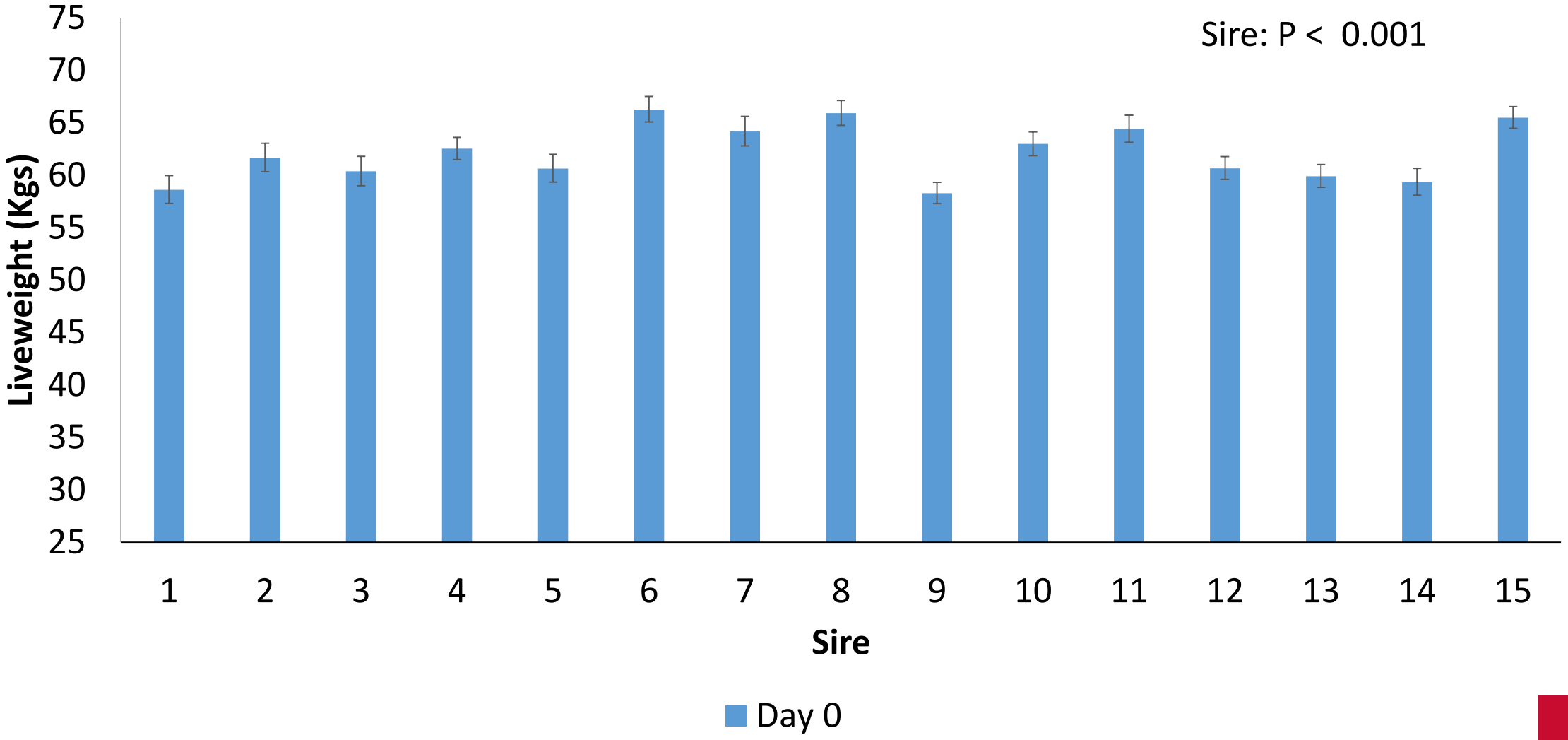
Results

Murdoch UNIVERSITY

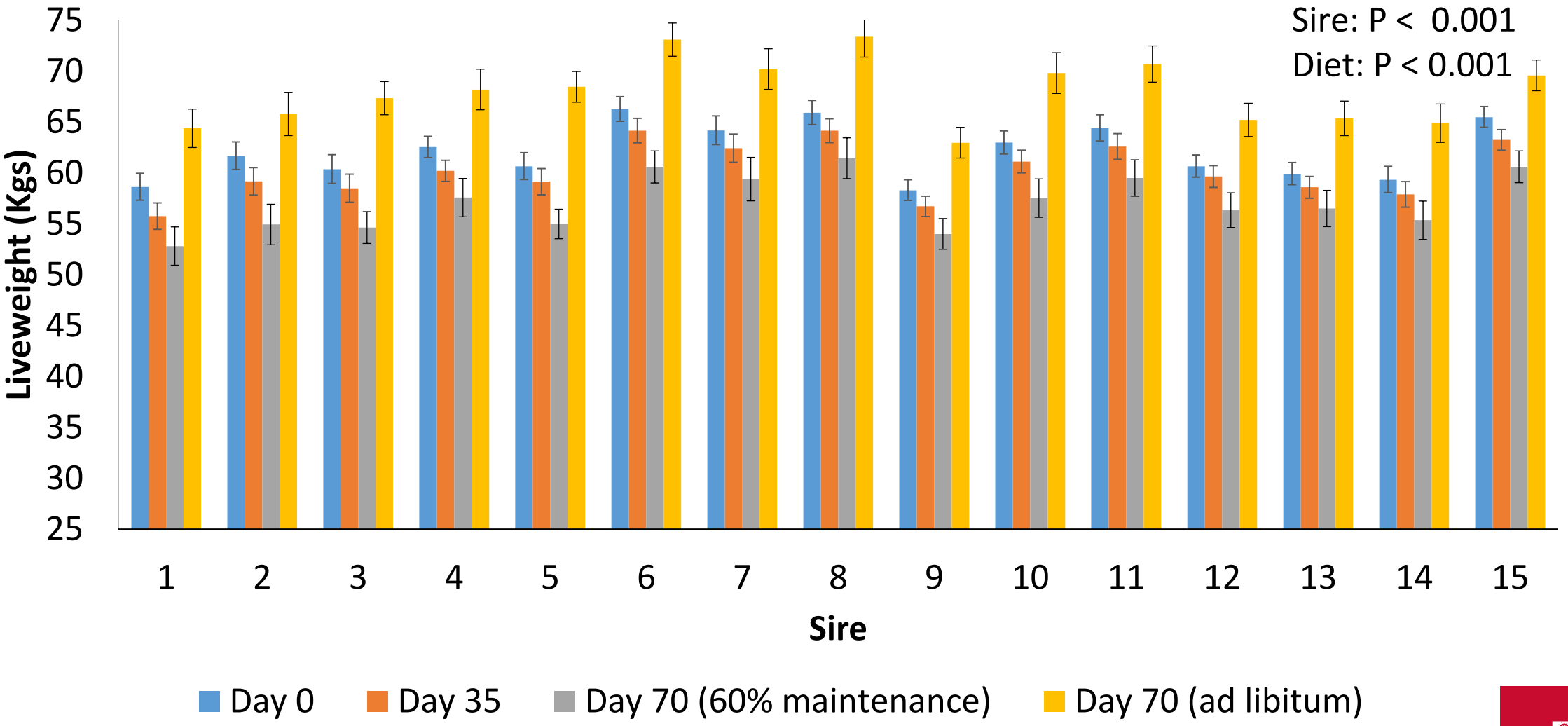
awi Australian Wool Innovation Limited

GOVERNMENT OF WESTERN AUSTRALIA
Department of Primary Industries and Regional Development

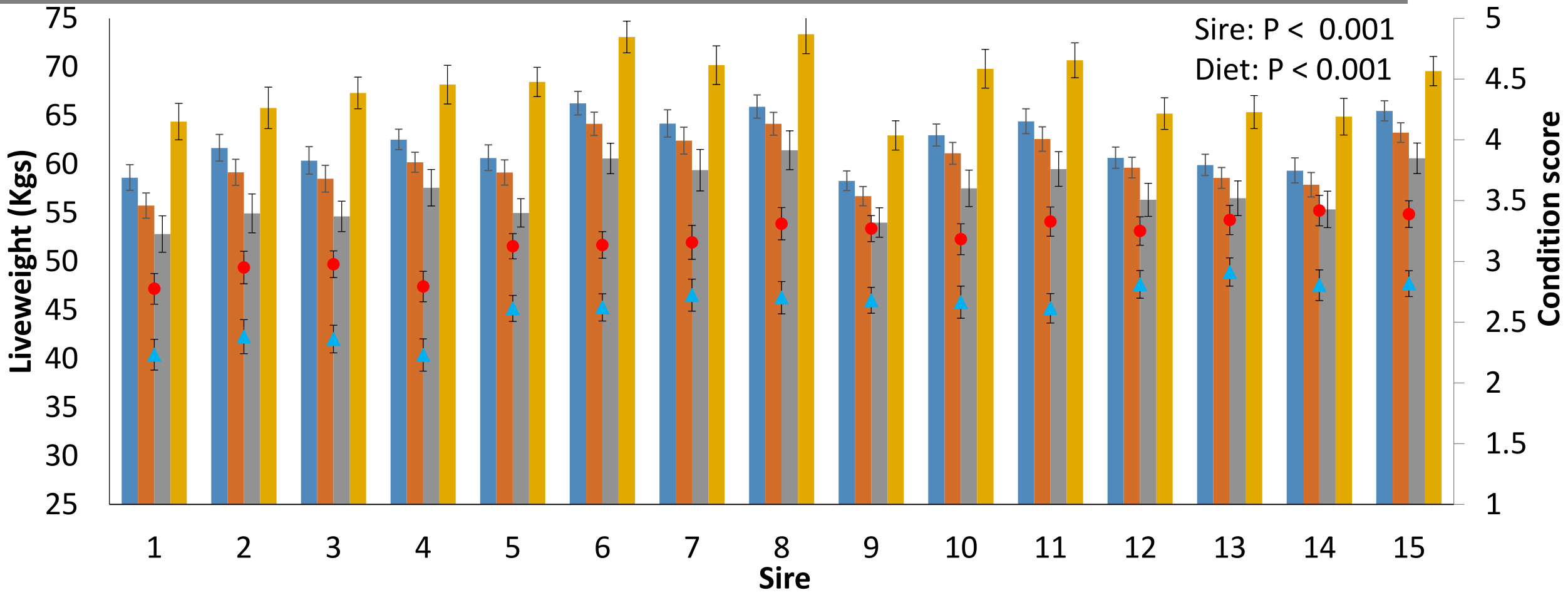
Liveweight and condition score



Liveweight and condition score



Liveweight and condition score



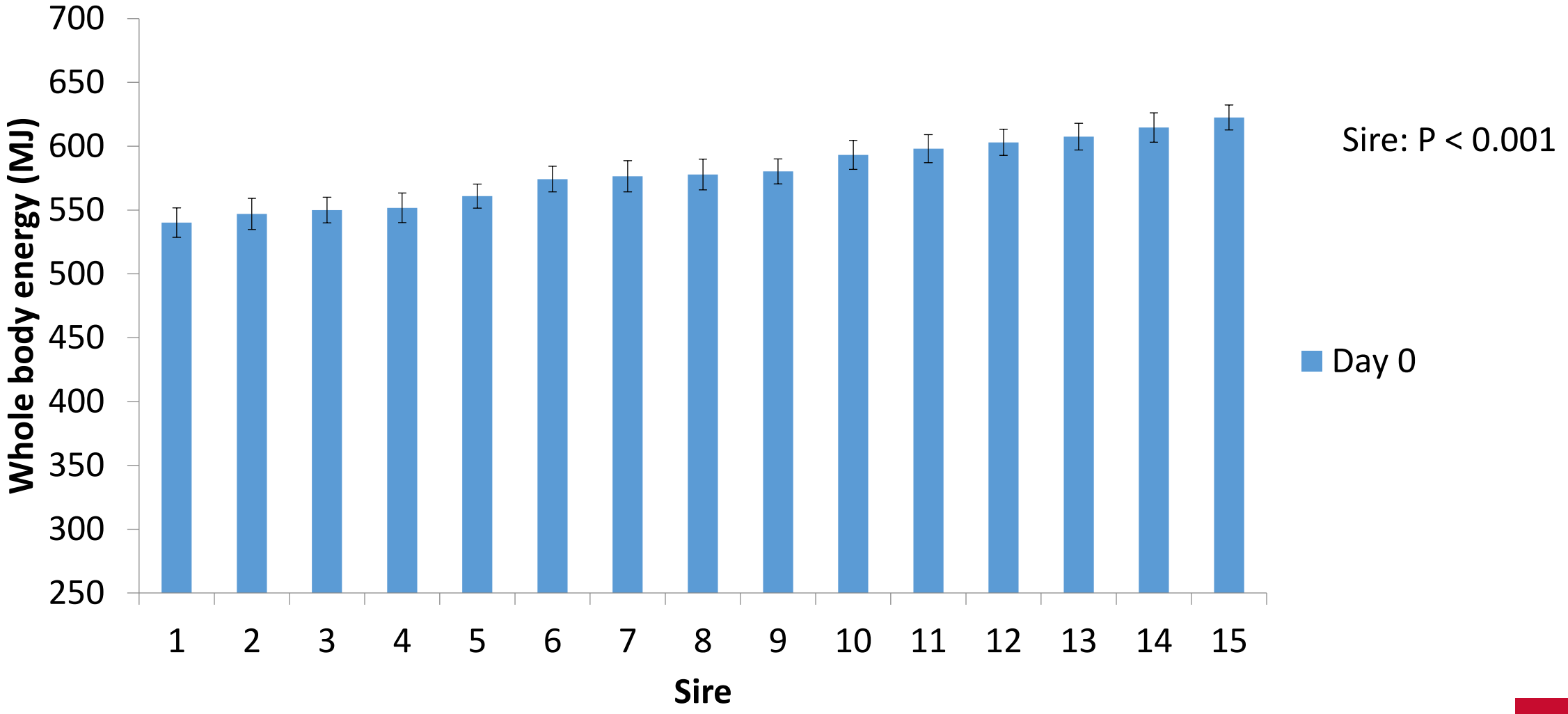
Murdoch UNIVERSITY

Liveweight and condition score

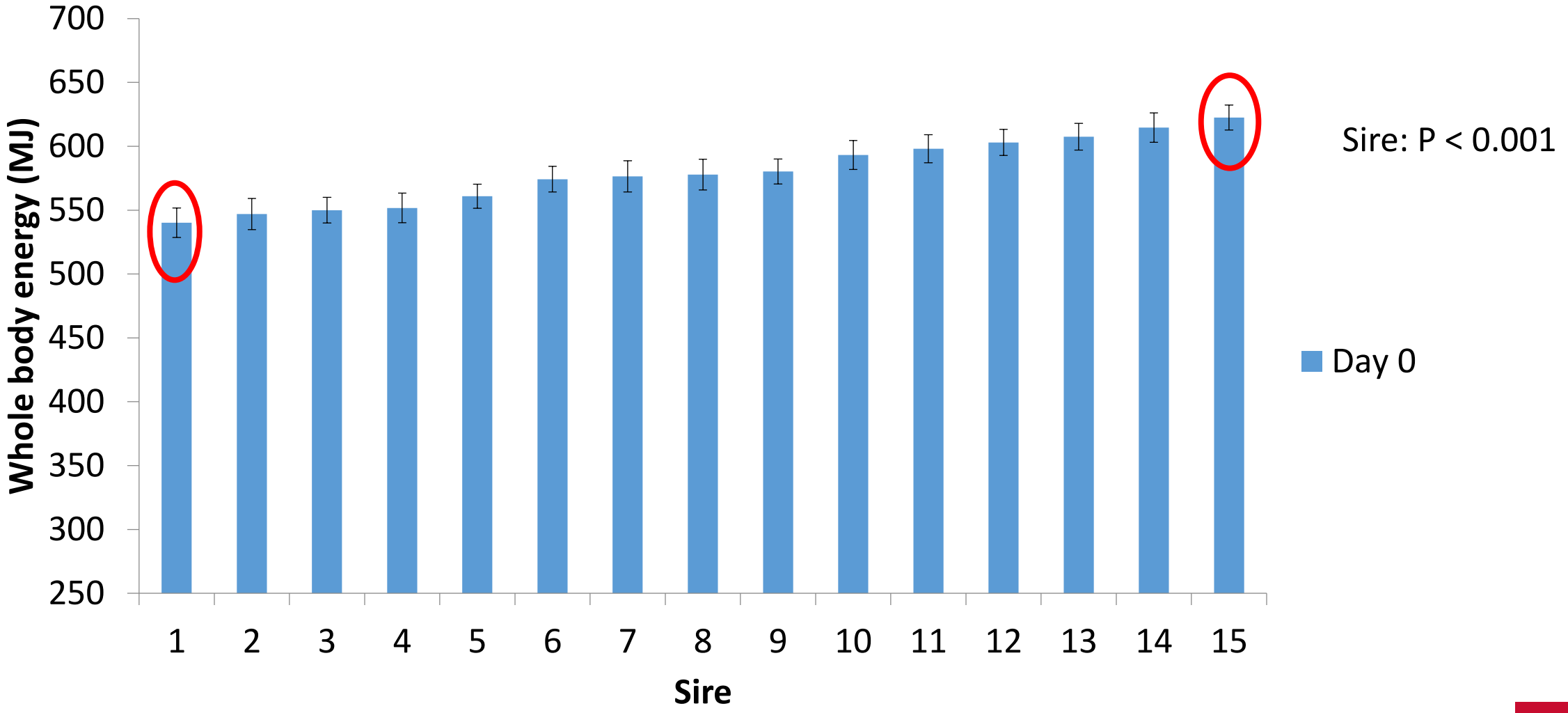
- Range in volunteered liveweight and condition score
  - 1 CS and 8kg
- Diet treatments successful
- Effects on WBE?
  - Variable
  - LW gain ≠ energy gain
  - 1kg fat = 35.9mJ and 1kg lean = 5.31mJ

Murdoch UNIVERSITY

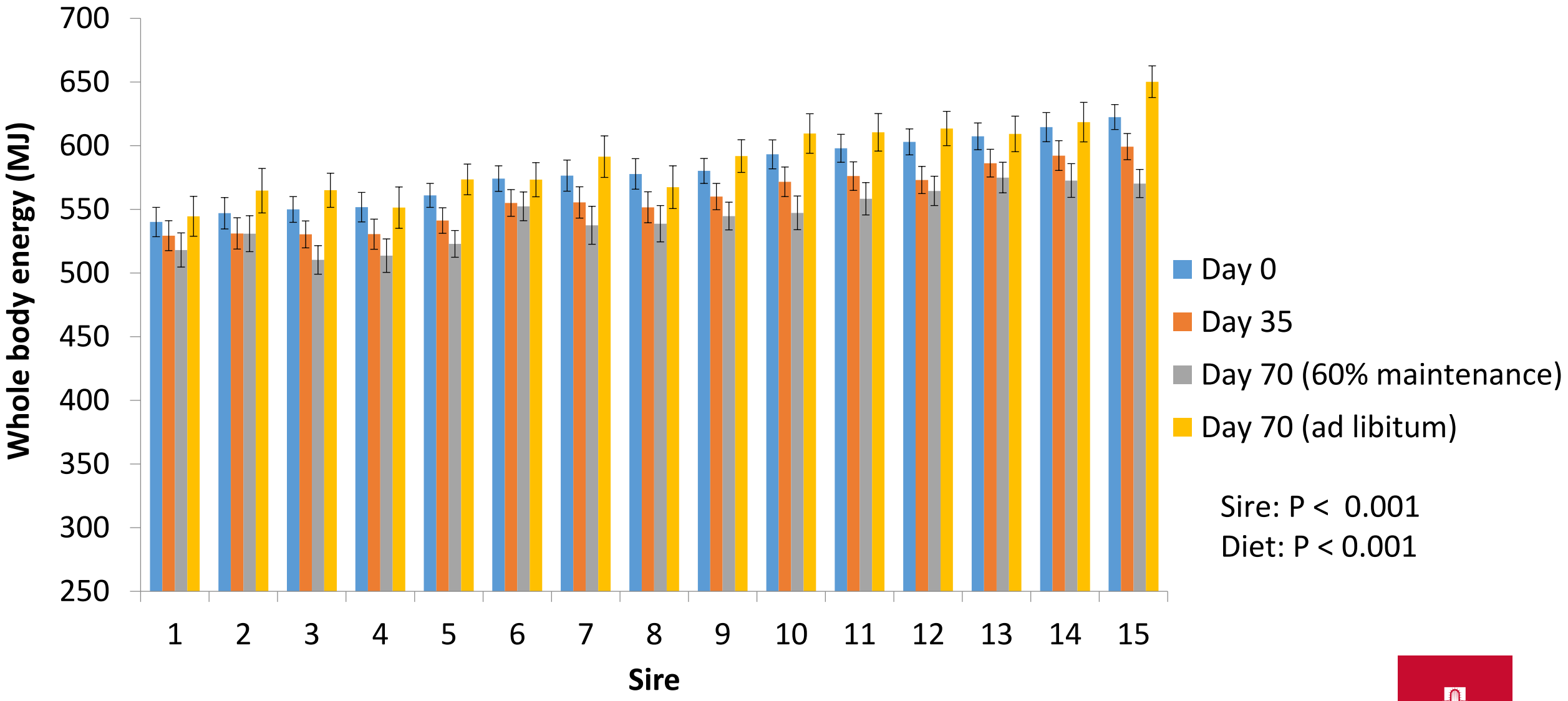
Whole body energy



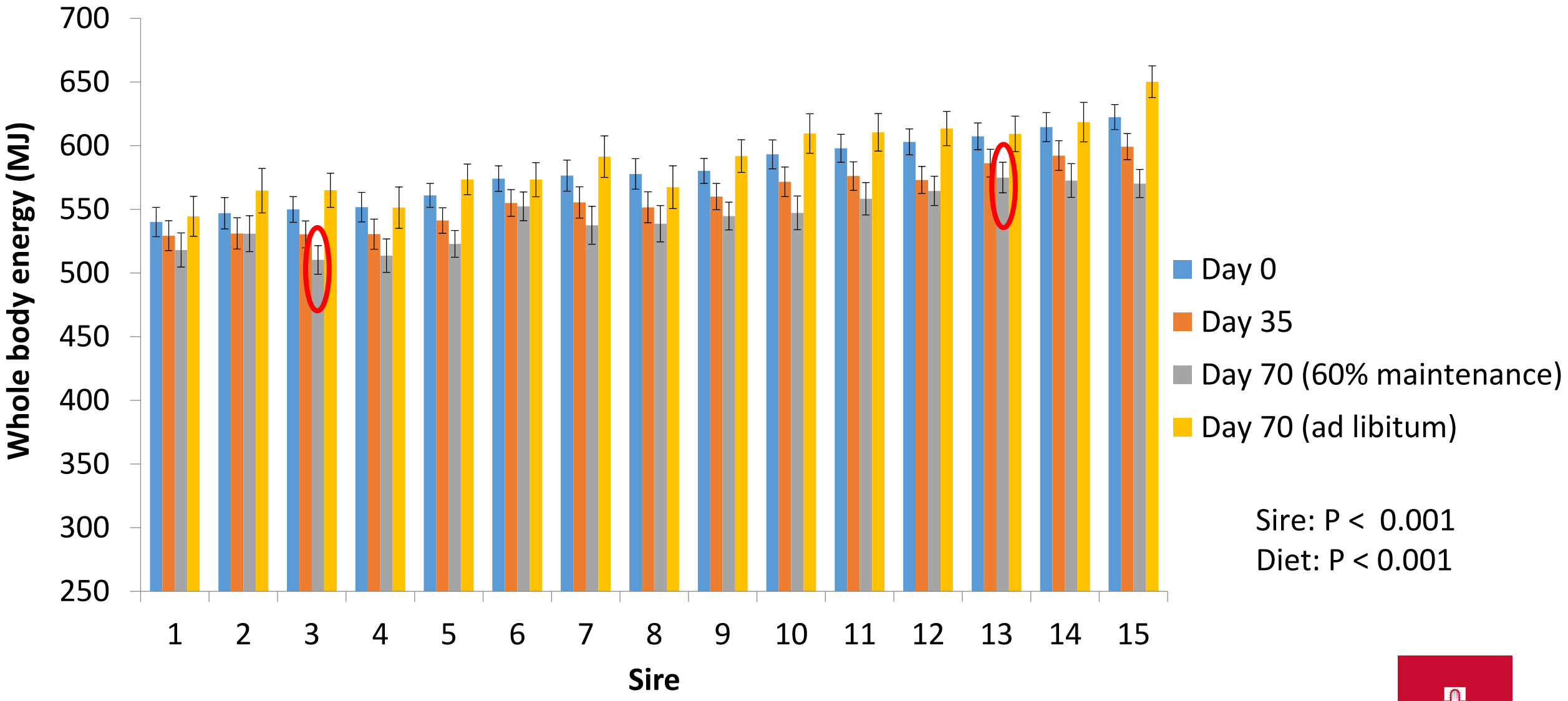
Whole body energy



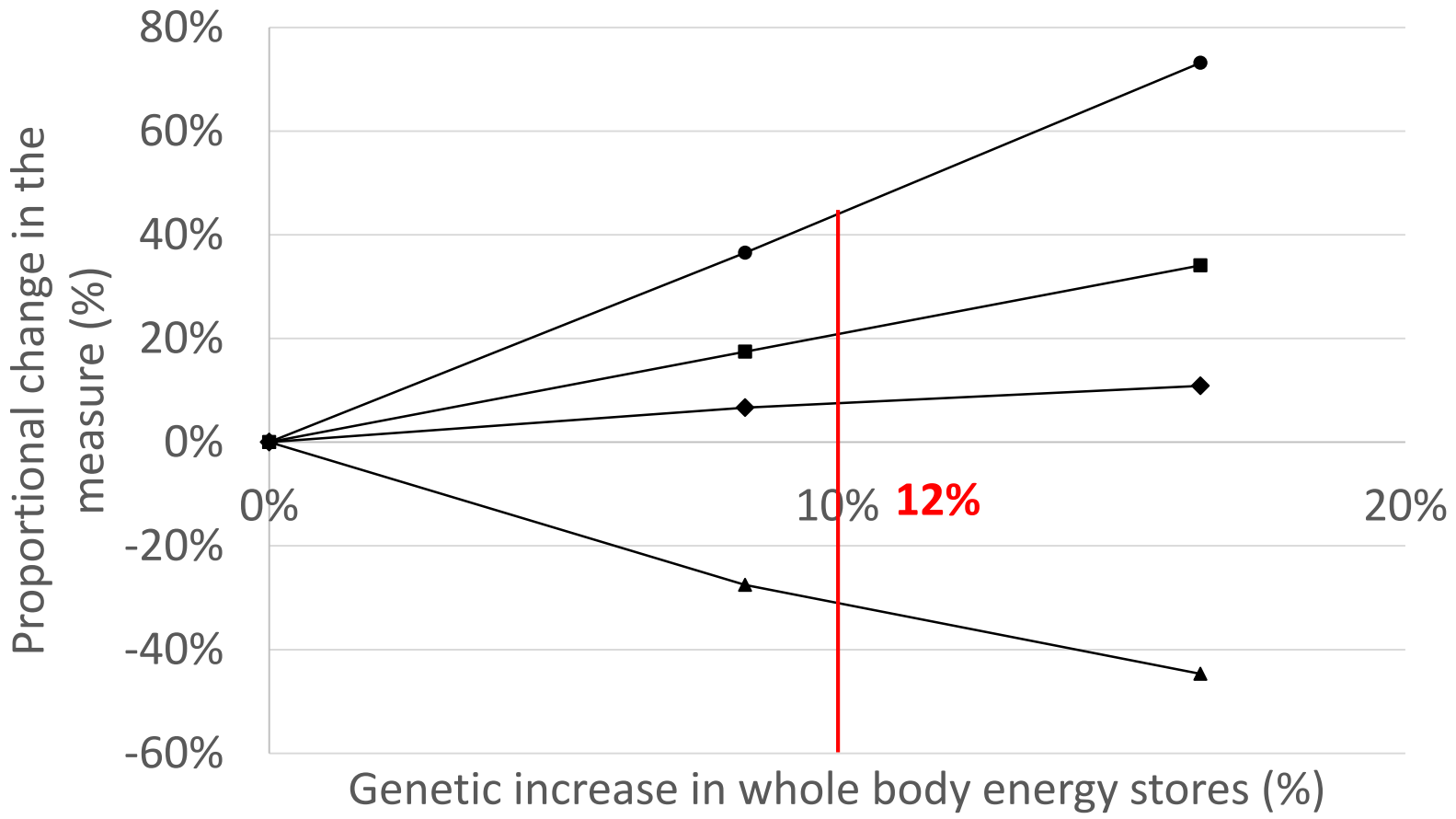
Whole body energy



Whole body energy



Whole body energy



Summary

- There are differences between sire groups for liveweight and condition score
- Differences in energy depletion when feed is restricted
- Differences in energy repletion when feed is readily available
- There are sire differences in whole body energy composition
  - on-going research will investigate differences in efficiency of energy utilization
- Proxies for the prediction of whole-body energy in sheep are being tested

Acknowledgements

Support provided by Woolgrowers through sire evaluation entry fees, site committee in-kind contributions, and sponsors of AMSEA.

The Australian Government who supports R&D, plus marketing of Australian wool.

Murdoch UNIVERSITY

awi Australian Wool Innovation Limited

GOVERNMENT OF WESTERN AUSTRALIA

Department of Primary Industries and Regional Development

Murdoch UNIVERSITY