Department of Primary Industries

Sustainability and Profitability of Grazing on Rehabilitated Mine Land in the Hunter Valley

UHMD Annual Forum November 2017

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Explanation of the Hunter mine project

- The Hunter mine grazing study was established to answer the question

"Can rehabilitated mine land sustainably support productive and profitable livestock grazing?"

and address community concerns, through a grazing study on two mine sites.

Highlights

- Sustainability – no change in ground cover
  - no increase in weeds
  - no heavy metal toxicity (Nickle marginal at one site)
  - pasture species diversity
- Production and profitability
  - Cattle grazing rehabilitated mine sites gained more weight, had better condition and were worth more money than mates grazing comparison sites.

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Two Sites

- Weigh cattle
- Soil test
- Blood Test
- Pasture Test
- Pasture availability and species
- 3.5 years (Jan 2014 to June 2017)
- Advisory panel to help buy/sell, stocking rate, supplementary feeding decisions

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MAC Analogue July 2015 looking toward rehab

HVO Analogue April 2017

MAC Rehab January 2015 looking toward analogue

HVO Rehab April 2017

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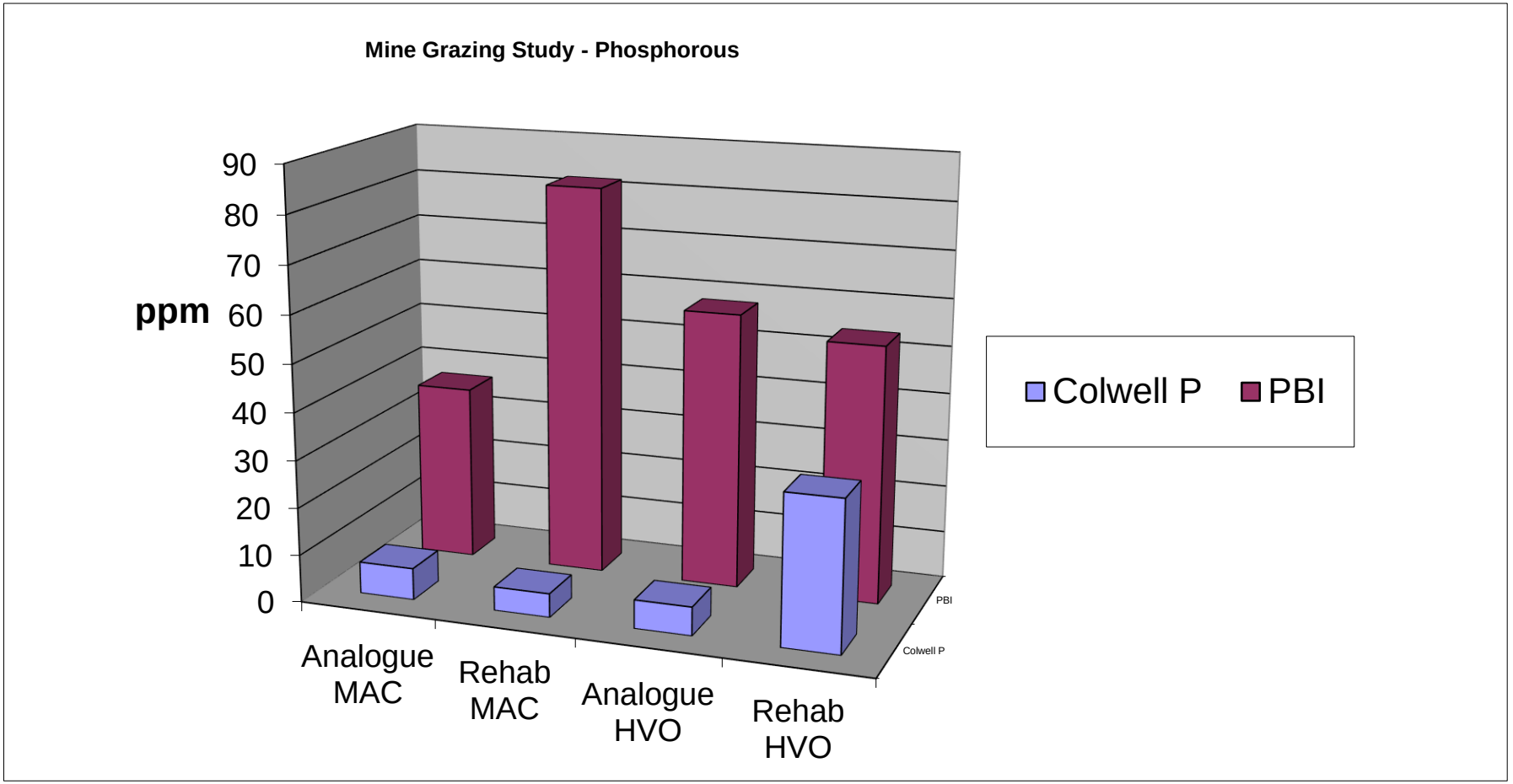
Soil test results

- pH – normal (Rehab neutral, analogue slightly acidic)
- Salinity – no problems
- Soil carbon – normal (HVO Rehab higher than others)
- Phosphorous – see next slide
- Sulphur – all low
- Potassium – all OK

Soil Test Results



Target 35+ppm (Colwell)

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Heavy metals in soil

Metal mg/kg (ppm)	Max level in soil (EPA Biosolids)	MAC ANA n=3	MAC Rehab n=3	HVO ANA n=2	HVO Rehab n=2
Cadmium	1	0.19	0.2	0.19	0.31
Chromium	100	30	57.3	20	18
Copper	100	11.7	14	9.8	11.5
Lead	150	8.7	9.1	11	13
Manganese	-	463	507	440	515
Nickel	60	23	71.7	11.25	11
Zinc	200	42	44.7	36.5	50

A few species dominate but much more diversity than expected !

- HVO

Analogue 144 species

Rehab 107 species

- Mt Arthur

Analogue 174 species

Rehab 87 species

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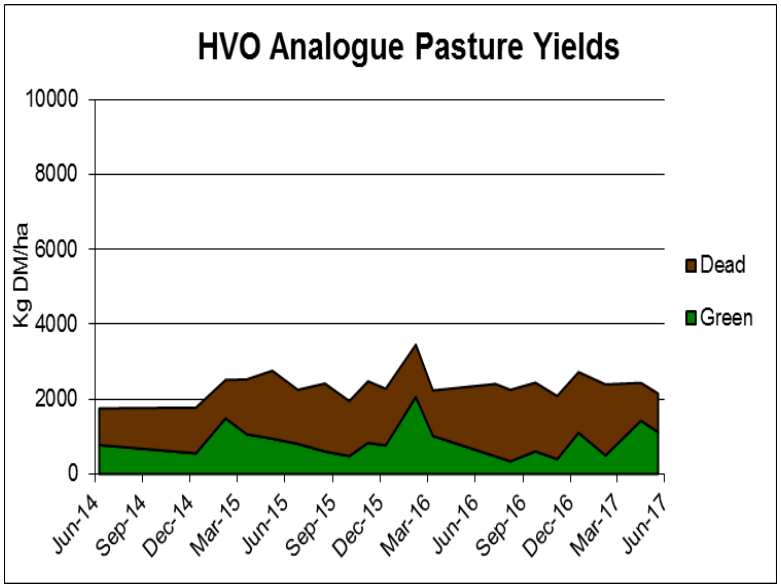

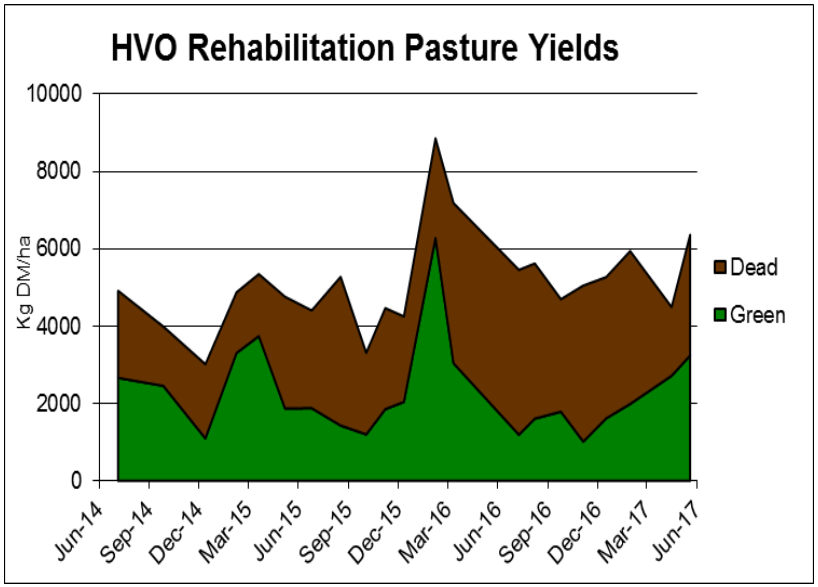

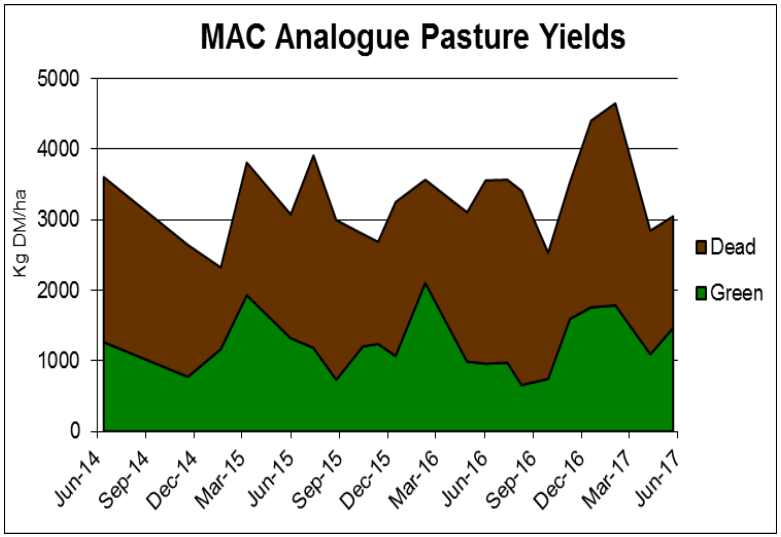

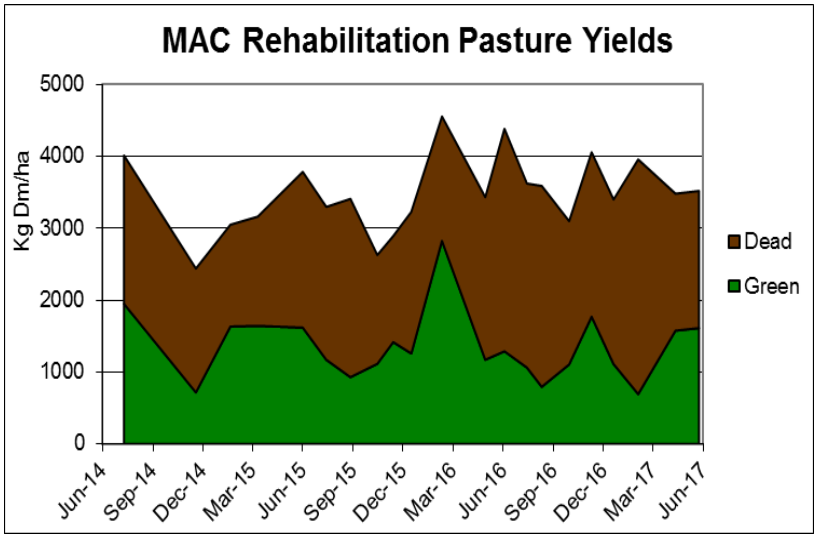

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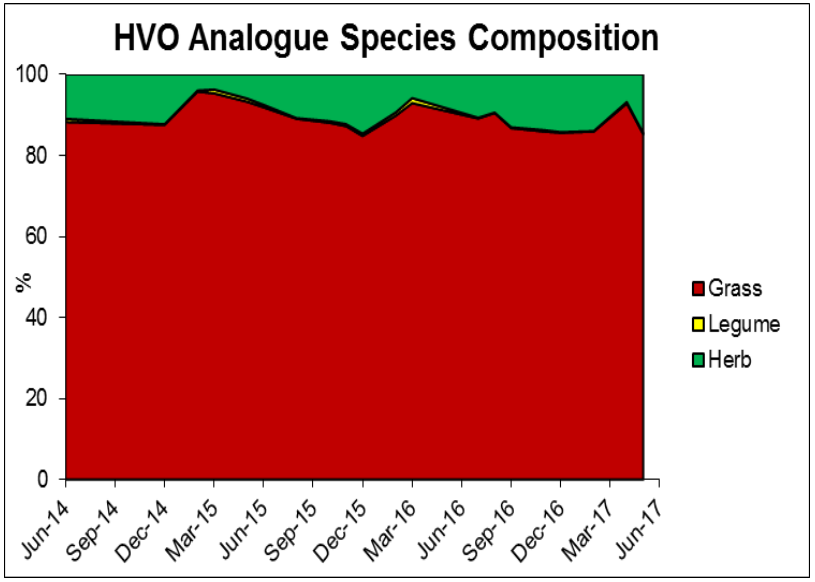

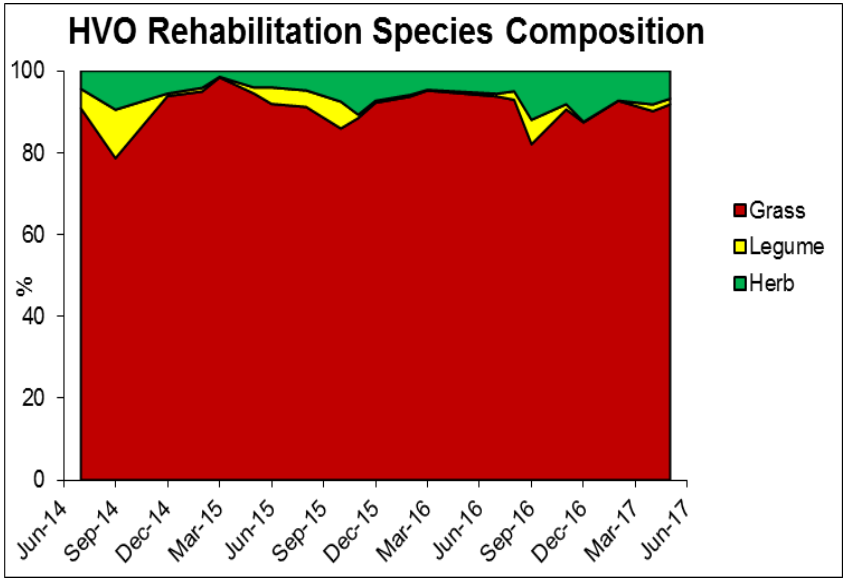

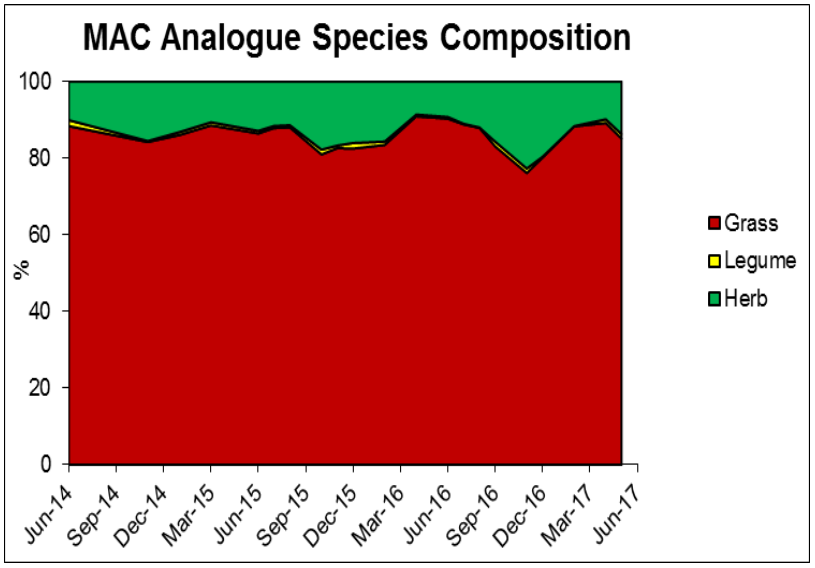

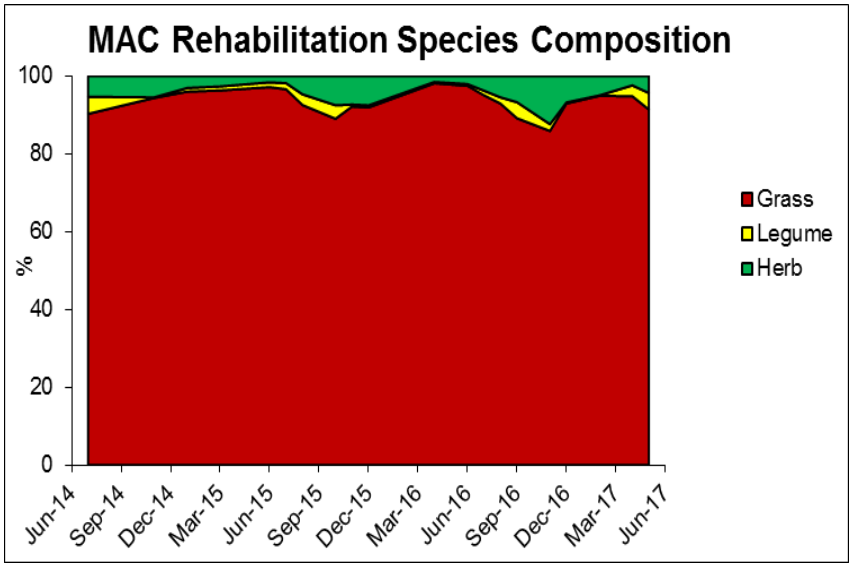

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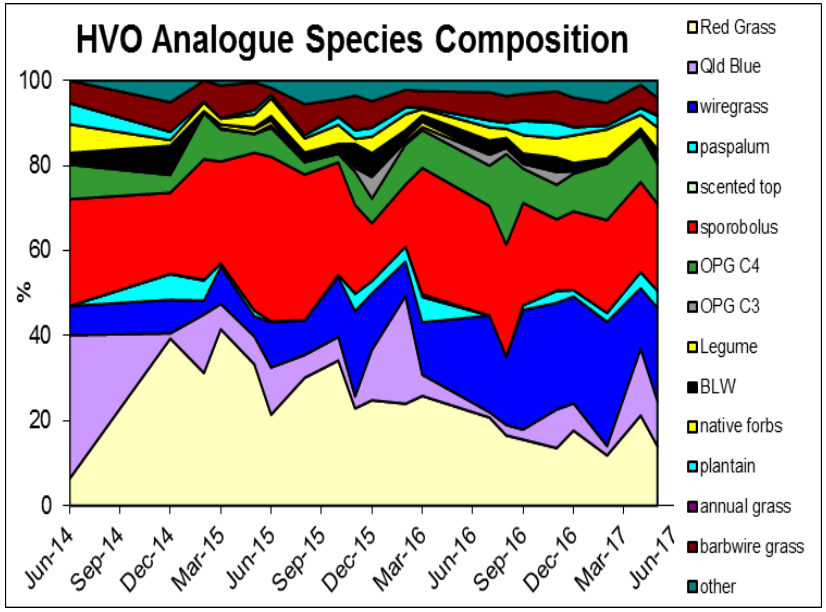

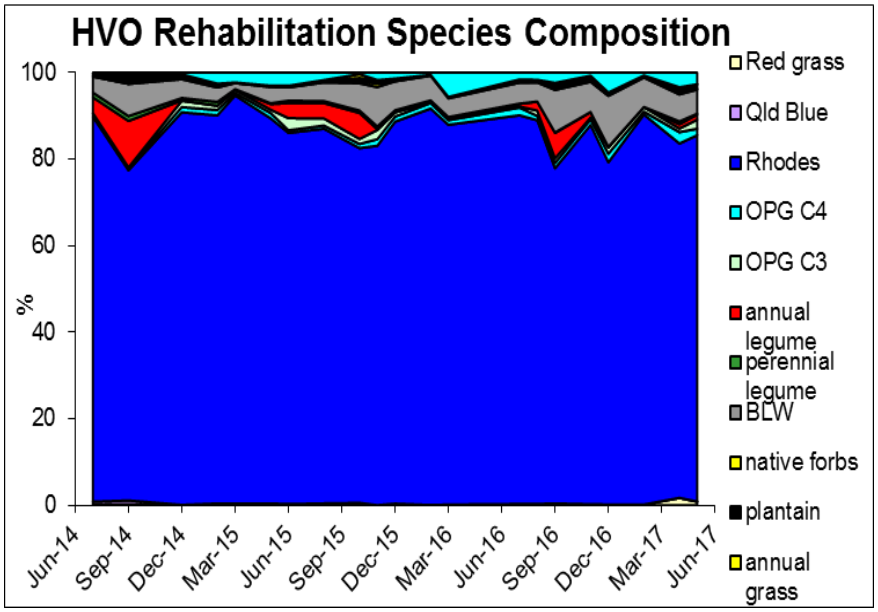

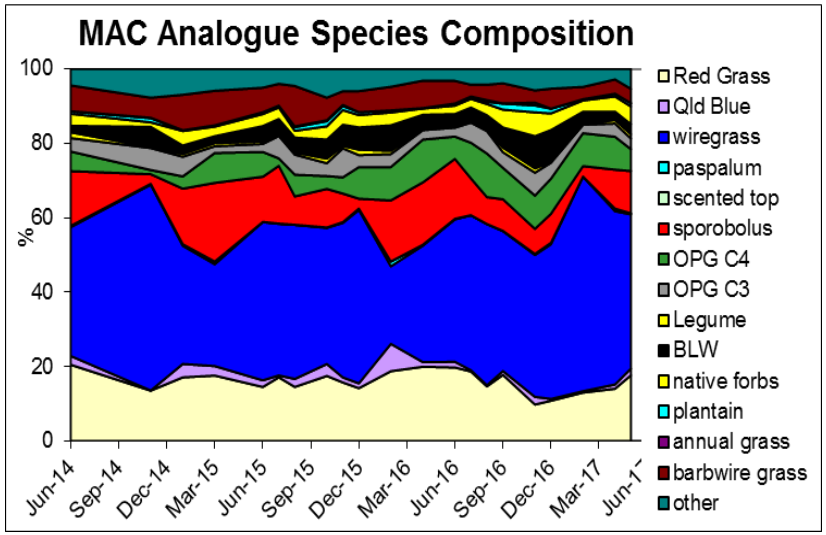

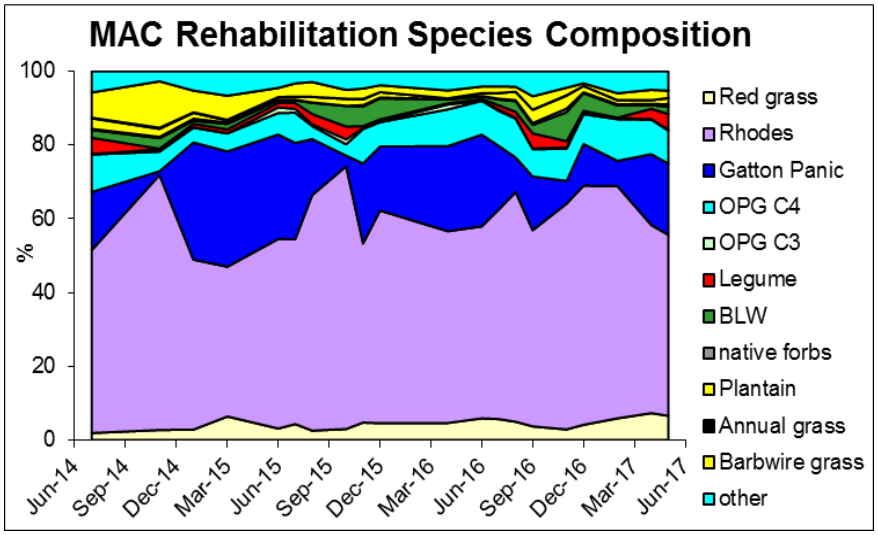

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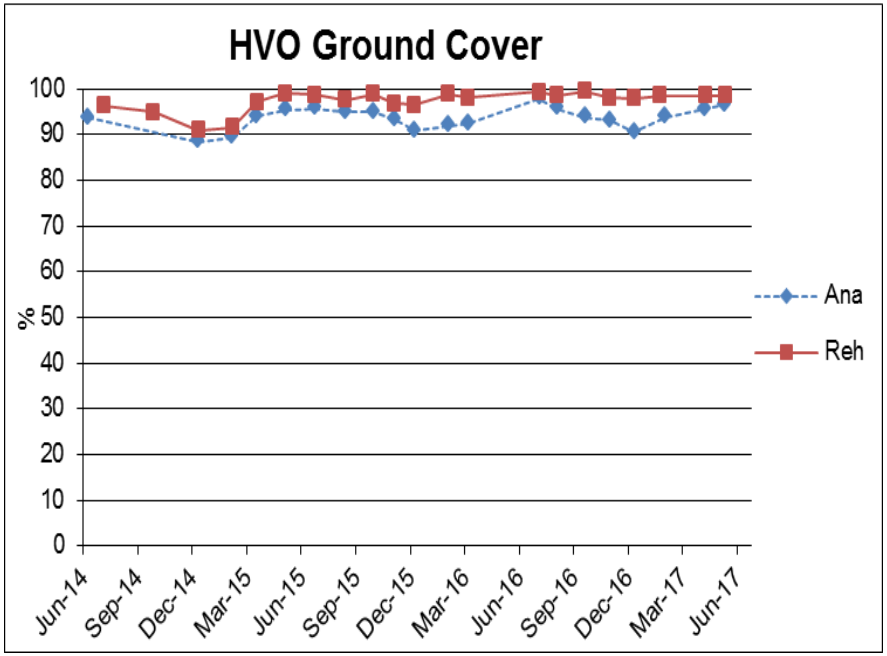
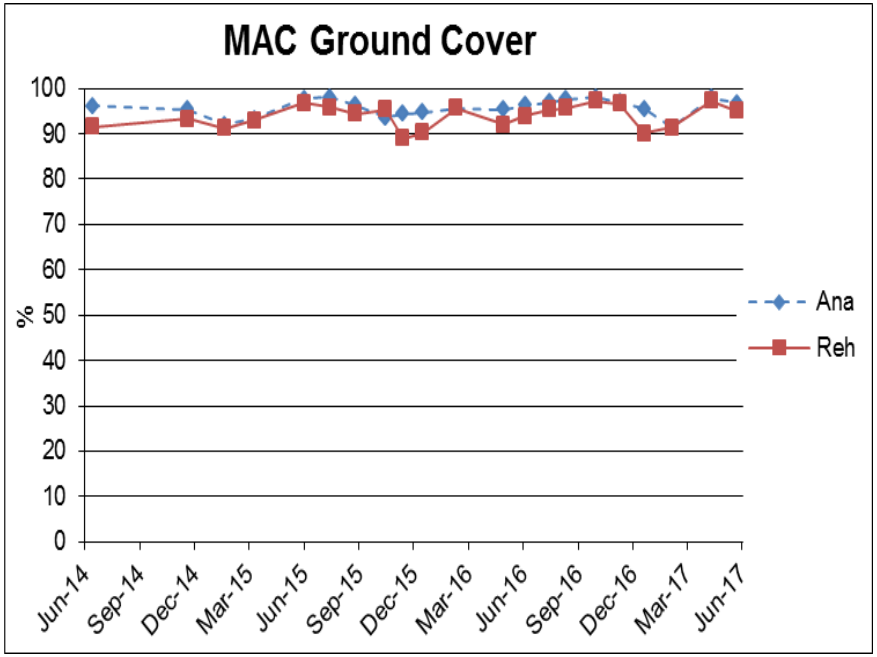
Ground cover





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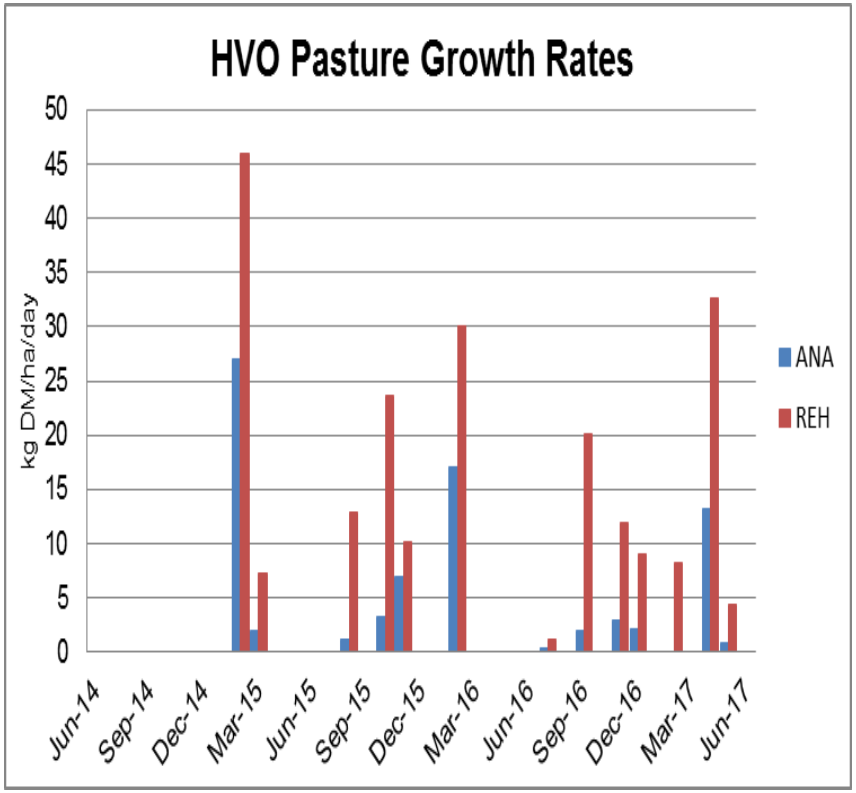
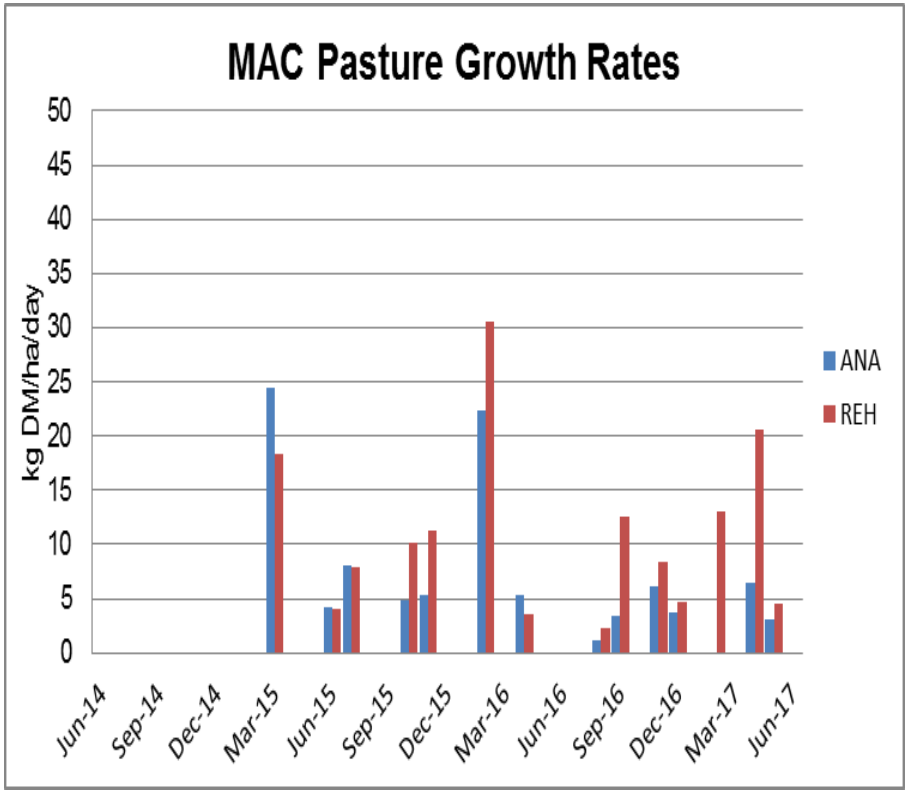
Pasture Growth Rates (cages)





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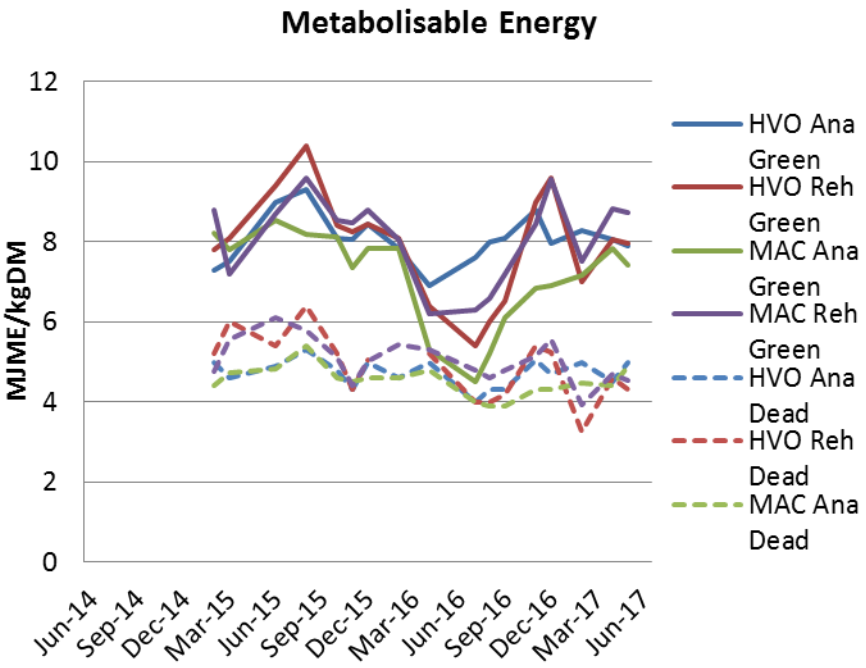
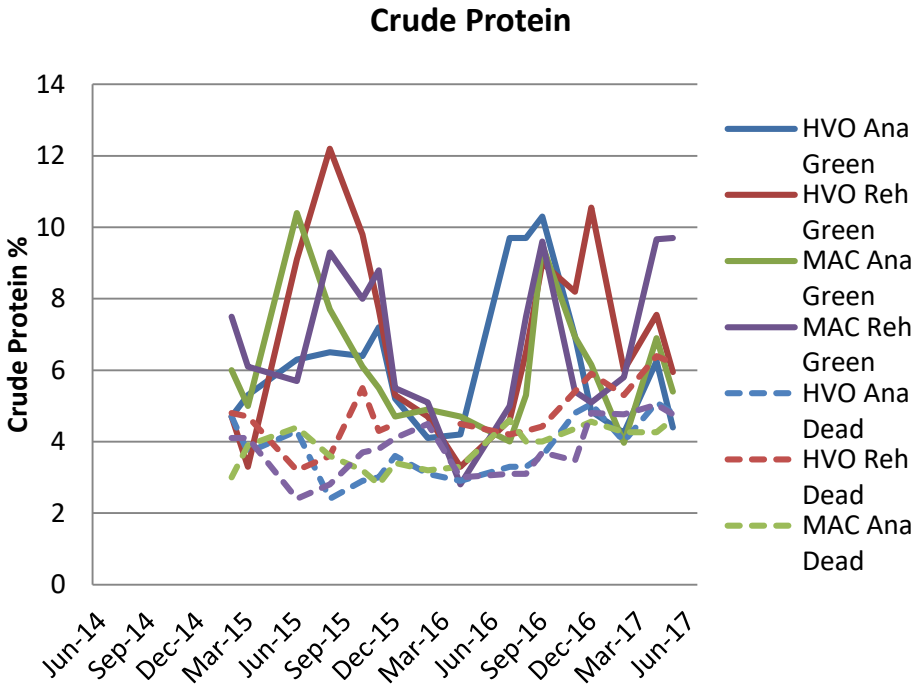
Feed Quality Analysis





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Heavy metals in pasture

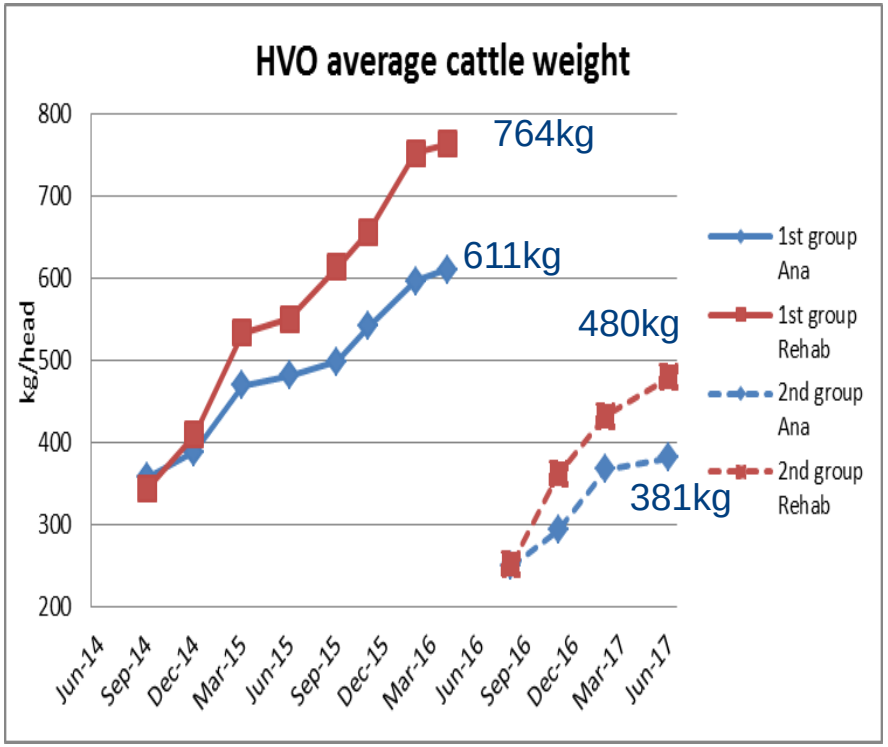
- 290 samples analysed
- Arsenic all < 0.4 mg/kg (ppm) (LOR)
- Cadmium all <= 0.2 mg/kg (LOR)
- Lead all <2 mg/kg (LOR)
- Selenium all <4 mg/kg (LOR)

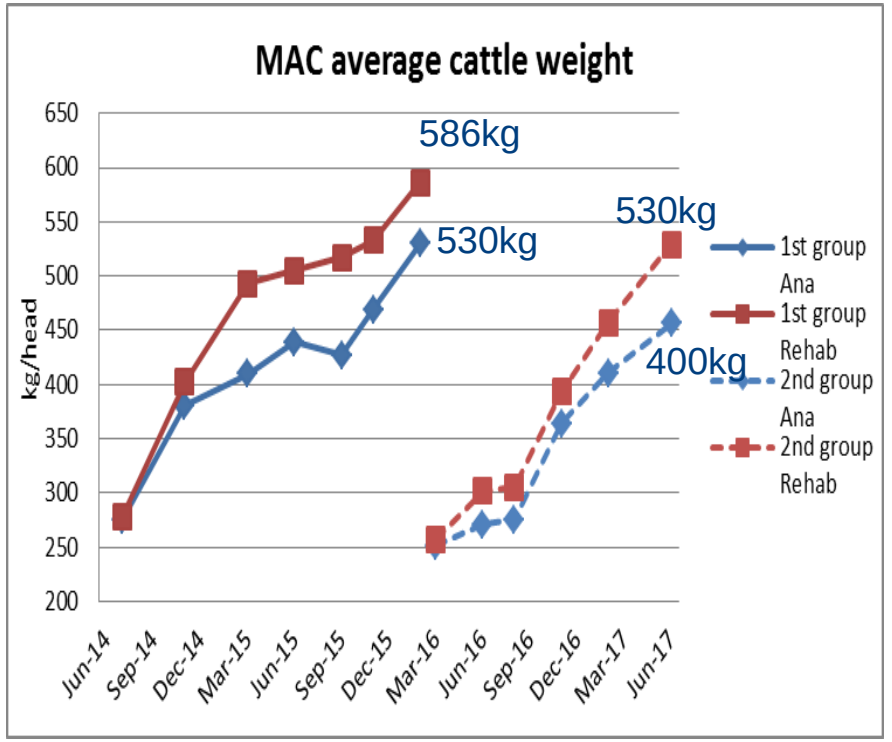
LOR = Limit of Reporting

Range in heavy metal and trace element concentrations (mg/kg) found in pasture samples

Element	Required Level	Maximum Tolerable Level	HVO		MAC	
			Ana	Rehab	Ana	Rehab
Boron	---	150	6.1 - 15.5	4.2 – 14.0	6.9 – 15.3	4.6 – 11.5
Chromium	---	1000	0.25 - 1.3	0.65 – 1.2	0.38 – 1.3	0.5 – 1.8
Copper	10	100	4.2 - 7.1	3.2 – 6.2	4.7 – 6.7	3.1 – 5.5
Manganese	20-40	1000	66 - 205	18 – 74	48 – 89	29 – 49
Molybdenum	---	5	<1 - 1.2	<1 – 1.1	<1	1.7 – 2.7
Nickel	---	50	<0.7 - 6.2	<0.7 – 1.1	<0.7 – 3.2	1.2 – 8.7
Zinc	30	500	37 - 124	14 - 145	28 - 56	19 - 61

Cattle weight





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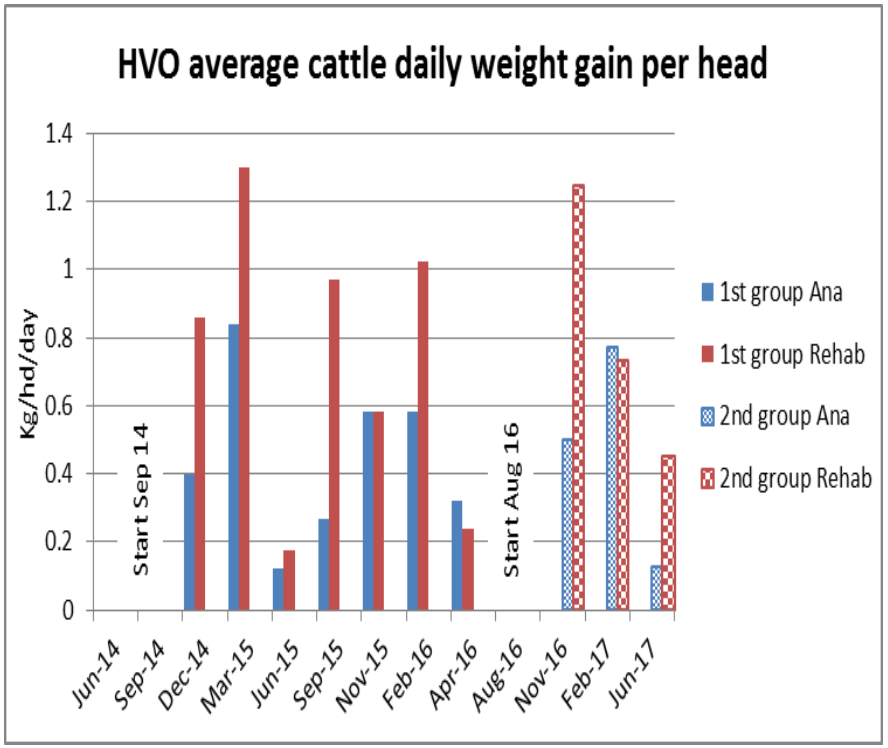
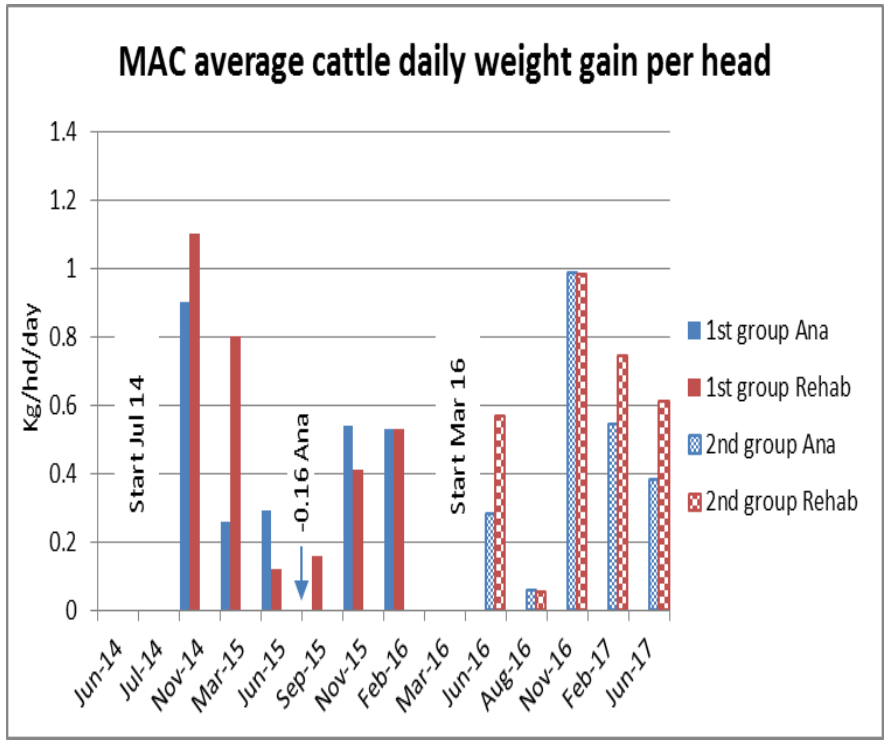
Daily weight gain





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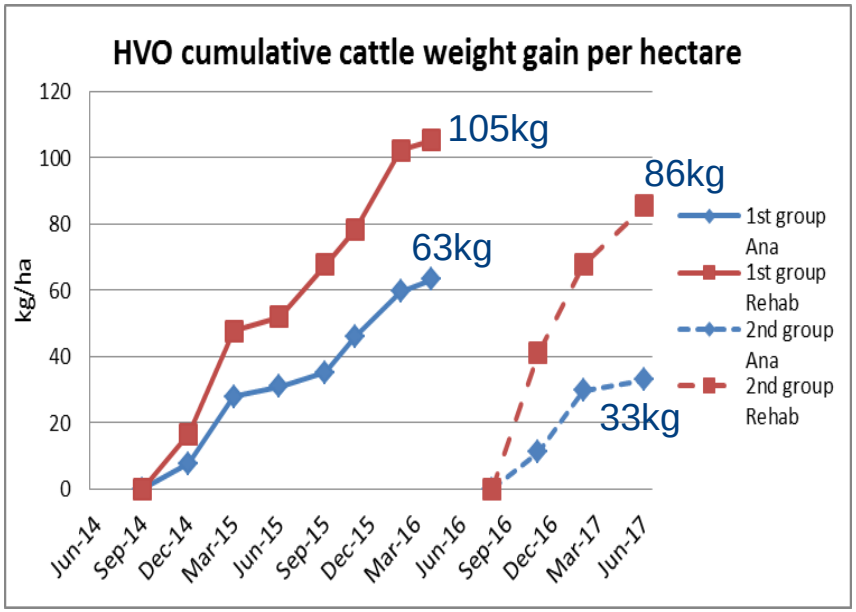
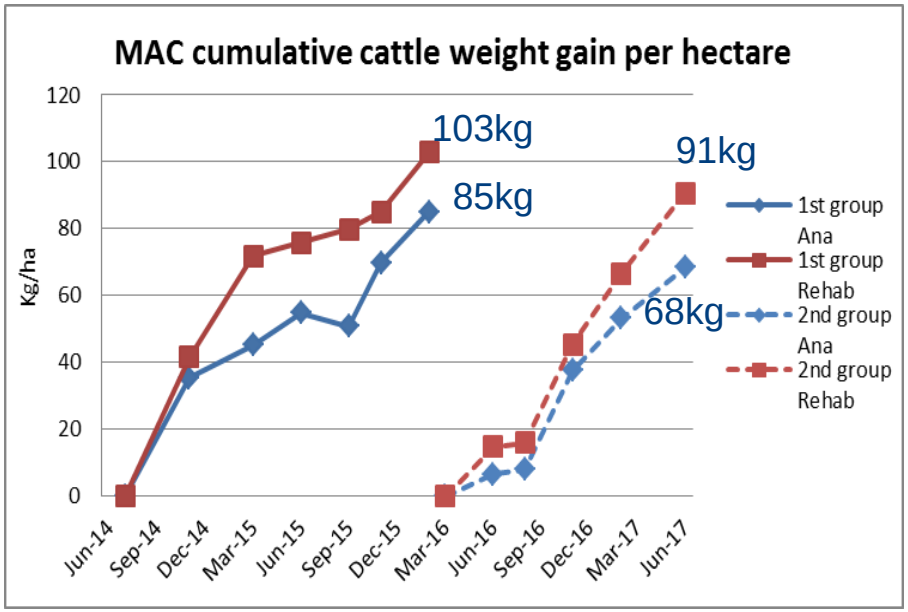
Weight gain per hectare





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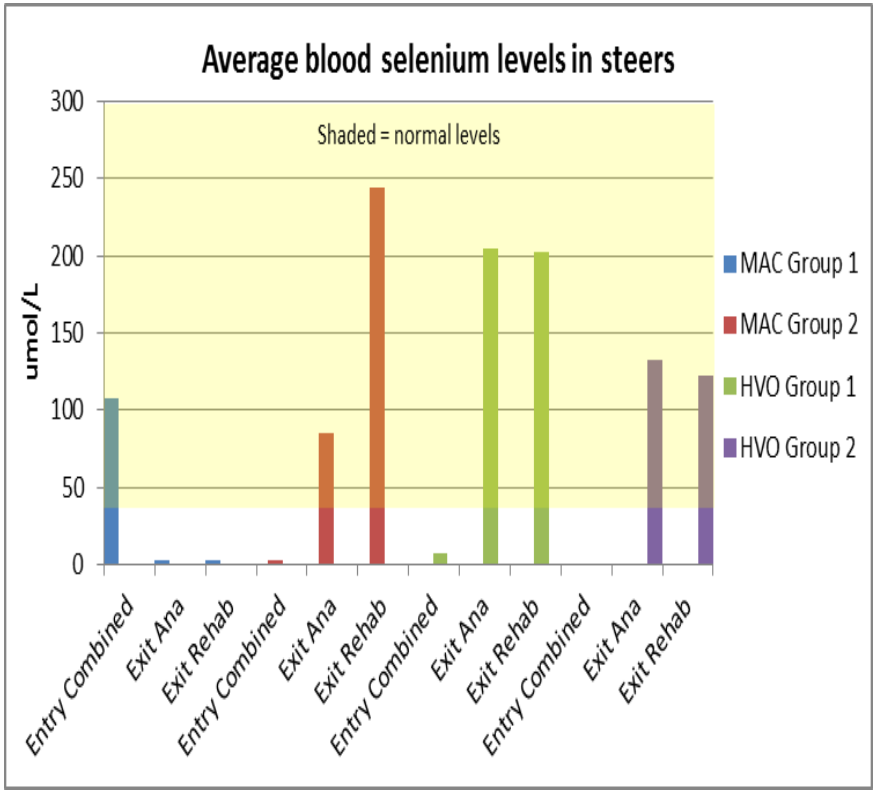
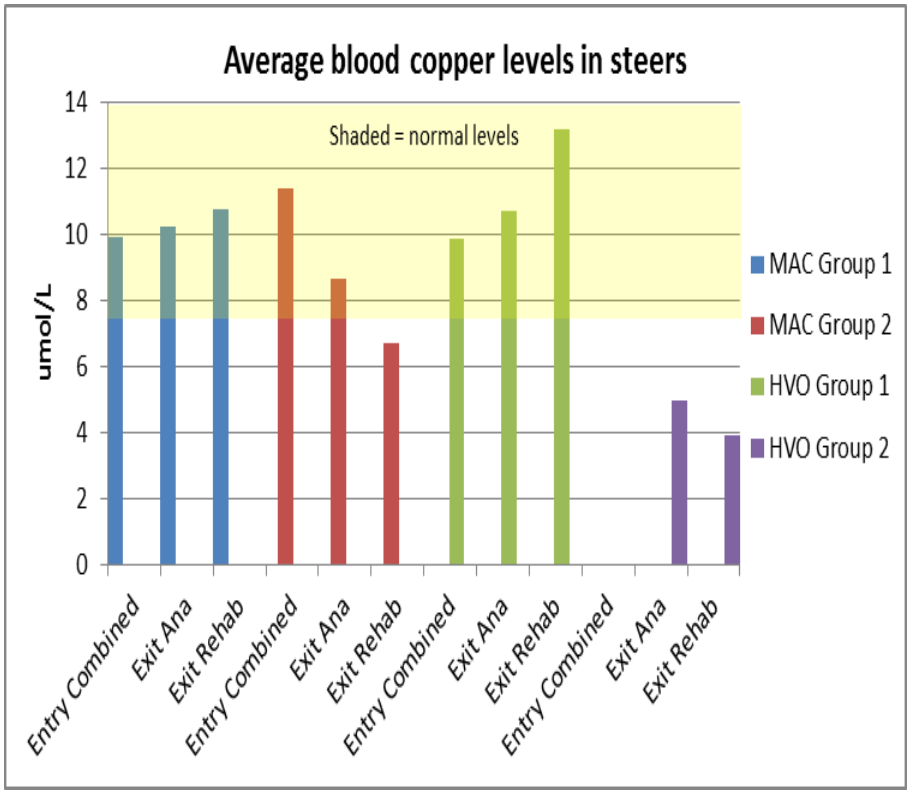
Blood test detail

				P	Se	Cu	Zn	Ca	Mg	SO_4	Vit. B12	Pb	Mn
Normal Range				0.8-2.8	40-300	7.5-16.0	8.0-23.0	2.0-2.75	0.74-1.44	0.7-2.0	130-500	<0.2	20-150
MAC	Group 1	Entry	Combined		108	9.9	9.7		0.92		263	<0.1	
		Exit	Ana	2.36	<5	10.3	11.0	2.46	0.95	1.39	273	<0.1	40
			Rehab	2.38	<5	10.8	12.0	2.46	0.96	1.46	289	<0.1	44
	Group 2	Entry	Combined	2.38	<5	11.4	14.6	2.47	1.01	1.35	309	<0.1	39
		Exit	Ana	1.97	85	8.6	12.8	2.49	0.96	0.95	282	<0.1	50
			Rehab	2.50	244	6.7	14.0	2.62	0.99	1.15	355	<0.1	59
HVO	Group 1	Entry	Combined		8	9.9	11.1		1.00	1.28	243	<0.1	
		Exit	Ana	1.74	205	10.7	11.5	2.51	1.01	1.66	334	<0.1	60
			Rehab	2.27	203	13.2	12.4	2.45	0.81	1.43	410	<0.1	70
	Group 2	Entry	Combined										
		Exit	Ana	1.37	133	5	10.9	2.77	1.04	1.72	296	<0.1	25
			Rehab	2.43	122	3.9	11.1	2.57	0.95	1.32	310	<0.1	37

Blood selenium and copper





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Summary:
Cattle final values Group 1

Site	Treatment	Average Final Weight	Average P8 fat depth	Average value $/head
Mt Arthur	Native analogue	537 kg/head	5.3 mm	$1506
	Rehab	586 kg/head	7.0 mm	$1822
HVO	Native Analogue	611 kg/head	9.3 mm	$1560 (estimated)
	Rehab	764 kg/head	23.7 mm	$2017 (estimated)

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Gross Margin results

	Group 1		Group 2	
Mt Arthur	Native	Rehab	Native	Rehab
Gross Margin	$8,950	$11,928	$5,488	$7,034
Gross Margin/steer	$895	$1,193	$549	$703
Gross Margin/DSE	$104	$138	$64	$82
Gross Margin/ha	$298	$398	$183	$234
HVO	Native	Rehab	Native	Rehab
Gross Margin	$7,217	$12,021	$1,452	$5,190
Gross Margin/steer	$722	$1,202	$145	$346
Gross Margin/DSE	$84	$139	$17	$40
Gross Margin/ha	$180	$301	$36	$130

Project Partners

- NSW DPI
- ACARP (Australian Coal Association Research Program)
- NSW Resources and Energy
- HVO (Rio Tinto) & MAC (BHP)
- Local Farmers
- Hunter Local Land Services (Vet)
- Support from UHMD

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New Project Proposal

ACARP Proposal No. 57089

“Examination of past and present mine rehabilitation to grazing land as a guide to future research.”