



Texas A&M System

Improving Life through Science and Technology.

Economic implications of maintaining rangeland ecosystem health

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Goals

Determine ecological and economic consequences of managing for alternate goals of:

1. Maintaining range condition
2. Maximizing profit
3. Improving range condition

Develop useful field criteria to aid managers achieve range maintenance or improvement



Ecological Economics

Ecosystem Simulation Model (SESS):

- North and south Texas rangelands
- Whole-ranch systems
- Hypothetical 1000 ha ranch
- Continuous season long grazing
- Rangeland health and productivity
- Cow-calf enterprises
- Corroborated with 55 years of research
- 30-Year NPV consequences

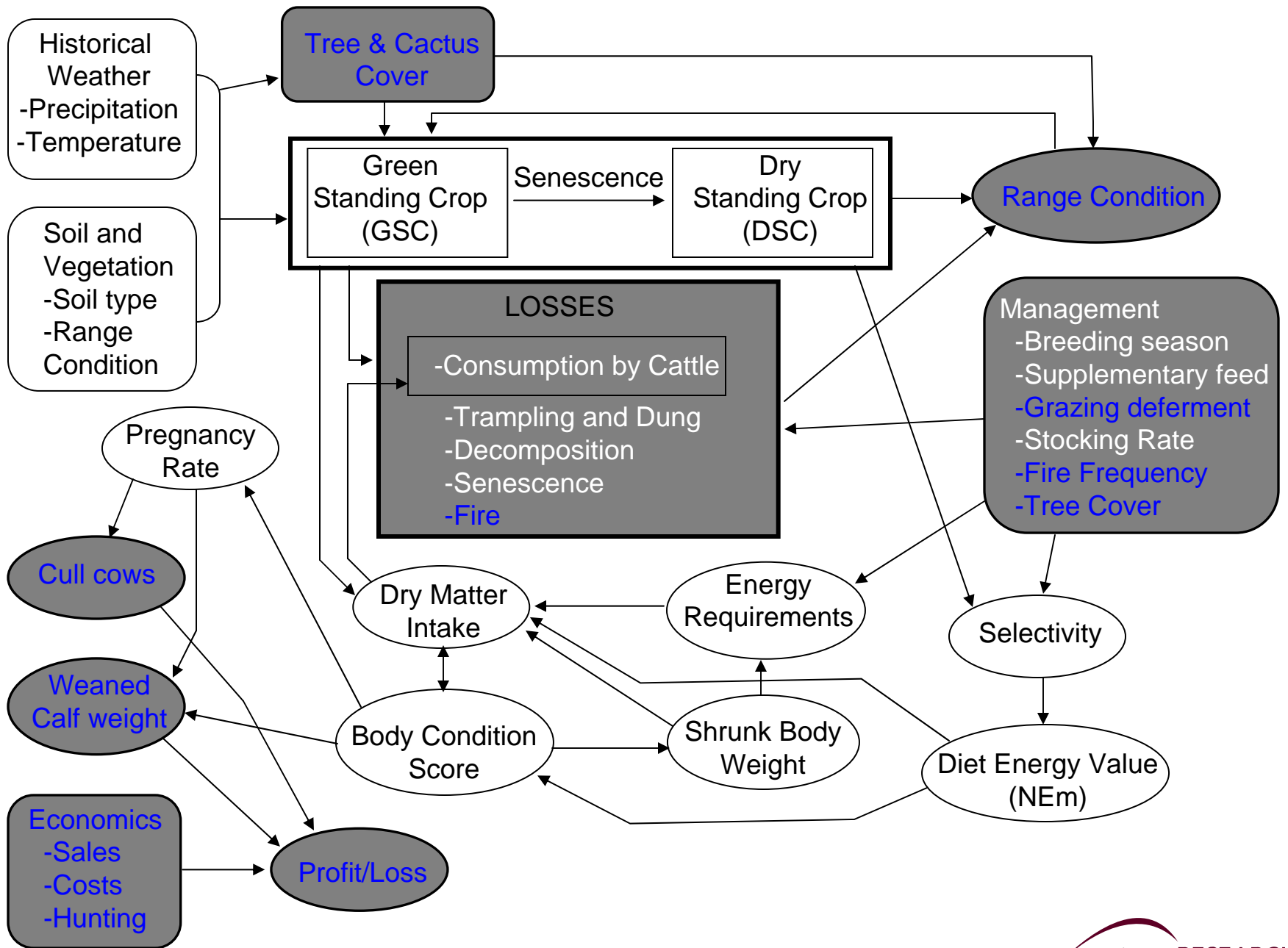


Fig. 1

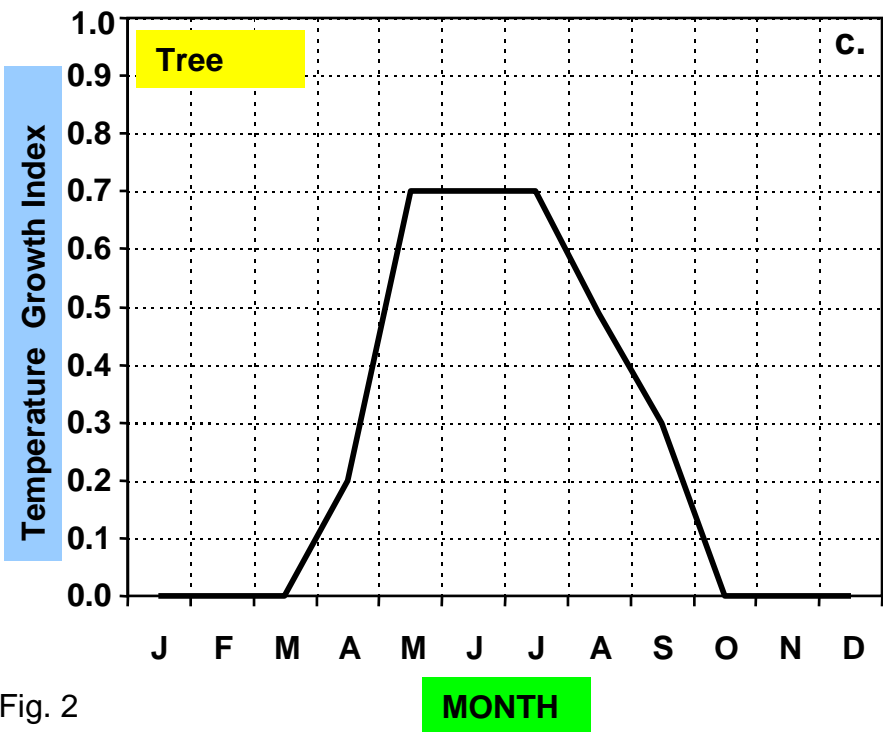
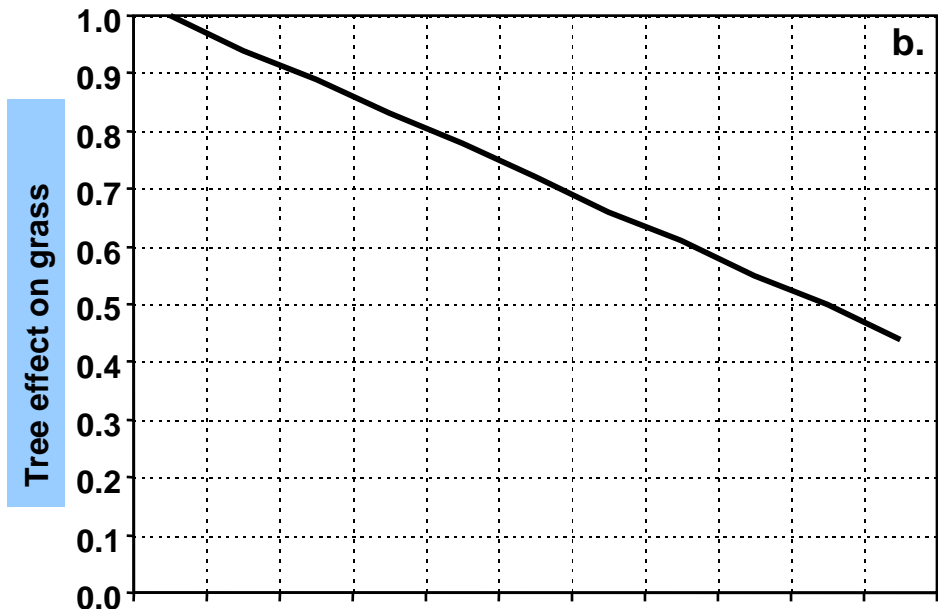
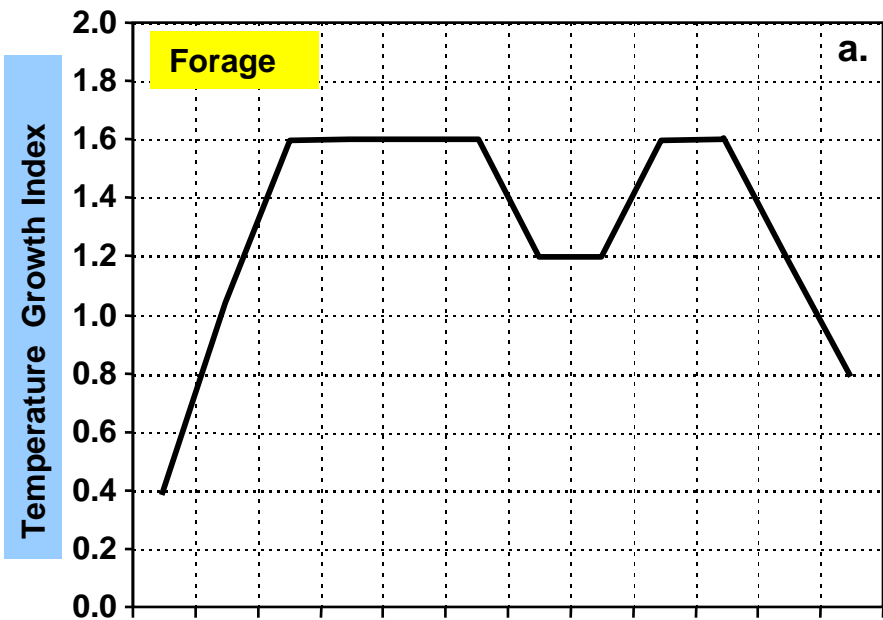
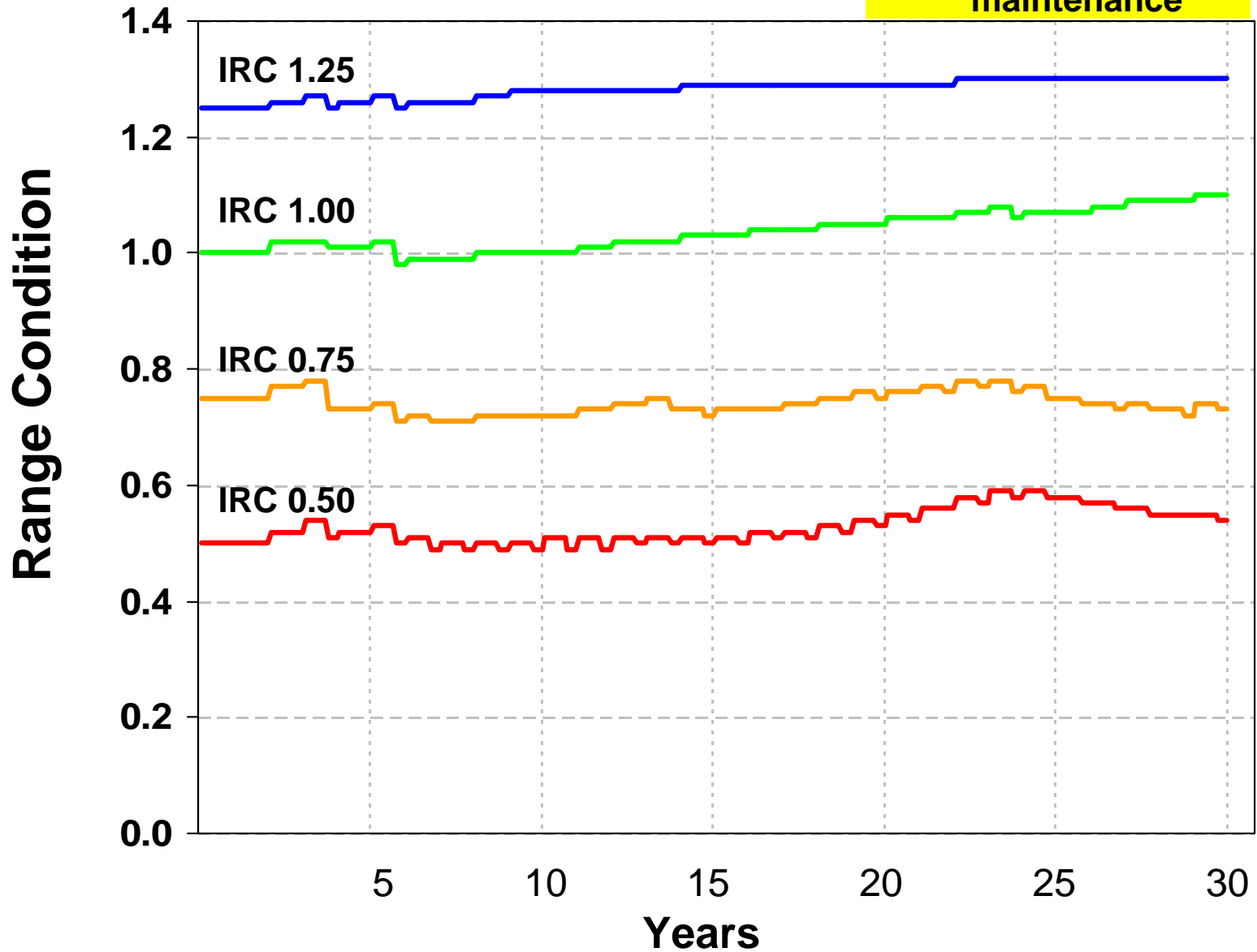


Fig. 2

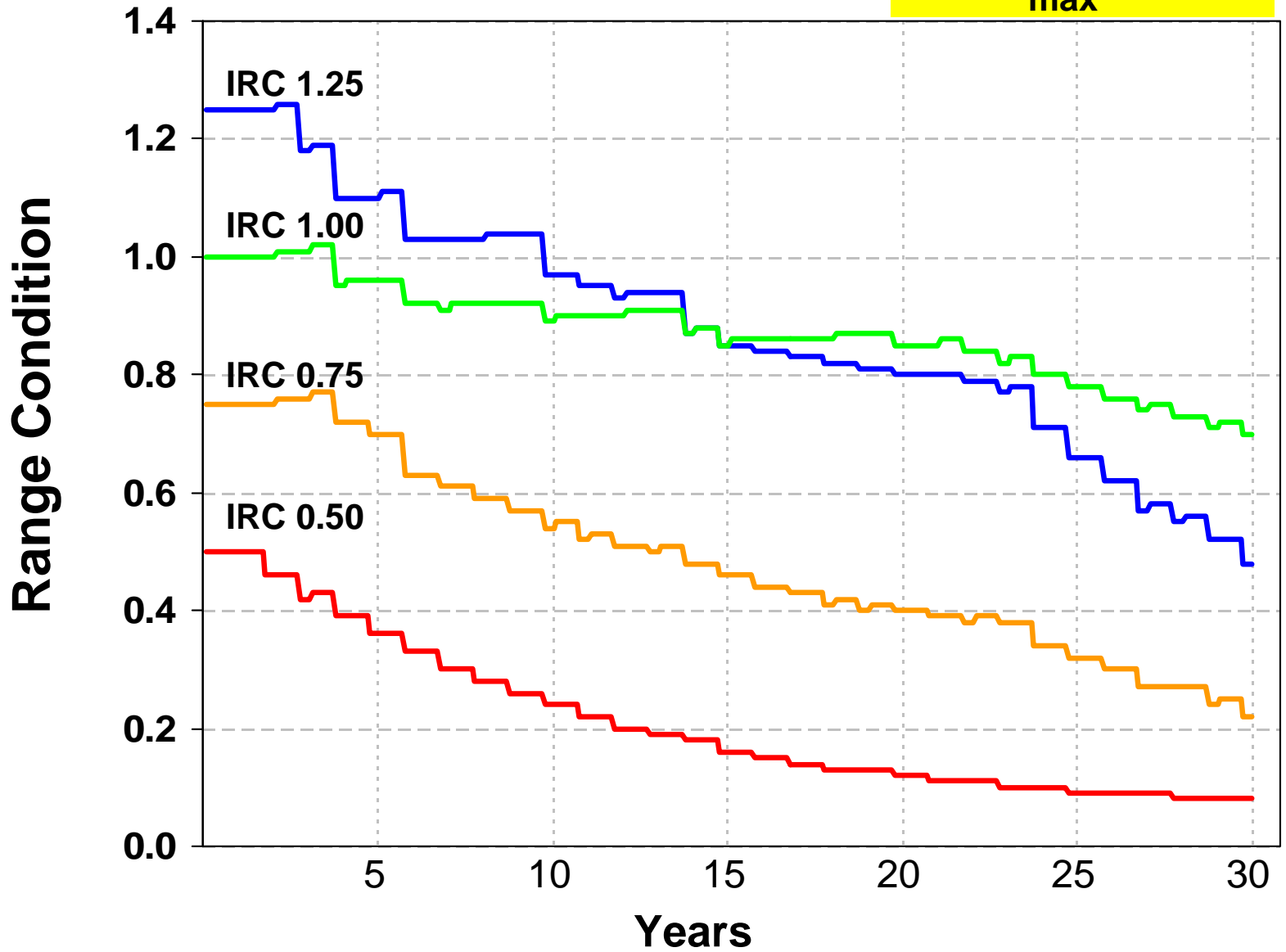
Stocking rates to achieve different goals over 30-years

Initial Range Condition	Management goal		
	NPV _{max}	RC _{maint}	RC _{Increase}
	————— AUU 100ha ⁻¹ —————		
1.25	50	31	31
1.00	26	24	15
0.75	18	13	8
0.50	6	2	1

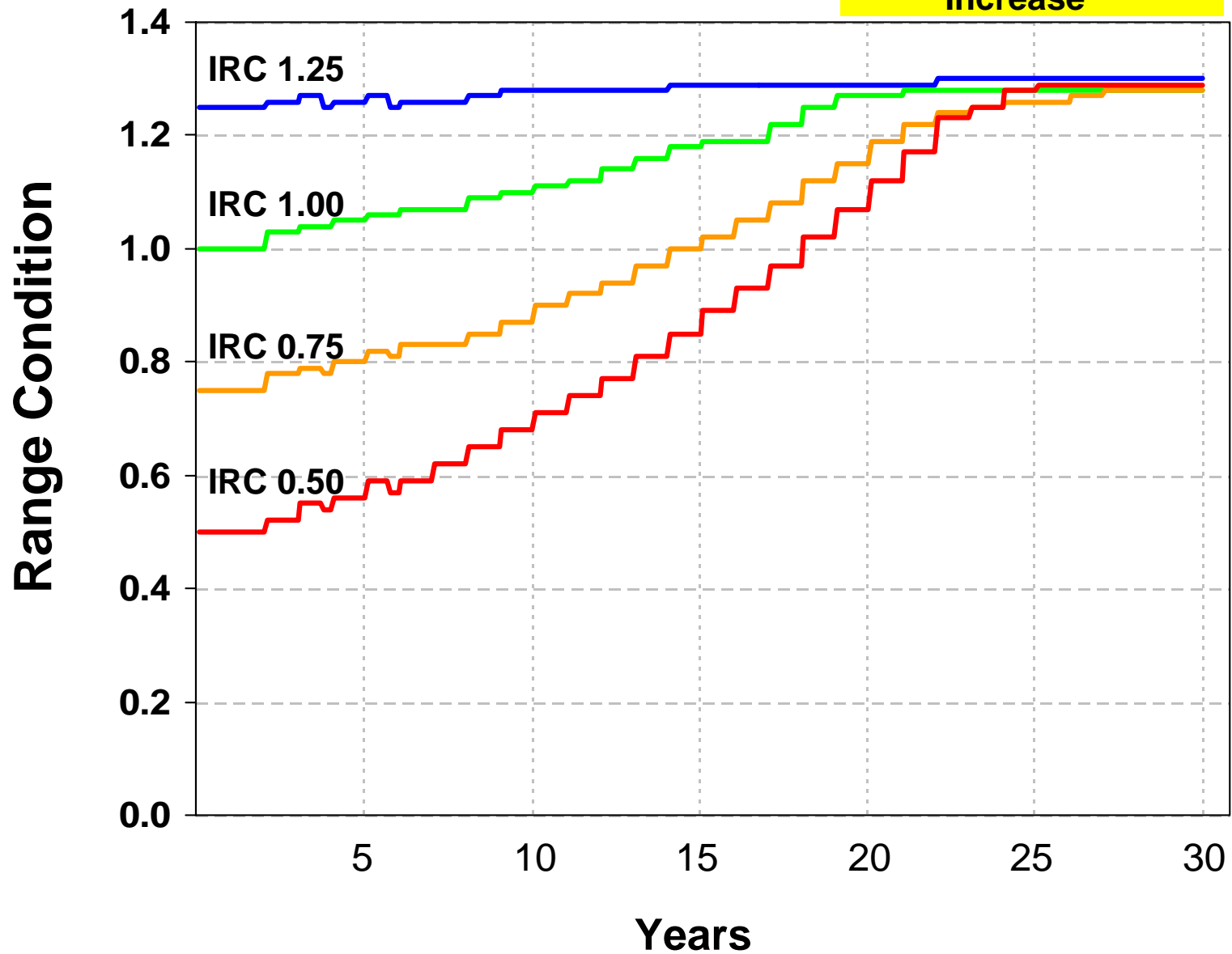
RC maintenance



NPV max



RC Increase



30-year NPV for different goals

Initial Range Condition	30-year NPV (\$ * 1000)		
	NPV _{max}	RC _{maint}	RC _{Increase}
1.25	1350	990	990
1.00	819	783	614
0.75	583	531	428
0.50	311	238	207

30-year NPV for different goals with different quail hunting income

Initial Range Condition	Stocking rate (AUY 100 ha ⁻¹)	30-year NPV (\$ * 1000)		
		Hunting income \$12 ha ⁻¹ yr ⁻¹	Hunting income \$18 ha ⁻¹ yr ⁻¹	% Increase
1.25	31	990	-	-
1.00	24	783	875	12
0.75	13	531	625	17
0.50	2	238	-	-

Revenue loss expected by managing for different goals

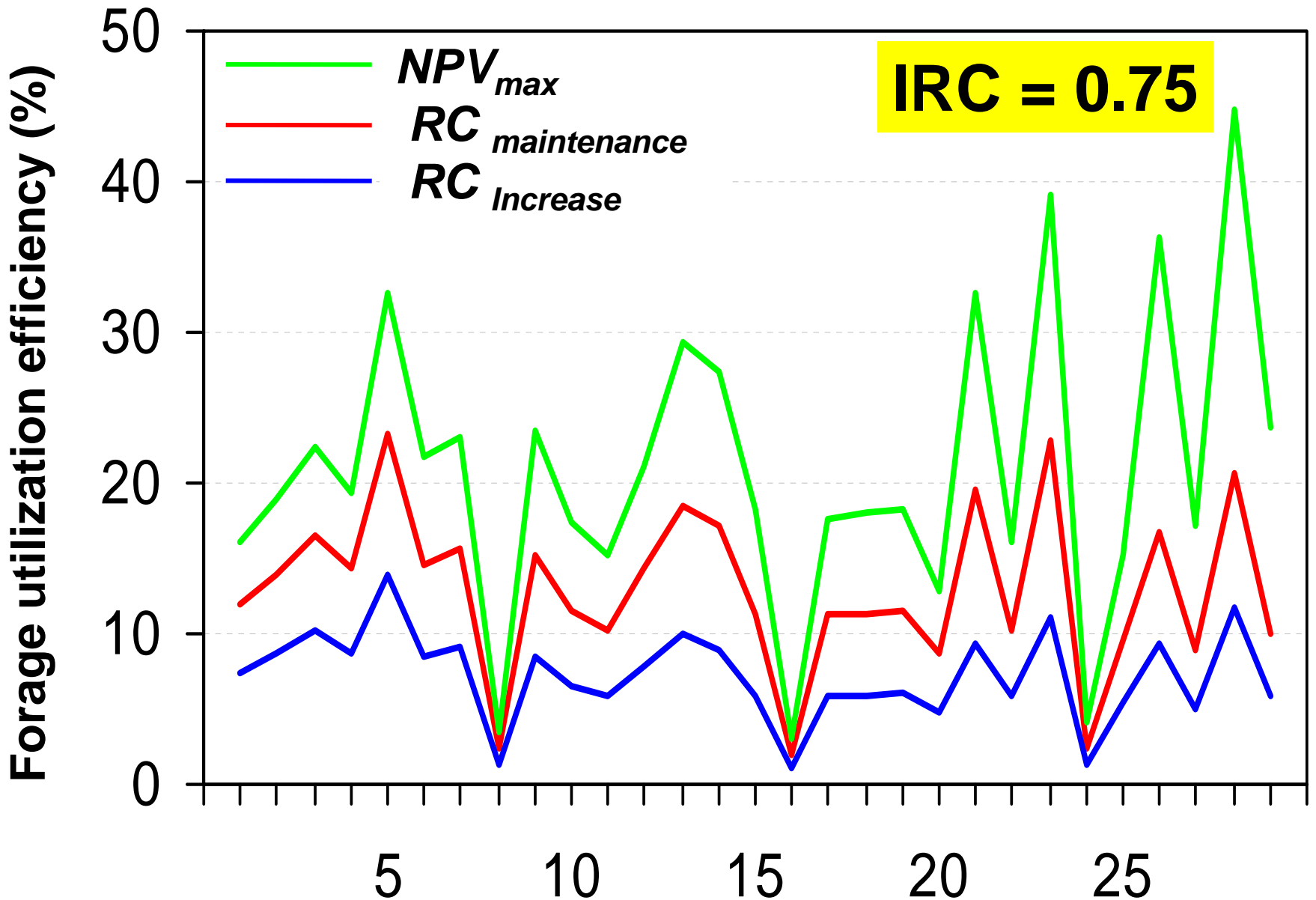
Initial Range Condition	Difference in 30-year NPV (\$*1000)		
	$RC_{\text{maint}} - RC_{\text{Inc}}$	$NPV_{\text{max}} - RC_{\text{Inc}}$	$NPV_{\text{max}} - RC_{\text{maint}}$
1.25	-	360	360
1.00	165	205	36
0.75	103	155	52
0.50	31	104	73



Animal performance

- NPV_{maximum}
 - 90% of max animal performance
- RC_{maintenance}
 - 93-94% of max animal performance

This is not sensitive enough to use in the field as an aid to maintain range condition



Mean 30-year forage harvest efficiencies when managing to achieve different goals

Initial Range Condition	Management goal		
	NPV_{max}	RC_{maint}	$RC_{Increase}$
1.25	33	22	22
1.00	21	19	12
0.75	20	13	7
0.50	10	2	1



Range field guides

- To maintain range
 - Leave $> 800 \text{ kg ha}^{-1}$
- To improve range
 - Leave $1500\text{-}2000 \text{ kg ha}^{-1}$



Conclusions

- NPV earnings are 4 x higher for excellent than poor range condition
- Maximum profit is at a stocking rate that decreases range condition
- At SR to maintain or improve range condition forfeit profit
- Low stocking rates will increase range condition but decreases income
- Quail income does not offset profit from excellent range condition



Conclusions

To improve range condition :

- Leave standing crop of 1500-2000 kg ha⁻¹
- cf. 1000 - 1500 kg ha⁻¹ advocated

To maintain range condition:

- Leave standing crop of > 800 kg ha⁻¹
- as advocated

If range condition lower than excellent:

- Need harvest efficiencies << 20%
- No comparable data indicating research need



Conclusions

Underscores:

- Need to regularly monitor amount of forage
- Need to manage stock numbers
- Inadequacy of animal performance as guide

Future modeling research:

- Impact of growing season recovery rest
- Impact of planned rotational grazing
- Implications of increasing scale
- Landscape effects
- Interactions of the above



Collaborators

- TAMU
 - Bill Grant, Mort Kothmann, Urs Kreuter
- ARECs
 - Jim Ansley, Bill Pinchak
- Mexico
 - Heriberto Diaz-Solis



END



Model corroboration

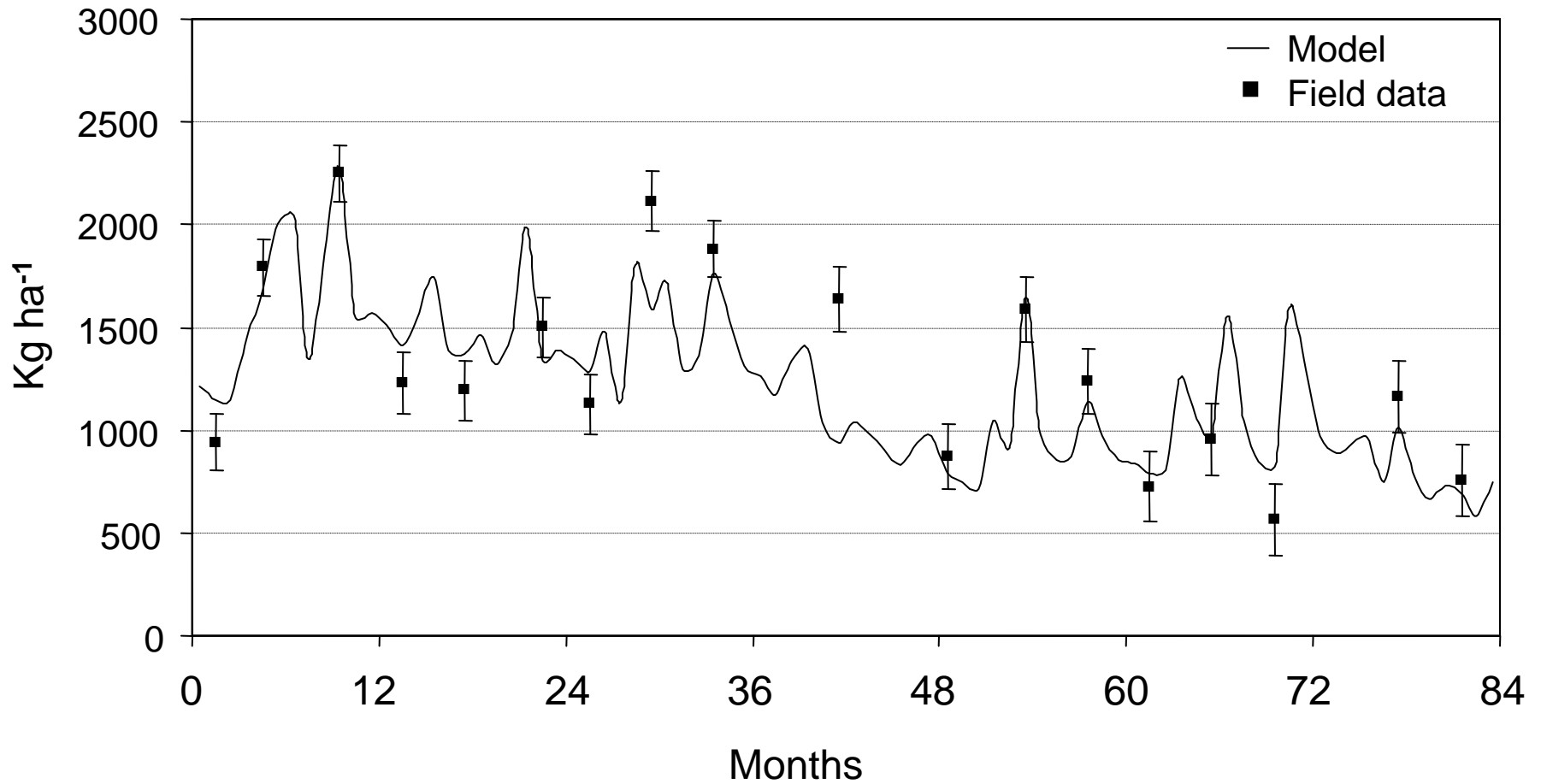


Fig. 3

Model output for pregnancy percentage and mean calf mass compared to field data

Year	Parameter			
	Pregnancy * (%)		Calf mass * (kg calf ⁻¹)	
	Data	Model	Data	Model
1995	90 ± 3.4	89	226 ± 4.5	215
1996	80 ± 3.4	90	188 ± 4.5	227
1997	89 ± 3.4	90	244 ± 4.5	233
1998	87 ± 3.4	88	223 ± 4.5	243
1999	89 ± 3.4	92	254 ± 4.5	279
2000	84 ± 3.4	89	260 ± 4.5	221
2001	86 ± 3.4	87	235 ± 4.5	189
Mean	86 ± 3.4	89	233 ± 4.5	230

* At weaning in late October