Ranch Profitability Given Increased Precipitation Variability and Flexible Stocking

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Profitability in Ranching Highly Variable

- Main causes:
- 1) Changing weather and climatic conditions which influence annual variation in forage production and cattle performance.
- 2) cyclical market prices
- 3)Often independent conditions but interact to provide significant management challenges

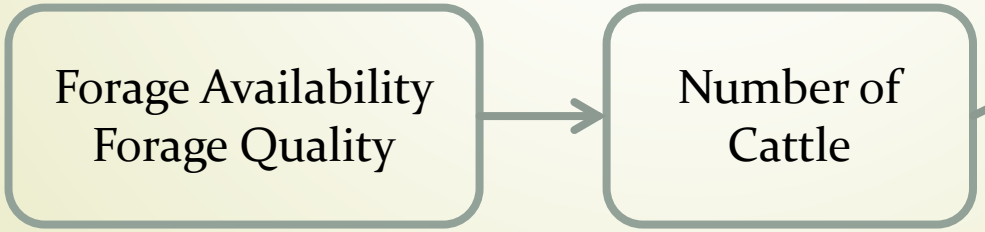
Previous Research

- Impacts of Drought on Cattle Production
  - Extent of negative impacts depend on:
    - Cattle Price Cycle
    - Drought Length
- Impacts of Climate Variation on Cattle Production
  - Causes variation in physical production
- Increasing Climate Variation
  - Financial Impacts
  - Separation of Direct and Indirect Impacts

Implications of a Variable Precipitation on Cattle Production

- Direct Effects

- Indirect Effects



Objectives of Analyzing Increasing Climate (Precipitation)Variation

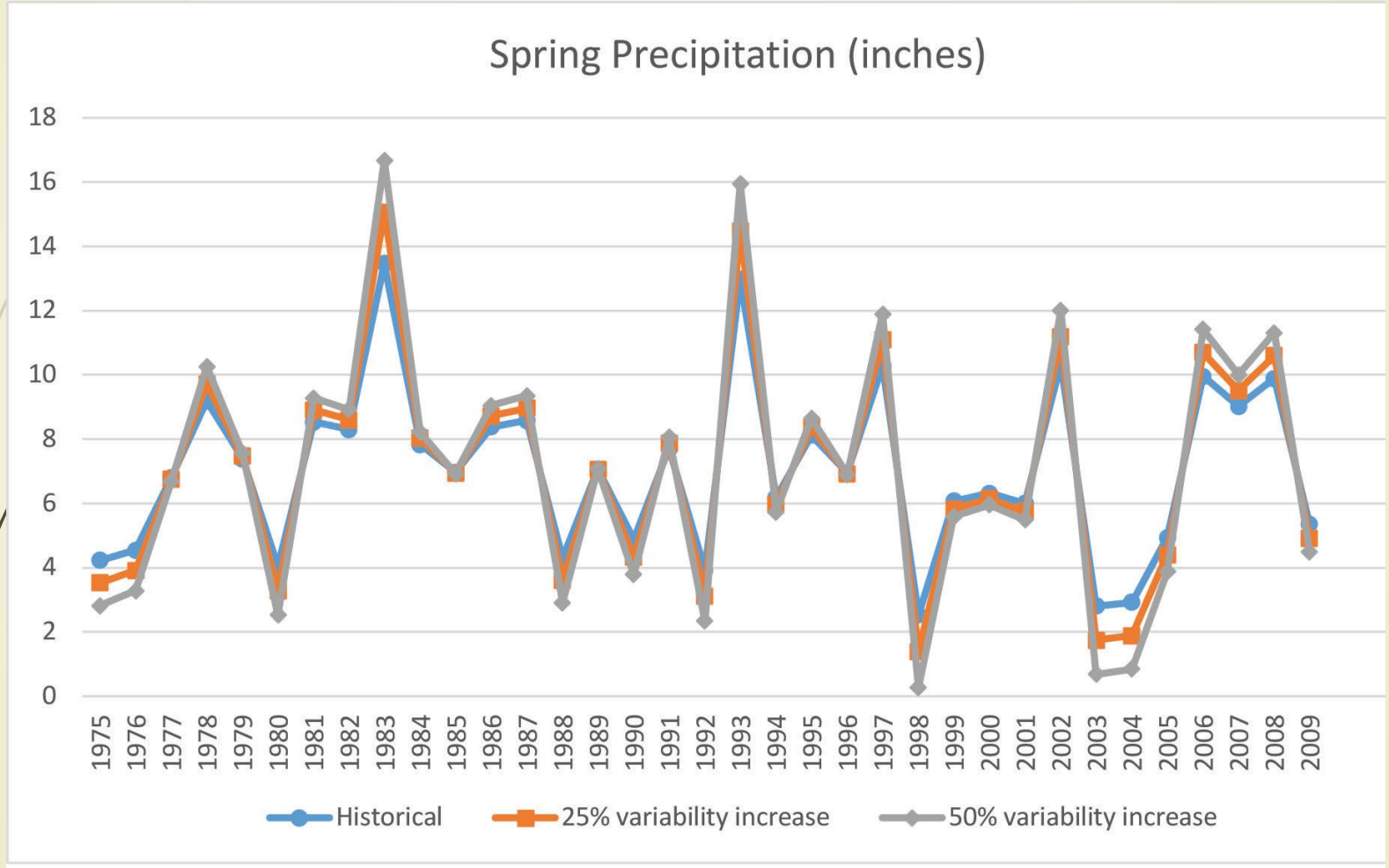
- Quantify the effects on forage production and calf gain.
- Determine financial consequences.
- Determine impacts on risk.
- Provide insight into management decisions to address profitability and potential risks.

How?

- Use data to quantify impacts of precipitation variability on cattle performance and forage production.
- Set up representative ranch model.
- Estimate outcomes across various precipitation and price conditions.

Precipitation Variation

- Precipitation
  - April-June Total Precipitation
  - Growing Season
- Climate Variation
  - Transformation of Precipitation
  - 25% — 50% Increase in Variation

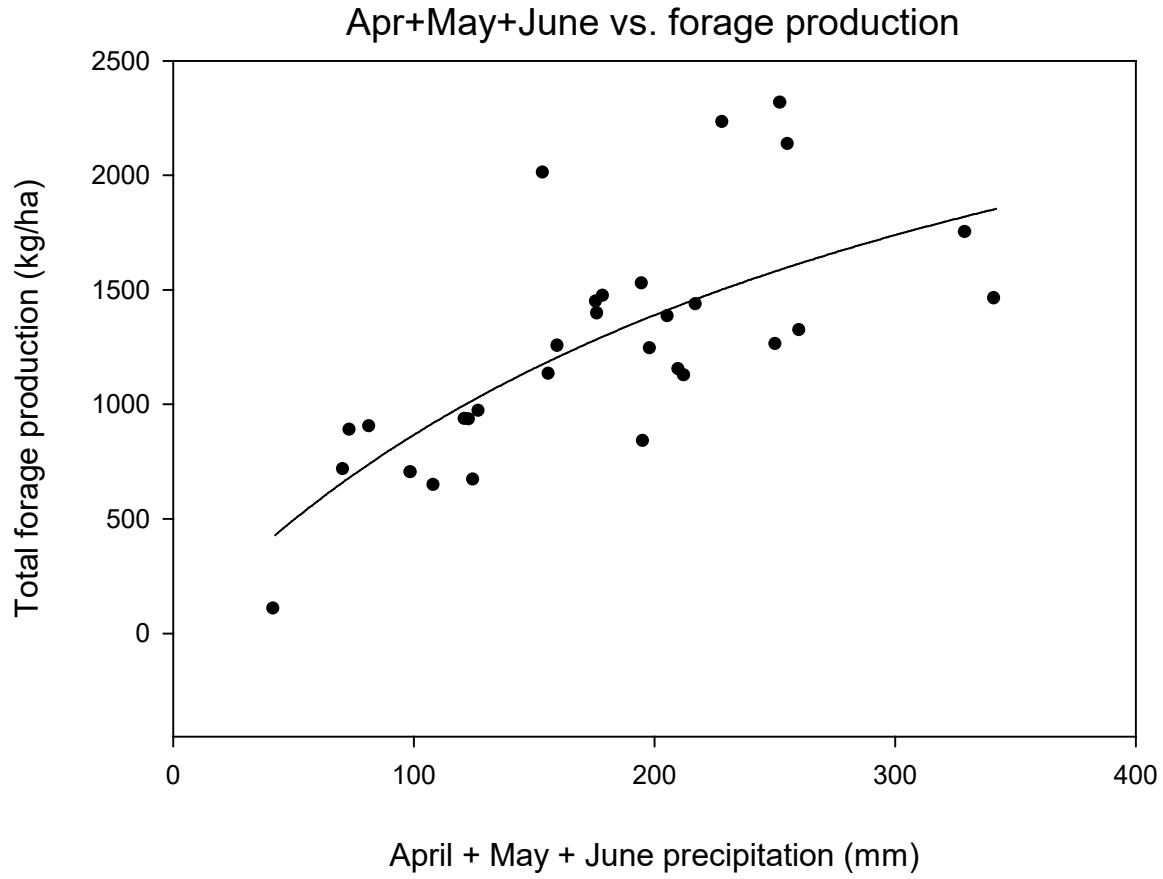

Spring Precipitation (inches)
18
16
14
12
10
8
6
4
2
0
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Historical
25% variability increase
50% variability increase

Estimated Production

- ARS:HPGRS; Cheyenne, Wyoming
- Justin Derner; Justin Reeves
  - Forage Production/Calf Gain
    - Function of Growing Season Precipitation
  - Historical ARS:HPGRS Data

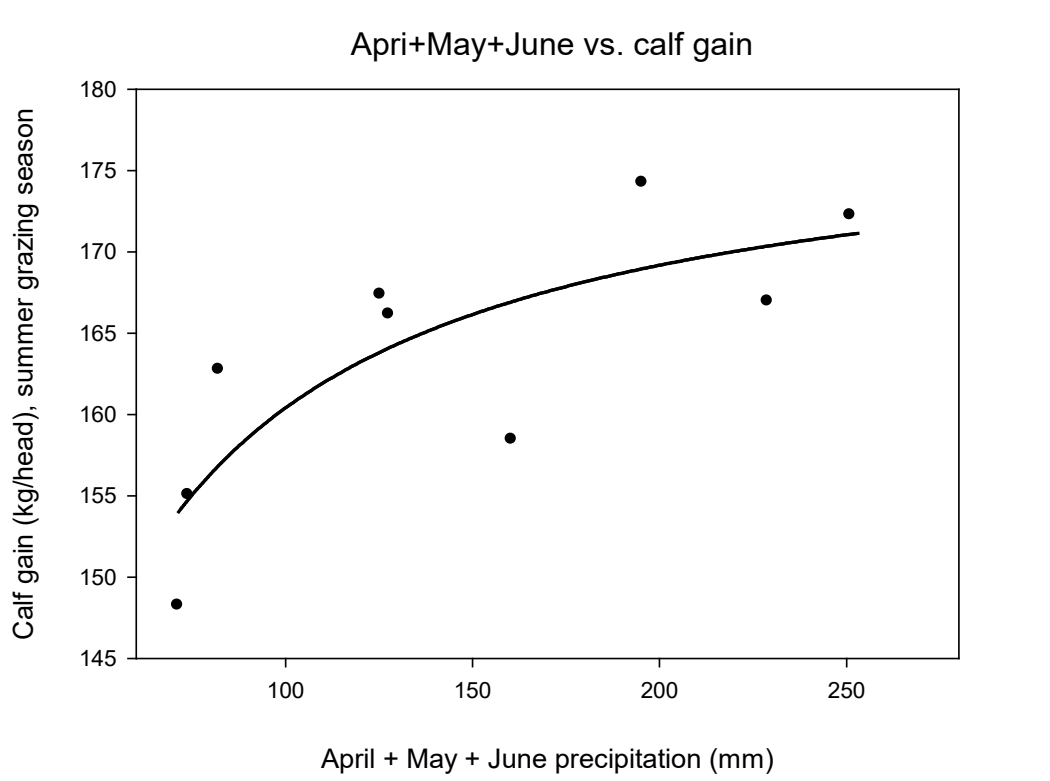
Maude, Heather. March 2014. [Photograph]. Double H Photography

Forage Model



*From Derner, based on: **Derner, J.D., Hart, R.H.,** 2007. Grazing-induced modifications to peak standing crop in northern mixed-grass prairie. *Rangel. Ecology Management* 60, 270-276

Calf gain model



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Ranch Characteristics

	Resource	Number of Acres
Land Resources Owned	Deeded Rangeland	2,827
	Irrigated Aflalfa Hayland	172
	Irrigated Meadow Hayland	225
Land Resources Leased or Purchased	State	308
	BLM	204
	USFS	139
	Privately Leased	100
	Total Acres	3,975

Ranch Characteristics

- Cow/Calf + Irrigated Haying
  - Hay is fed in winter seasons
  - What is not fed is sold
- Model Activities

	Item	Date
Activities	Calving Date	Apr. 15
	Weaning Date	Oct. 15
	Retain Calves	Oct. 31
	Sell Calves	Oct. 31
Feed Usage	Turnout Date	May 1
	Hay Fed	Nov. 1-May 1
	Federal Land	May1-Oct. 31

Ranch Herd Characteristics

Efficiency Measures	
Calf Birth Rate	90%
Minimum Cow Replacement	15%
Minimum Bull Replacement	20%
Required Minimum Heifers for Sale	12%
Maximum Heifers Kept	80%
Cow to Bull Ratio	18

Methods and Procedures

- Multi-Period Linear Programming Model(MLP)
  - Maximize Net Present Value of Future Stream of Profits
  - 35-year Planning Horizon
  - Incorporate Price Variability
    - 100-iterations
- Incorporate Historical Climate Variation
- Mimic Increasing Climate Variation

Do we need to impact both forage and calf gains?

- Forage supply impacts carrying capacity
- Calf gains impacts revenues

- Both have different impacts on production

Modelling Precipitation Effects (separate effects cow-calf only)

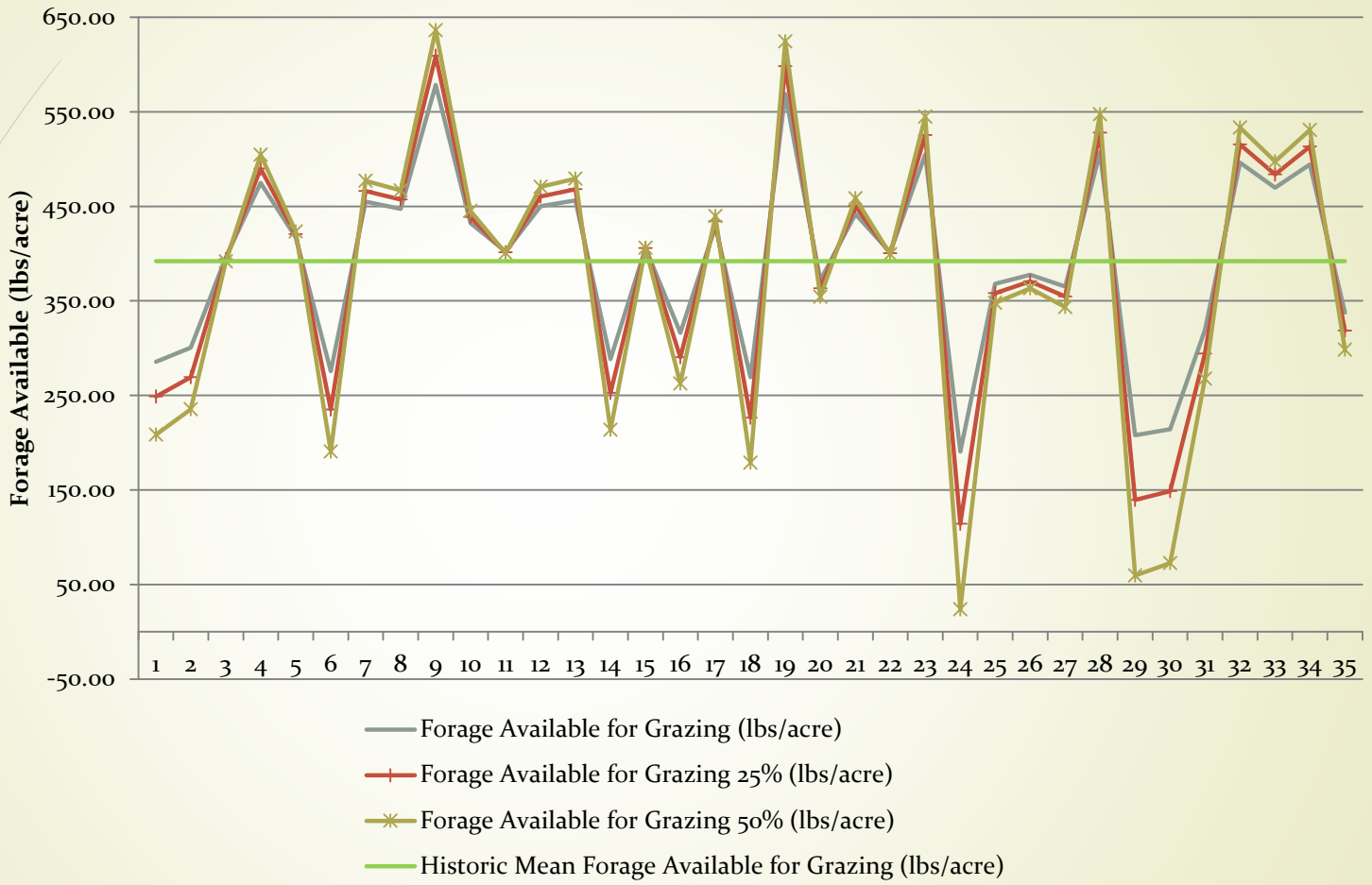
Number	Name	Climate	Goal
1	Base	Static	Static Forage Production Static Calf Weights
2	Weights	Historical Climate Data	Weaning Weights: Historical Climate
3	Weights25	25% Increase in Variation	Weaning Weights: Climate Predictions
4	Weights50	50% Increase in Variation	Weaning Weights: Dramatic Climate Change
5	Forage	Historical Climate Data	Forage Production: Historical Climate
6	Forage25	25% Increase in Variation	Forage Production: Climate Predictions
7	Forage50	50% Increase in Variation	Forage Production: Dramatic Climate Change

Weaning Weights with Precipitation Variation

	Mean	Min	Max	Std. Dev.
Historical Climate	522	482	540	14
25% Climate Variation	518	438	541	24
50% Climate Variation	506	253	543	58
* Static weaning weight is 525 lbs				

Maude, Heather. March 2014. [Photograph]. Double H Photography

Forage Available For Grazing



Effects on Annual Income

	Net Income from Cattle	Change in Net Income from Cattle	Net Discounted Income from Cattle	Change in Net Discounted Income
Base	22,445	--	8,350	--
Std. Dev.	(22,329)		(12,160)	
Weight	18,368[a]	-4,077	6,193[e,f]	-2,157
Std. Dev.	(14,592)		(7,870)	
Weight25	18,804[a,b]	-3,641	6,562[e]	-1,788
Std. Dev.	(13,945)		(7,414)	
Weight50	17,865[a,b]	-4,580	6,218[e,f]	-2,132
Std. Dev.	(14,042)		(7,605)	
Forage	17,411[b]	-5,034	6,684[e]	-1,666
Std. Dev.	(17,661)		(10,071)	
Forage25	14,592[c]	-7,853	5,798[f]	-2,552
Std. Dev.	(16,764)		(9,507)	
Forage50	10,777[d]	-11,668	4,838[g]	-3,512
Std. Dev.	(15,739)		(8,529)	

*Same superscripts signify no stastically significant differences. α=0.05

Effects on Total Net Present Value

	Net Present Value (NPV)	NPV as Percent of Base	Coefficient of Variation	Change in NPV	Off-Ranch Income
Base	311,721	--	0.29	--	27,000
Std. Dev.	(88,878)				
Weights	236,068[a,b]	76%	0.24	-75,653	23,000
Std. Dev.	(57,094)				
Weights25	249,061[a,b]	80%	0.19	-62,660	24,000
Std. Dev.	(47,505)				
Weights50	236,831[a,b]	76%	0.22	-74,890	24,000
Std. Dev.	(50,951)				
Forage	253,044[a]	81%	0.33	-58,677	30,000
Std. Dev.	(83,487)				
Forage25	221,760[b]	71%	0.39	-89,961	31,000
Std. Dev.	(85,538)				
Forage50	186,674[c]	60%	0.40	-125,047	33,000
Std. Dev.	(74,455)				

*Same superscripts signify no stastically significant differences. α=0.05

Implications of Isolating Profitability Impacts from Calf Gains Versus Forage Production

- Variable forage production impacts overall stocking rates and has bigger impact on profitability
- Variable calf gains impacts partially offset by price difference of lighter weight calves versus heavier weight calves and impact on profitability less.

Implications of Climate Variation for Cow-Calf Operations

- These results suggest that cow/calf producers are extremely vulnerable to any climatic changes that result in increased precipitation variation.
- Given the production lag from retaining heifers until the time she bears a calf, producers have a difficult time matching herd demand to changes in annual forage production. Our model suggests that an optimal strategy is to lower stocking in all years in order to forgo the costs of destocking and restocking in order to fully utilize forage production in every year.
- Even if mean precipitation stays constant as in our model, wider swings in wet and dry cycles makes carrying a large herd through the dry years extremely costly. This strategy of lowering stocking, however, would require additional sources of income in order to account for the decreased profitability of the cow/calf enterprise.

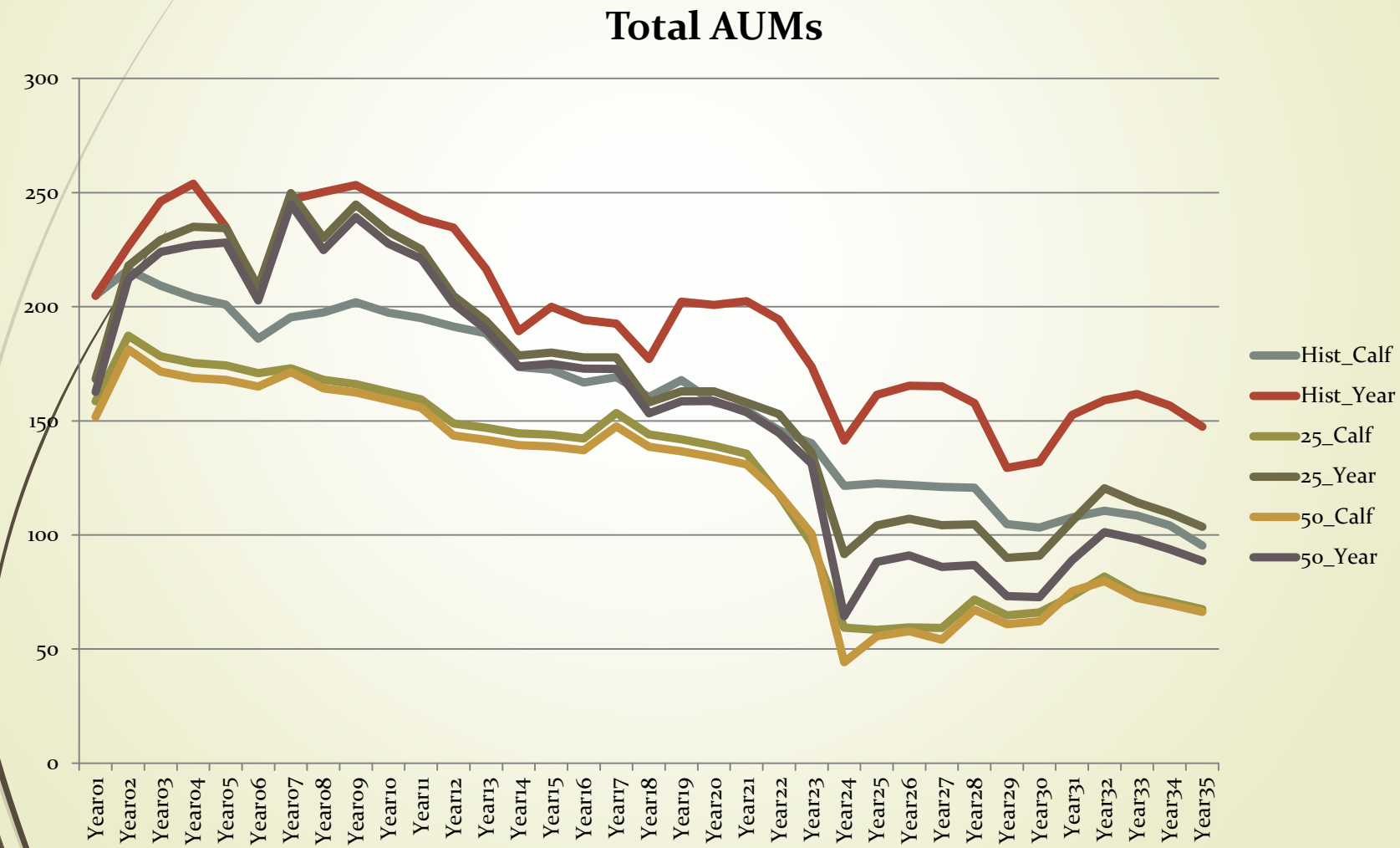
Comparison of Cow/Calf and Cow/Yearling

- Add ability to hold steer calves
- Yearlings now can be sold off rapidly in response to less forage production
- Maintain a stable breeding stock (keep genetics), but still practice adaptive stocking
- Less lag time to increase stocking densities if forage production improves compared to cow/calf only.

Comparison of Cow/Calf and Cow/Yearling

- Steer calves retained and fed over winter
- Weight gains based on Volesky et al. (2002) of .693 lb/day gain over 182 day winter feeding period.
- Added to calf weaning weight.
- Used USDA data to estimate summer gains given precipitation.

Impact of Precipitation Variability on Forage Usage



Effects on Total Net Present Value Across Precipitation Profiles by Operation Type

Net Present Values	Avg. Precip. Cw-Clf	Hist. Precip. Cw-Clf	Hist. Precip. Cw-Clf-Yr.	25% Inc. Cw-Clf	25% Inc. Cw-Clf-Yr	50% Inc. Cw-Clf	50% Inc. Cw-Clf-Yr
Average	$511,866	$281,535	$347,006	$229,418	$310,055	$219,459	$296,510
Std. Dev.	$43,832	$33,050	$32,247	$5,918	$22,415	$5,800	$21,795
Coeff. Of Variation	0.086	0.117	0.093	0.026	0.072	0.026	0.074

Flexibility can address likelihood of losses

Table 1. Probability of Annual Returns Less than $0

Static Weather Cow/Calf	Historical Weather Cow/Calf	Historical Weather Cow/Calf/Yearling
8.8%	15.7%	13.7%

Implications of Climate Variation to Cattle Production

- Static forage models inaccurate
- Managers should manage for climate variation.
  - Has an effect on profits.
- Make decisions to mitigate drought years
  - Rather than capitalizing on wet years.
  - Flexible stocking can improve profitability, but not clear it reduces income variability.
  - Can reduce probability of negative income.

Implications

- Precipitation Variation has a large impact on livestock production and profitability
- Flexible systems are going to become more necessary
- The ability to adapt will help:
  - Economic stability
  - Ecological stability
- Need information to help improve stocking decisions
- Accurate long-term Forecasts!
- Example USDA ARS GRASS CAST model

Some considerations of Cow/Yearling operations

- Livestock handling (Facilities) costs
- We didn't model *conversion to* Cow/Calf/Yearling – there will be a year when you don't take steer calves to market
- Cash flows, operating notes and added costs with the transition.
- Part of cash flow issue could be offset as transition over a period of years

Questions?

Maude, Heather. March 2014. [Photograph]. Double H Photography