INTERPRETING THE DATA PUZZLE

Rangeland Monitoring 101

May 26th, 2022

Deep Well Ranch

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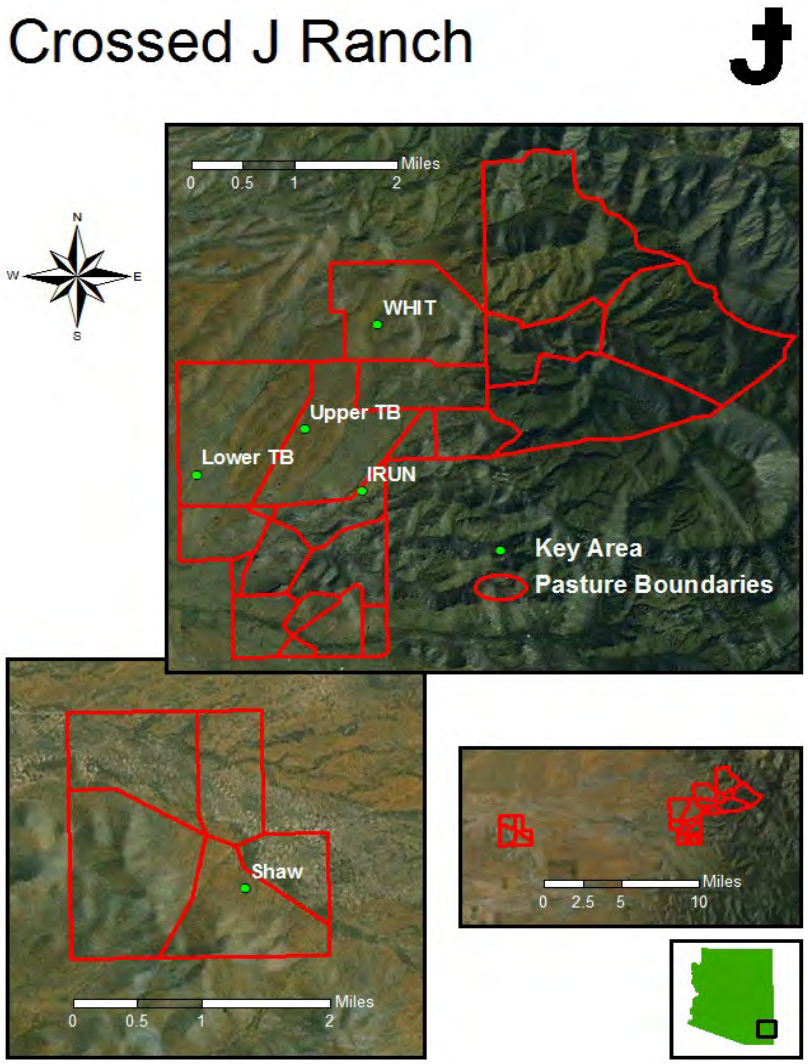
Overview

- Monitoring
  - Study Area
  - Monitoring Methods
- Analysis
  - Binomial Comparison Analysis
  - Time-Series Analysis
- Contributing Factors
  - Grazing
  - Climate
- Range Assessment
  - ESDs and S & T Models
    - Ecological Assessment
    - Productivity Assessment
- Summary/Conclusions

Study Area



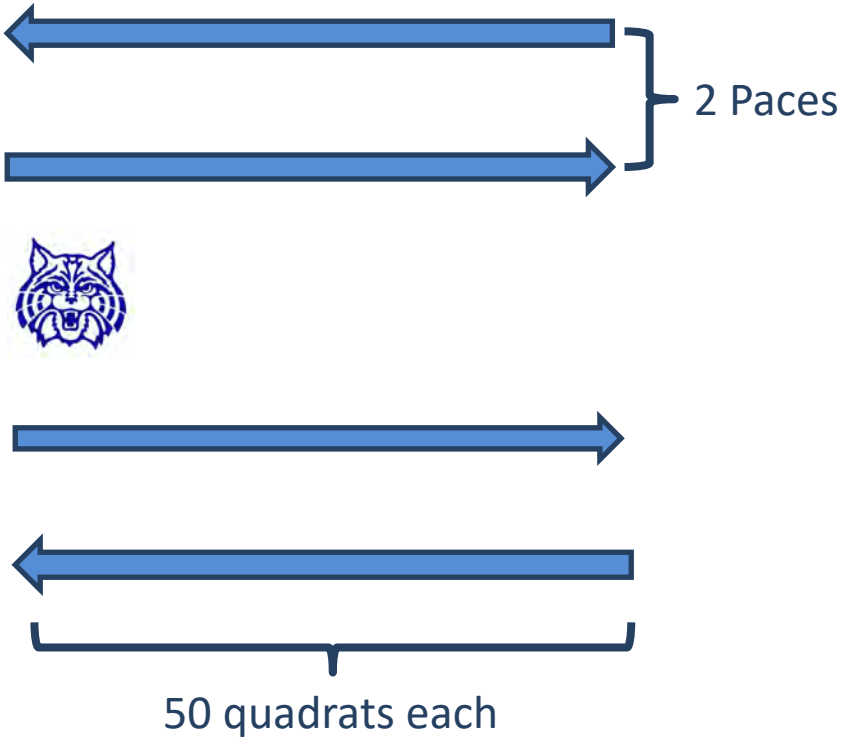
- Crossed J Ranch
- Adjacent to Chiricahua National Park
- Approximately 9,500 acres split in 2 management units
- MLRA 41-3, 12-16” PZ

Goals of the CJR:

“Green grass and fat cows” -Riggs

Monitoring

- Sampled annually around Oct. from 1982-2011*
- Point Ground Cover
- Pace Frequency
  - 40 x 40 cm quadrat
  - 4 parallel transects, 2 paces apart
  - 50 quadrats each transect
  - Quadrats placed 1 pace apart



*1989, 1990 (LTB), 2003 (freq), 2004 & 2009

Monitoring

CJR Lower TB Key Area

Ground Cover	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	2010	2011
Bare Ground	13.5	13	25	32	22.5	20.5	16			49.5	30	36.5	42	27	37.5	35	44	60	50	34.5	44	35.5	47	53.8	3.75	8.25	4		15	8
Gravel/Rock	4.5	2	1	1.5	4	4	2			1	1	1	1	1	3	3	2						1	0.25			0.25		3	
Litter	55	56.5	20	33	43	49	34.5			33	43.5	39	34.5	58	34.5	48	36	21.5	32	45.5	43.5	63.5	51	42.5	96	89.3	91.3		71.3	
Live Basal	27	28.5	54	33.5	30.5	26.5	47.5			16.5	25.5	23.5	22.5	14	25	14	18	18.5	18	20	12.5	1	1	3.5	0.25	2.5	4.5		10.8	6
Frequency																														
Perennial grasses																														
black grama	9.5	12.5	5	8	4	8	9.5			5	4.5	3.5	7.5	2	7.5	3.5	3	1.5	2	1	2.5		1	1		0.5				
blue grama	98	98	98	100	96	100	100			99.5	99.5	99	99.5	99	97	97	98	97	89	98.5	98		27	26	18	40	37.5		58	
Lehmann lovegrass					0.5					0.5	1	0.5	1		0.5		2	1.5			1.5		3	13.5	80.5	25	56.5		28.5	
ring muhly				1		1	0.5			1				0.5	0.5			0.5		1										
sand dropseed					1	1					3	1	0.5	0.5		0.5	1	0.5												
sideoats				1	2		0.5					1	1			0.5					0.5									
squirreltail																														
three awn	7	11.5	3	11	9	7	10.5			26.5	40.5	25	19	8	4.5	3	6	3	2	5.5	2					3.5	2.5		6	
wolftail	3	2	2.5	6.5	7	6	5			10.5	12.5	11	9	3	3	1.5	1													
Perennial forbs										74.5	6	1.5	4.5	2.5	1.5		3	53	9	83	3									
amaranth					6	5					5.5	2	10.5	3.5	4					5.5						1.5			7	
croton				2.5	2																									
dove weed																											0.5		1	
flameflower																										7.5			2	
globemallow		3		1.5		1	1			2	0.5	0.5	2	0.5	0.5			1		1	1.5		1	0.5	1	2			1	
hairy evolvulus																								0.5						
horsenettle	7.5	1.5	1	5	1	2	1			5.5	7.5	5.5	11	6.5	7.5	2.5	3	11	10.5	3.5	6		4	1	10	19	4		29	
locoweed		4			1							64								5			1			16	10.5			
pincushion																								0.5						
ragweed																										2				
senecio					3	2	2.5																							
sida																		53			48.5				35	5	7		17	
spiney aster																										4				
vetch																										0.5			4	
zinnia																									1.5	2				
Trees and Shrubs																														
burroweed			1	3.5	1	3	2.5			2	5	4	5	8.5	9.5	4	8	6	5	22	11.5		18	32	6.5	18.5	5.5		1	
mesquite						1	0.5			1	1.5	1	1	1	2	1			1	1	2.5		1		2.5	1	2		1	
prickly pear							0.5														0.5		1			1				
Annuals																														
annual forbs	94	35	3	5	7	27				8.5	72.5	91.5	86.5	74.5	95.5	1.5		35	44.5	4.5	31.2		94	7	89	64	78.5		90	
annual grasses	18	97.5	8	4	1		0.5			4.5	10	31	17.5	16	50	69.5		7	47.5	46.5	91		97	92	98	66	95		62	

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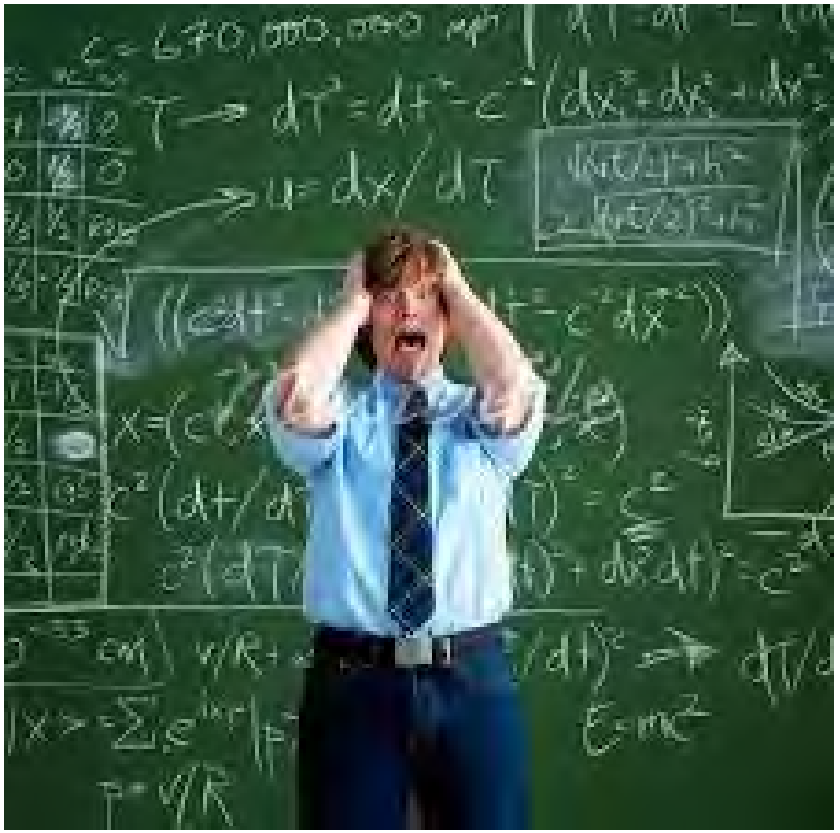
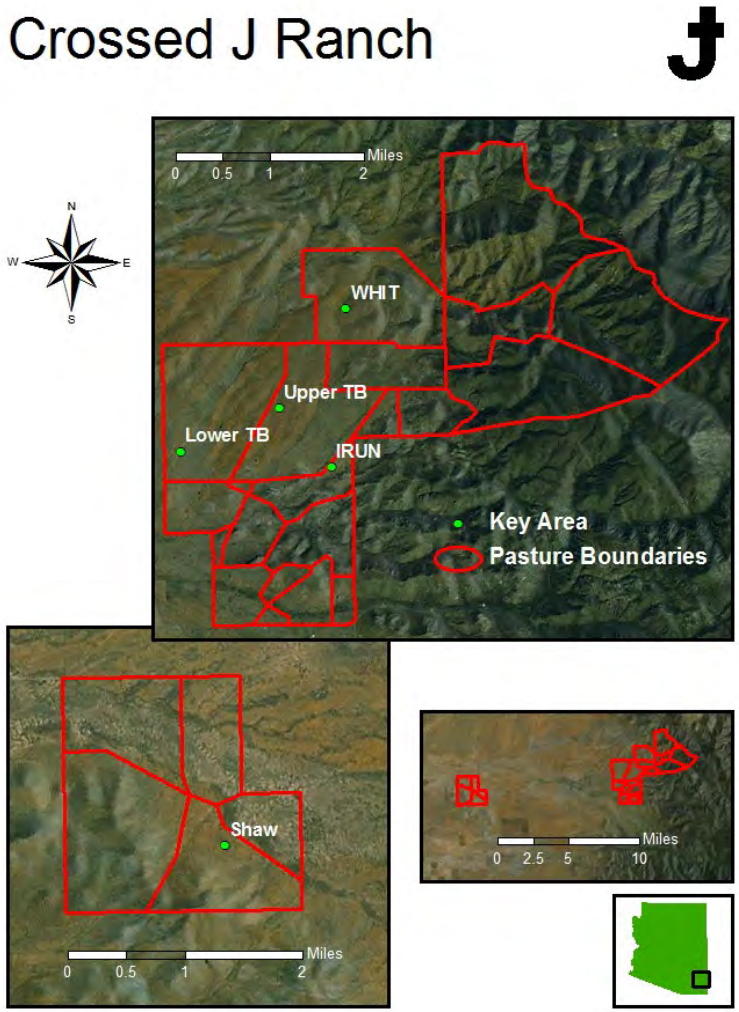


Analysis



- 3 Key Areas
  - Lower TB
  - Upper TB
  - Shaw
- Ground Cover
  - Bare Ground
  - Live Basal
- **Frequency**
  - **Key Forage Species**

Upper TB

1988

1996

2003

2010

Analysis

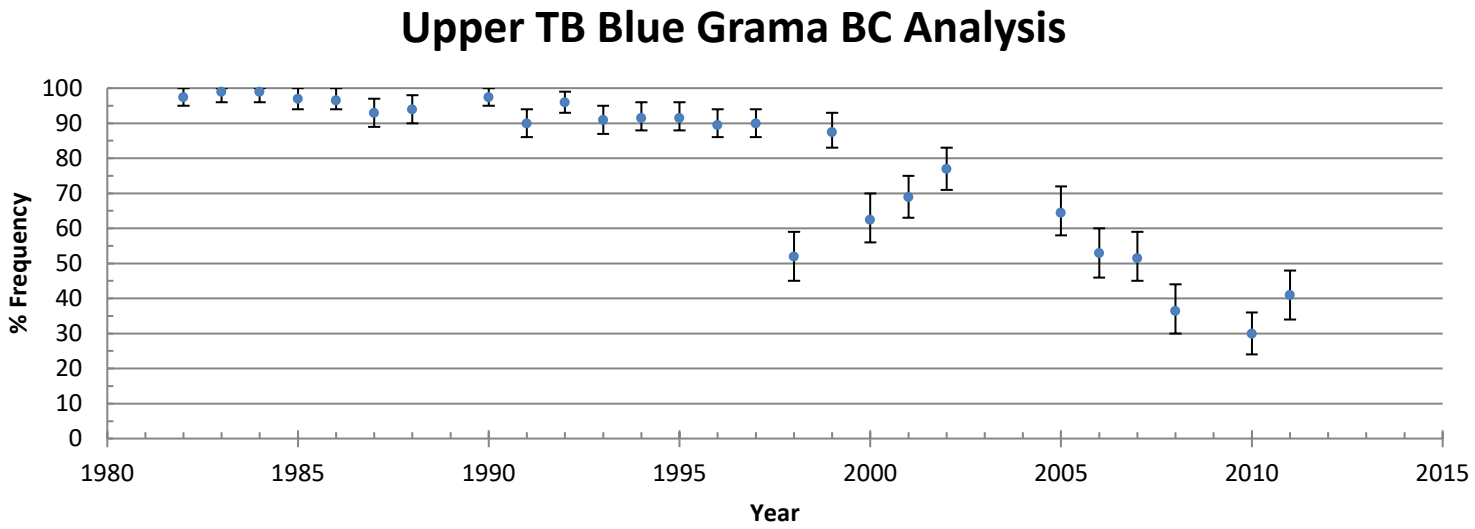
Sites/Locations: • Upper TB -- Cooperative Extension > Cochise > Crossed J > Upper TB

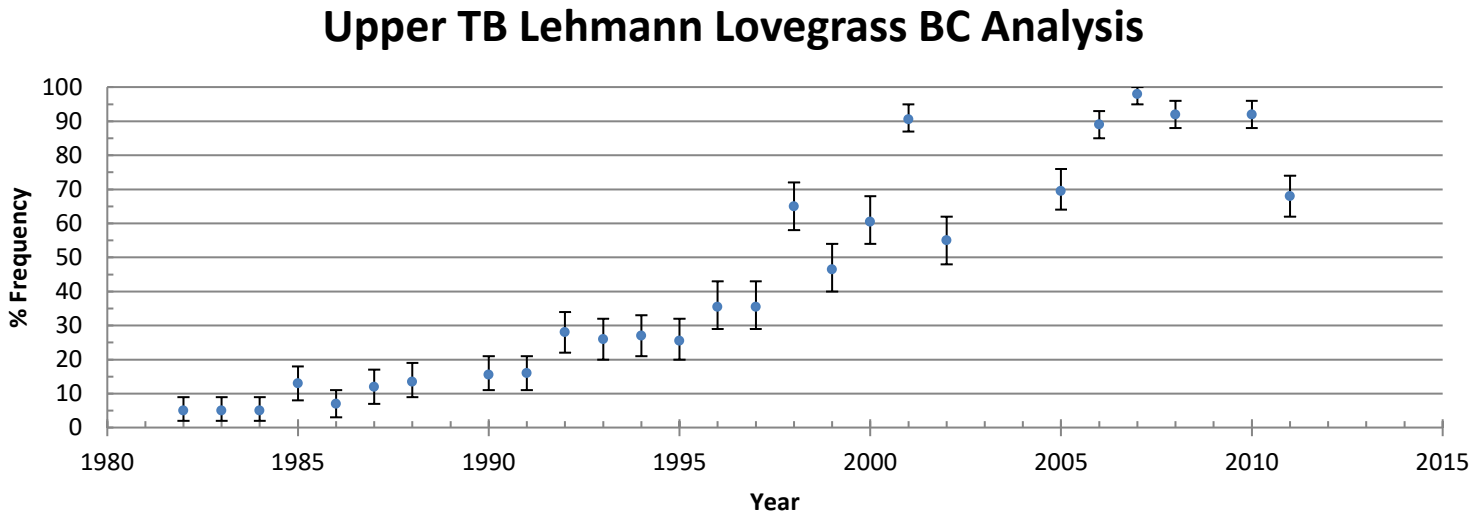
% Frequency											Quadrat Size: 40x40 cm
Species		Events									
		Upper TB 10/06/11	Upper TB 09/25/12	Upper TB 10/04/13	Upper TB 10/02/14	Upper TB 10/20/15	Upper TB 10/26/17	Upper TB 09/28/18	Upper TB 10/28/19	Upper TB 11/06/20	Upper TB 11/22/21
Woody Species											
yerba de pasmo	BAPT	1 ±2	1 ±2	1 ±2			1 ±2				
burroweed	HATE										1 ±3
nipple beehive cactus	MAMA16										1 ±3
catclaw mimosa	MIBI12	3 ±3	1 ±2		2 ±2	3 ±3	1 ±2	5 ±5	6 ±5	1 ±3	2 ±3
mesquite	PRJU3			1 ±2	1 ±2	1 ±2		2 ±3			
Grasses - Perennial											
perennial threeawn	ARIST	2 ±2	1 ±2		1 ±2	3 ±3	4 ±3	7 ±5	2 ±3	5 ±5	1 ±3
cane beardgrass	BOBA3	1 ±2		1 ±2	1 ±2						
sideoats grama	BOCU	3 ±3		1 ±2				2 ±3		2 ±3	2 ±3
black grama	BOER4	1 ±2			1 ±2						2 ±3
blue grama	BOGR2	41 ±6	24 ±6	15 ±5	27 ±6	9 ±4	28 ±6	15 ±7	7 ±5	25 ±8	20 ±8
hairy grama	BOHI2						1 ±2				
Lehmann lovegrass	ERLE	68 ±6	48 ±7	95 ±3	87 ±5	93 ±4	95 ±3	98 ±3	97 ±4	86 ±7	97 ±4
wolfstail	LYPH	1 ±2									

Analysis

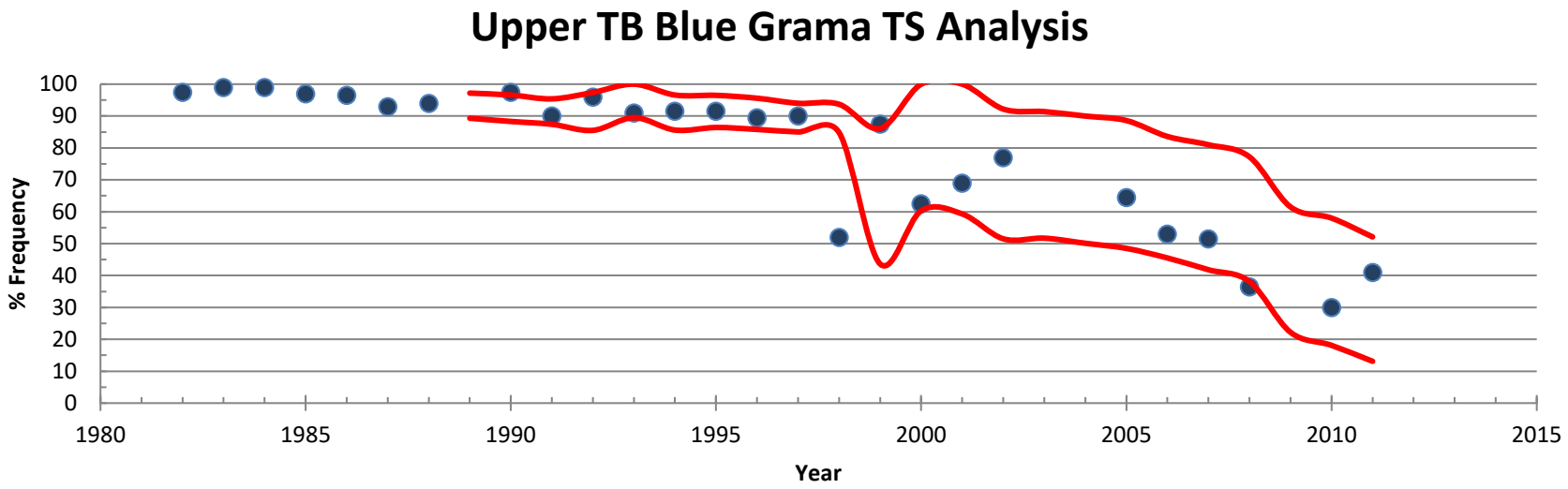
blue grama	BOGR2	41 ±6	24 ±6	15 ±5	27 ±6	9 ±4	28 ±6	15 ±7	7 ±5	25 ±8	20 ±8
hairy grama	BOHI2						1 ±2				
Lehmann lovegrass	ERLE	68 ±6	48 ±7	95 ±3	87 ±5	93 ±4	95 ±3	98 ±3	97 ±4	86 ±7	97 ±4

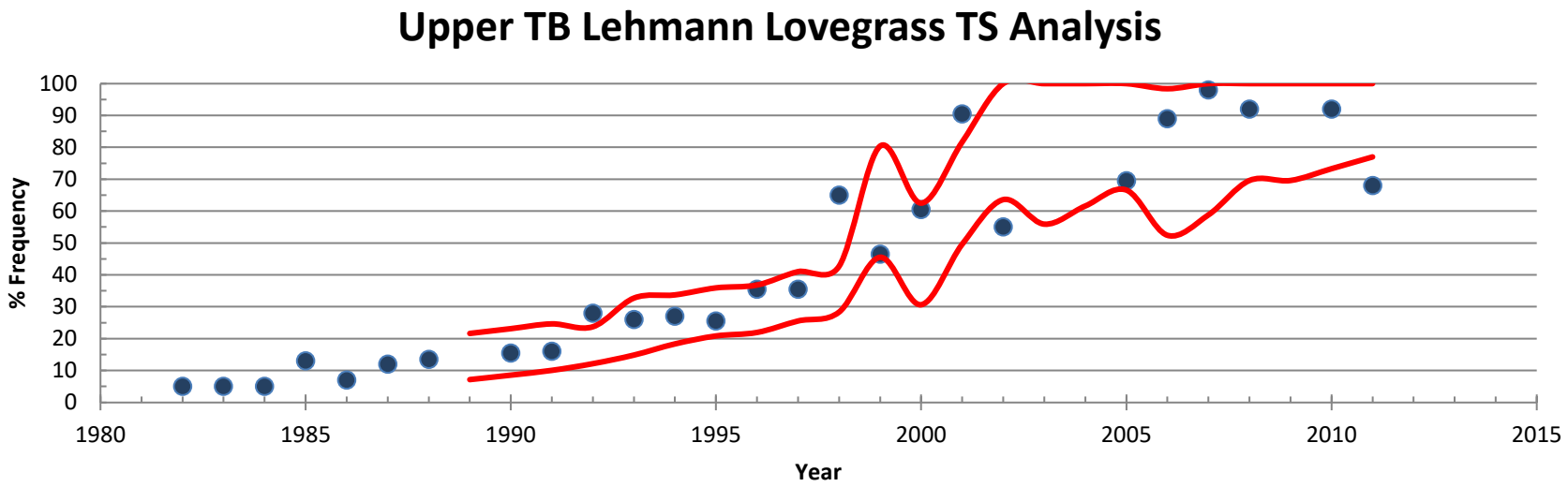
Upper TB Frequency





Upper TB Frequency





Shaw

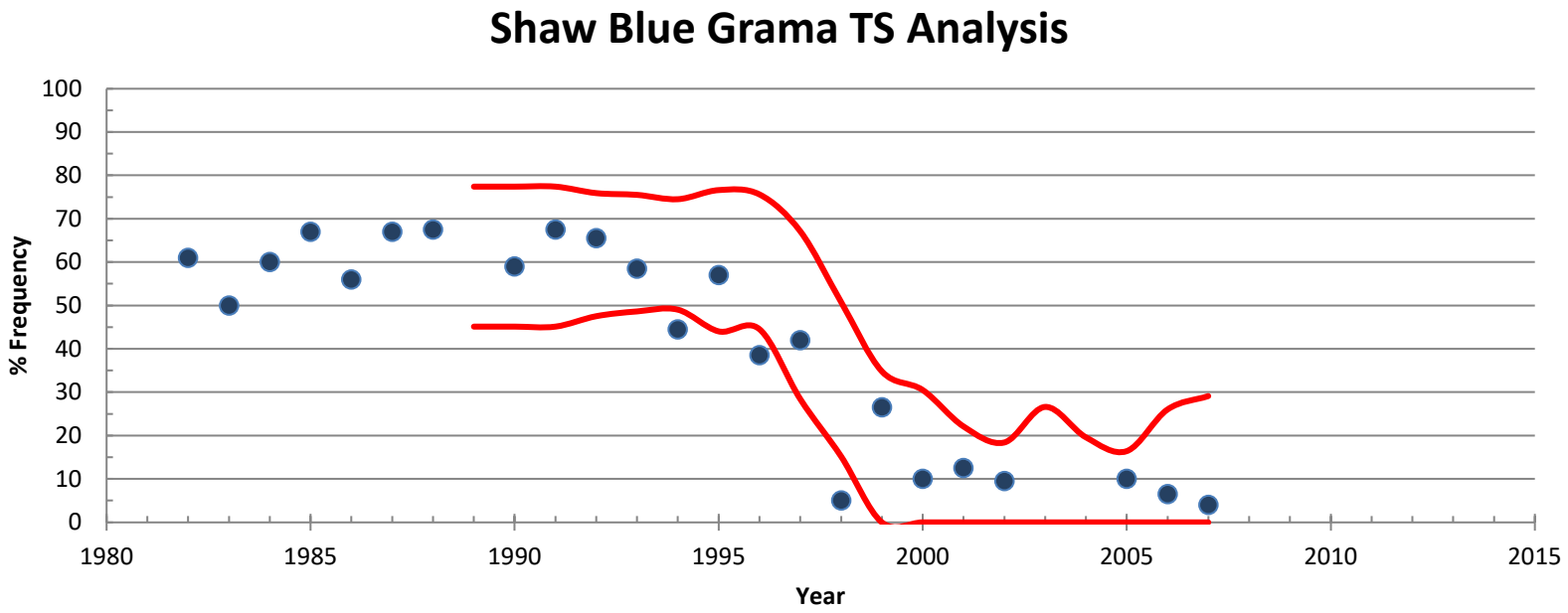
1988

1996

2003

2005

Shaw Frequency



Has there been significant change on the CJR?

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Contributing Factors: Stocking Rate

- Stocking rate is the most important factor determining vegetation community response to grazing.

  (Hart et al. 1993, Hickman et al. 2004)

- Assumes the vegetation community will show a predictable and proportional response to stocking rate.

  (Paulsen and Ares 1962, McNaughton 1983, Hart et al. 1993, Hickman et al. 2004)

- Theory criticized for being overly simplistic.

  (Westoby et al. 1989, Laycock 1991, Behnke and Scoones 1993)

Contributing Factors: Climate

- Climatic variability is the primary driver of vegetation change on rangelands.

  (Westoby 1980, Clarkson and Lee 1988, Milchunas et al. 1989, O'Connor 1991, O'Connor 1995, Allen et al. 1995, Biondini et al. 1998)

- Drought is one of the main drivers of plant stress and mortality

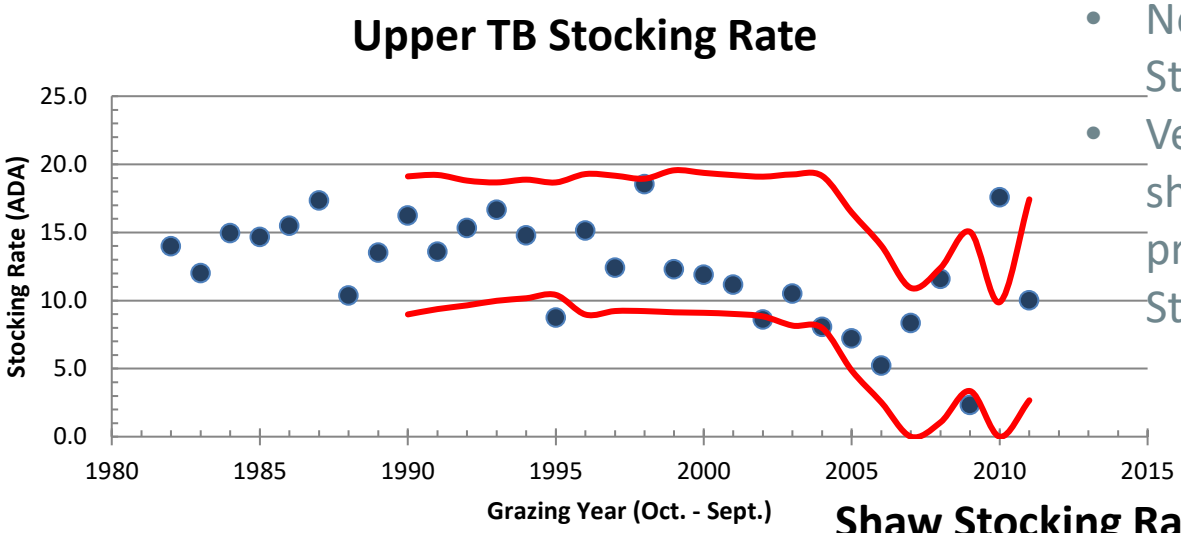
  (Burton et al. 1978, Wilhite and Glantz 1985, Wilhite 1993)

- Over-emphasis on climatic variability as a driver of vegetation change
  - minimizes the influence of grazing on arid and semi-arid rangelands

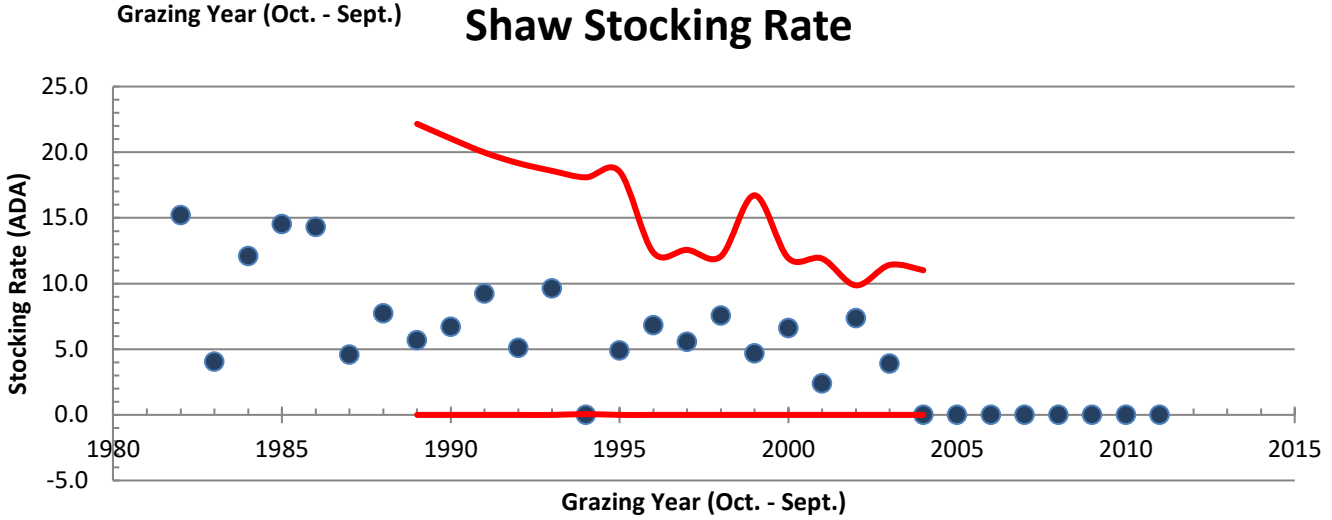
    (Ellis and Swift 1988, Ellis 1994)

Quantitative Approach

- Stocking Rate Time-Series Analysis



- No significant increase in Stocking Rate on CJR*
- Vegetation community will show a predictable and proportional response to Stocking Rate.

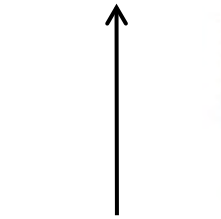


*UTB 2010

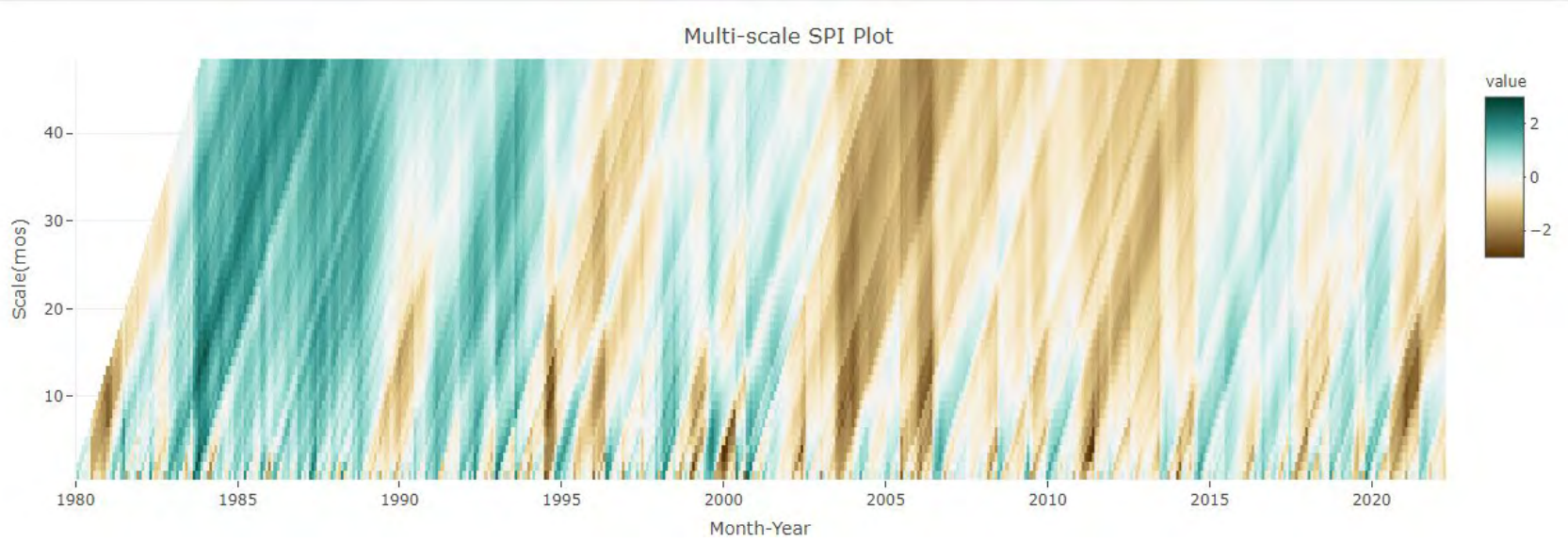
Quantitative Approach

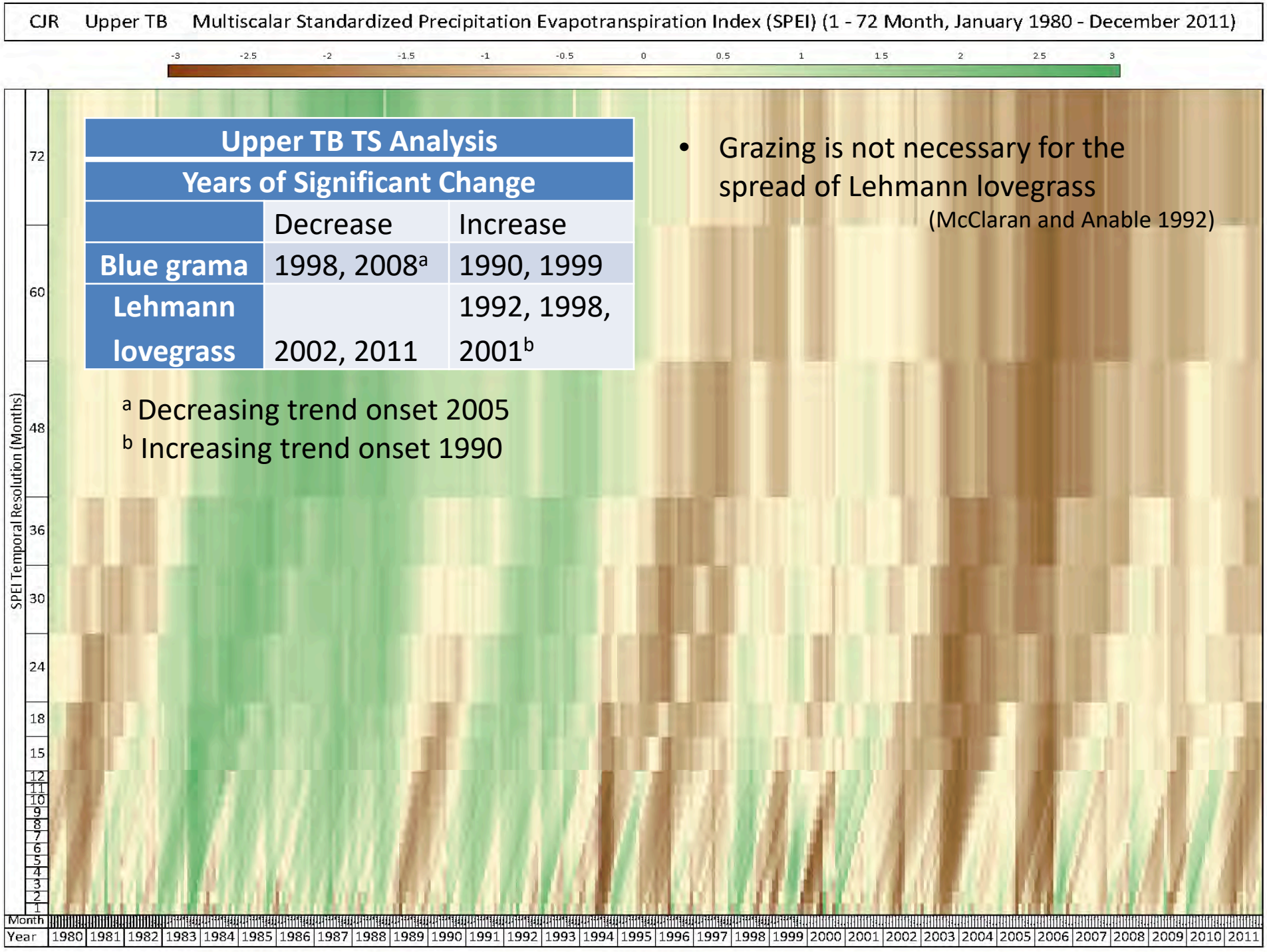
Multi-scale Plot (aka Barf Chart)

Long-term Drought



Short-term Drought





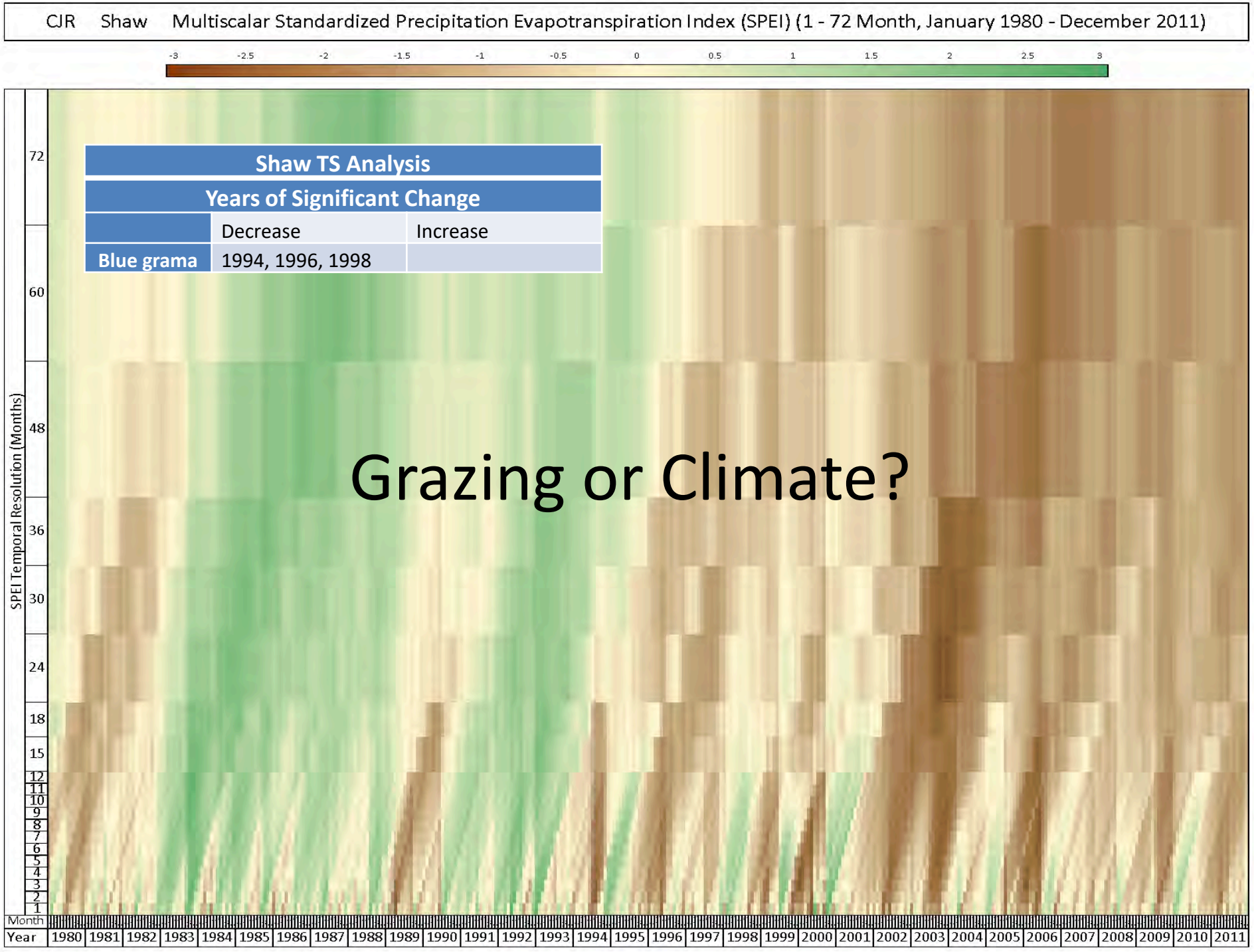
Upper TB TS Analysis		
Years of Significant Change		
	Decrease	Increase
Blue grama	1998, 2008[a]	1990, 1999
Lehmann lovegrass	2002, 2011	1992, 1998, 2001[b]

[a] Decreasing trend onset 2005

[b] Increasing trend onset 1990

- Grazing is not necessary for the spread of Lehmann lovegrass

(McClaran and Anable 1992)


CJR Shaw Multiscalar Standardized Precipitation Evapotranspiration Index (SPEI) (1 - 72 Month, January 1980 - December 2011)
-3 -2.5 -2 -1.5 -1 -0.5 0 0.5 1 1.5 2 2.5 3
Shaw TS Analysis
Years of Significant Change
Decrease
Increase
Blue grama
1994, 1996, 1998
Grazing or Climate?
SPEI Temporal Resolution (Months)
72 60 48 36 30 24 18 15 12 11 10 9 8 7 6 5 4 3 2 1
Month
Year
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 2010 2011

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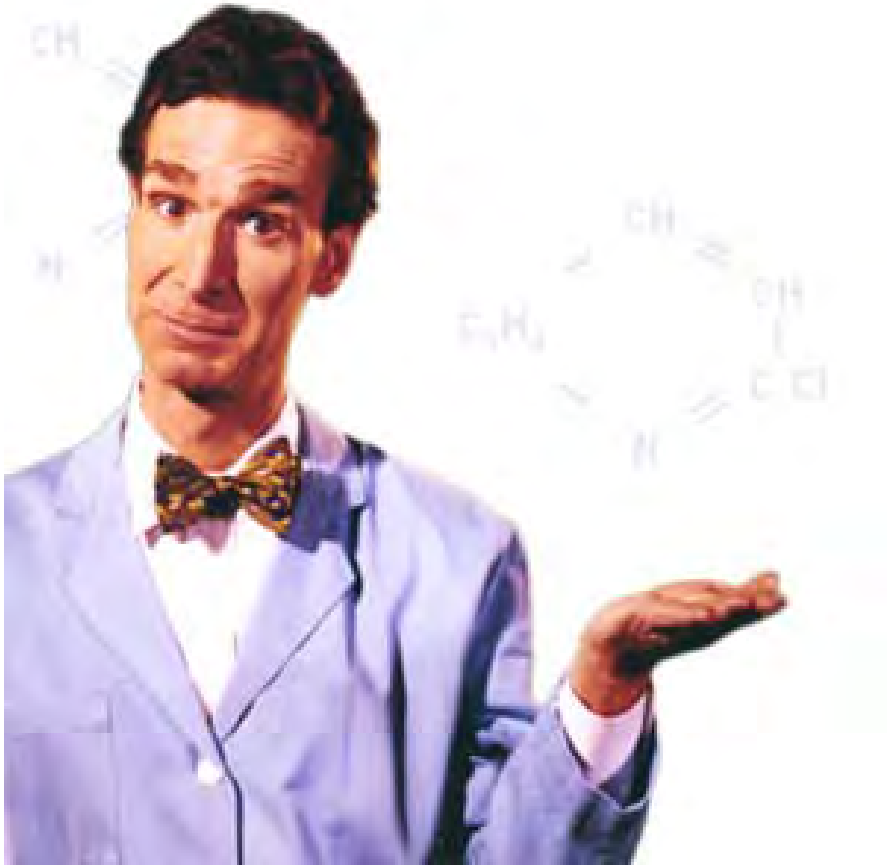
Range Assessment



- Rangeland assessment should be based on sound ecological principle and scientific information.

  (Smith 2003)

- 2 basic approaches to rating range assessment on a site:
  - Ecological Range Assessment
  - Productivity Range Assessment

  (Hacker 1973)

Ecological Range Assessment

- Ecological condition **is not** affected by the intended use of the range.

(Smith 2003)

- Soil is the most important and most basic physical resource on rangelands.

(SRM Task Group 1995a)

  - Accelerated Erosion
  - Ground Cover
    - Bare Ground & Live Basal Vegetation
  - Site Conservation Thresholds

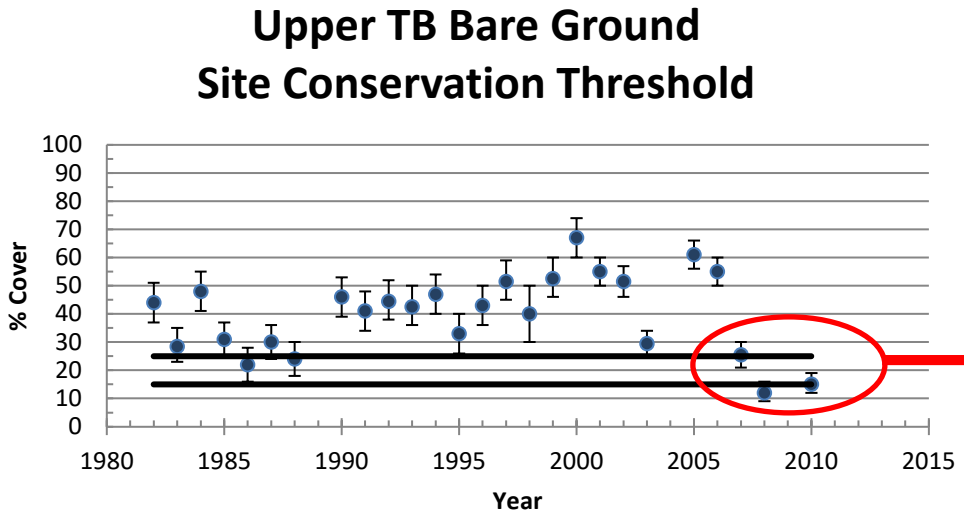
Site Conservation Thresholds (SCTs)

- Ecological thresholds describe a complex set of potentially interacting components.

(Briske et al. 2005)

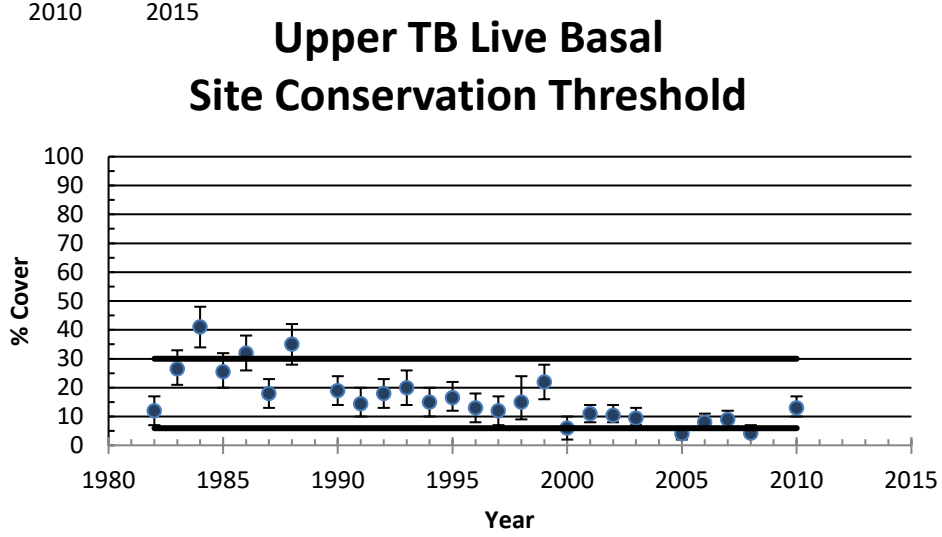
- Thresholds can effect both structural and functional modifications during ecosystem transitions at various temporal scales.
  - Extended periods of “at-risk” conditions, site potential may be permanently changed
  - A specific disturbance (e.g. grazing, destruction or introduction of plants), event (e.g. drought or fire) or a combination of these factors may trigger the occurrence of a threshold.

Upper TB
Loamy Upland 41-3, 12-16” PZ



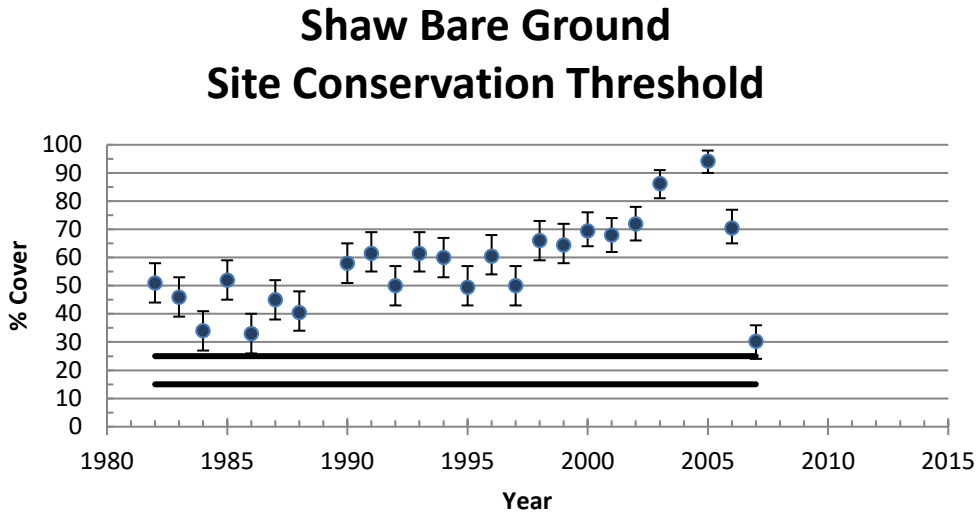
% Bare Ground > SCT is “at risk”

Increase in Lehmann



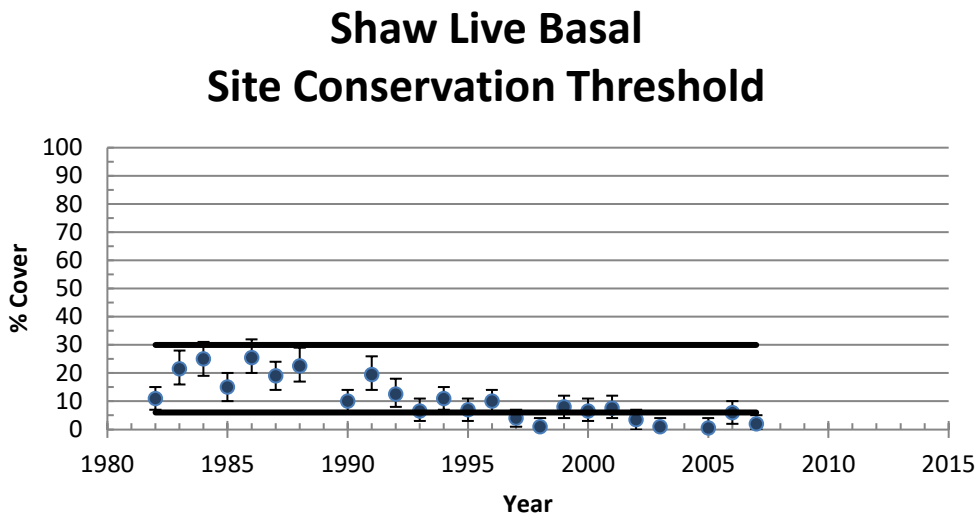
% Live Basal < SCT is “at risk”

Shaw
Loamy Upland 41-3, 12-16” PZ



% Bare Ground > SCT is “at risk”

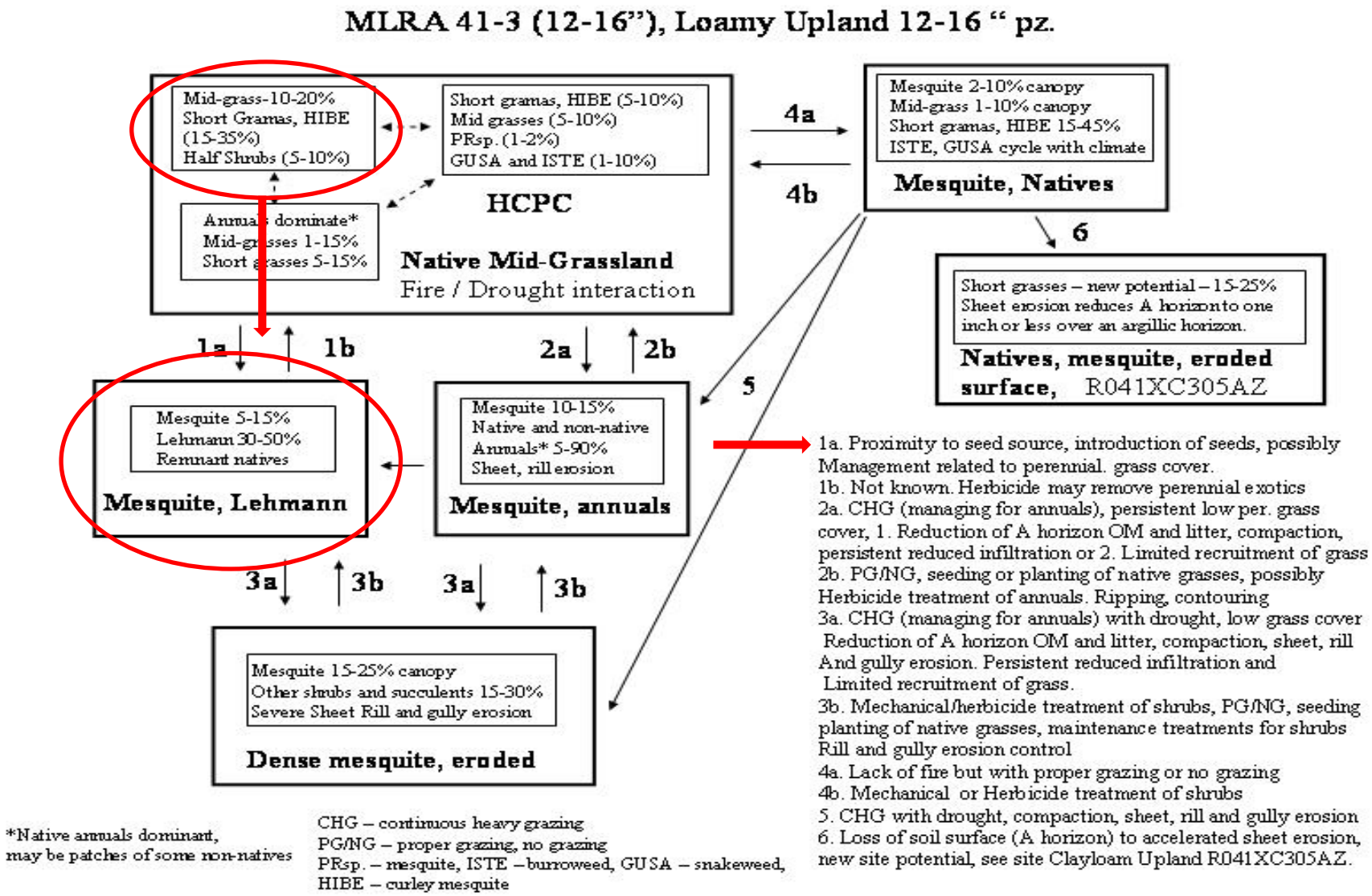
% Live Basal < SCT is “at risk”



Productivity Range Assessment

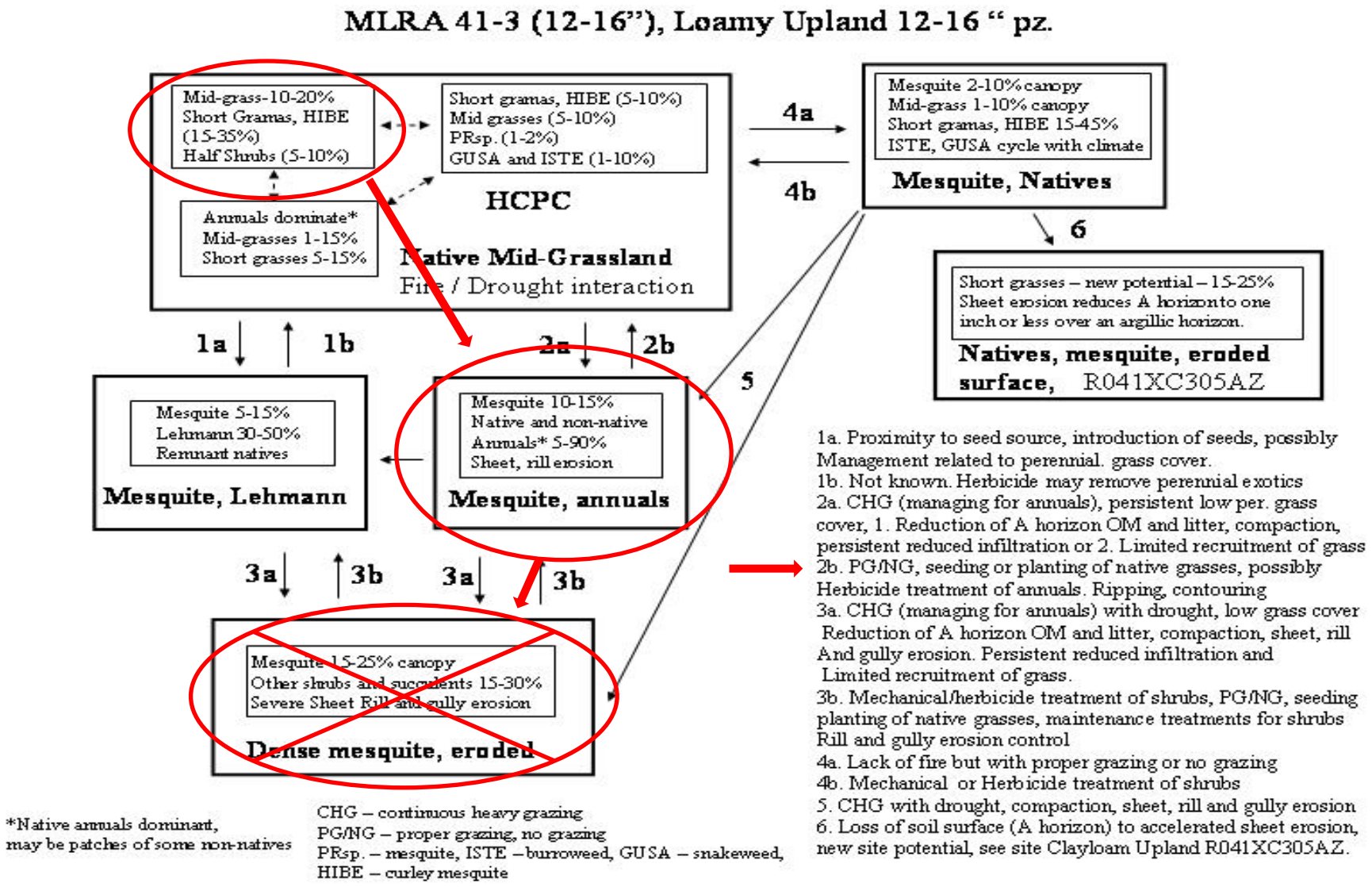
- Productivity assessment **is** affected by the intended use of the range.
- State-and-Transition Models
  - Desired Plant Community
    - Best meets the goals of the operation

Upper TB



Adapted from NRCS ESIS

Shaw



Adapted from NRCS ESIS

Summary & Conclusions

- Monitoring data collected and analyzed from 1982-2011 on the CJR
- Time-Series Analysis to isolate significant ecological change
- Contributing factors to change
  - Lower TB and Shaw
    - Drought triggered shift in vegetation community
  - Upper TB
    - Possibly drought conditions
    - Inevitability of Lehmann lovegrass encroachment
- Range Assessment
  - Ecological Range Assessment
  - Productivity Range Assessment
- Shaw is a resource priority

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Questions?