Thinking through range improvement practices: prescribed fire, Yeoman's plow, and composting

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UC Cooperative Extension Area Livestock & Range advisor
September 12, 2019

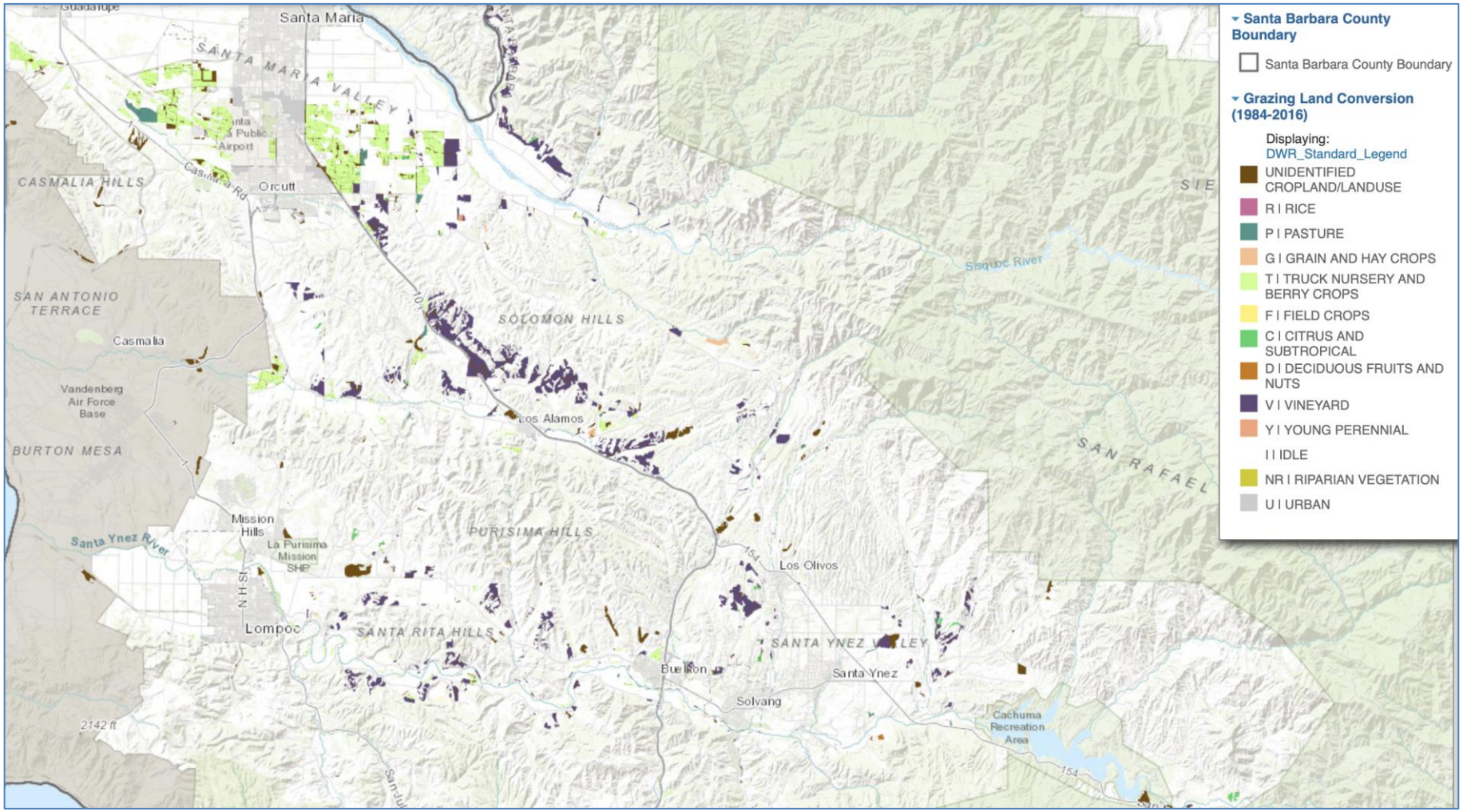
We are losing available grazing lands…

Table. Rangeland conversion by acres (1984-2008)

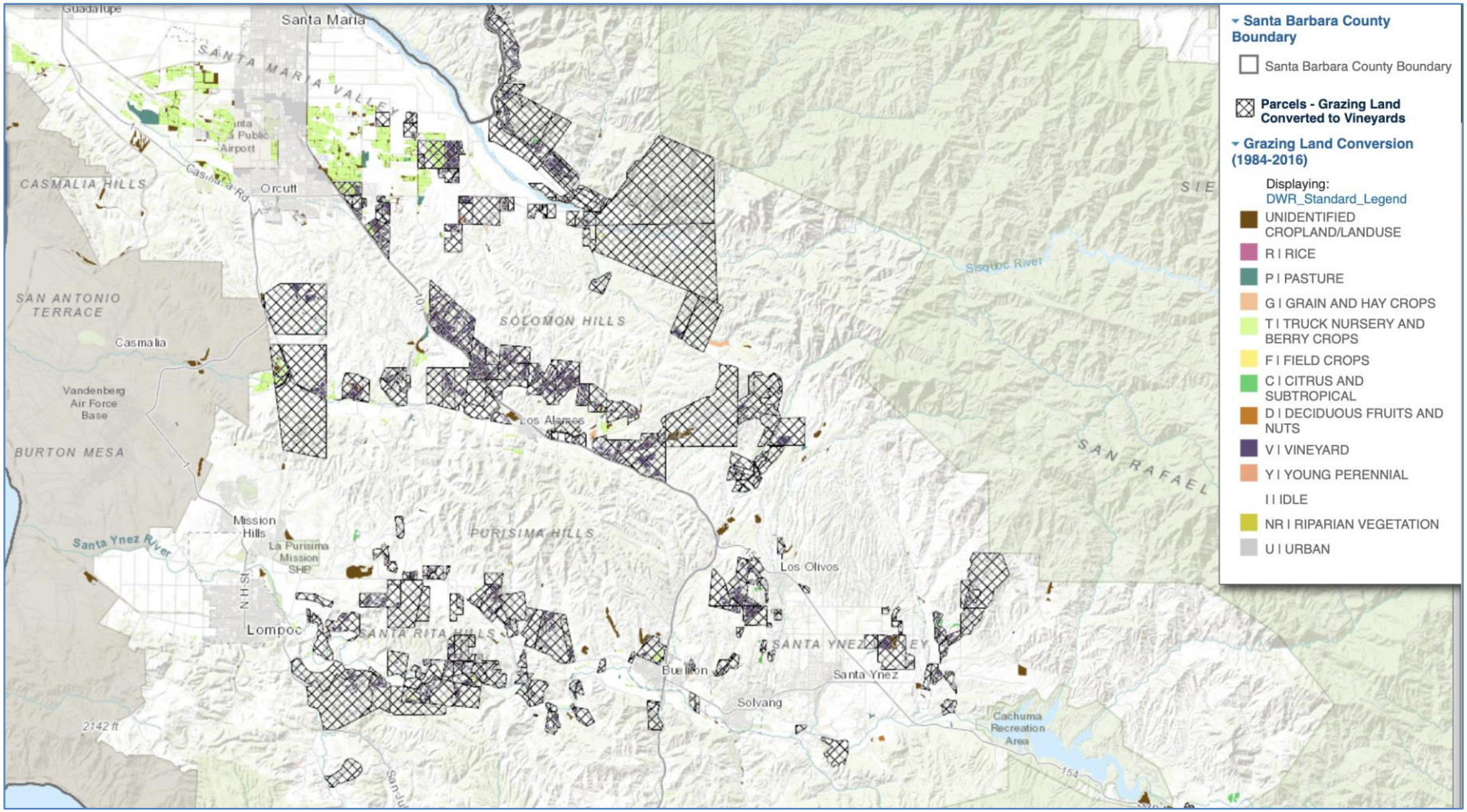
County	Rural residential	Residential	Vines	Orchards	Bare plowed ground	Dry farmed	Row crops	Total
Santa Barbara	1,942	1,815	7,420	687	788	3,344	2,482	34,140
San Luis Obispo	11,757	5,155	3,609	1,072	1,833	813	217	26,541

Cameron, D. R., Marty, J., & Holland, R. F. (2014). Whither the Rangeland?: Protection and Conversion in California's Rangeland Ecosystems. *PloS one*, *9*(8), e103468.

Maybe more than we know…



Maybe more than we think…



Implication…

Need to make the lands that we still have in grazing more productive

NEWS

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L.V.M. date
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M.J.S.
RETURN

11-2-72

NITROGEN FERTILIZER BOOSTS BEEF YIELDS

SANTA BARBARA--Tests by University of California Farm Advisor Lin Maxwell have proved the value of nitrogen in increasing beef production in Santa Barbara County.

Maxwell, a cattle expert and county director of Agricultural Extension, said his studies showed cattlemen can net as high as one extra pound of beef from each pound of actual nitrogen applied to open grassland.

• • •

The University of California farm advisor said the study showed that Santa Barbara County cattlemen, faced with rising taxes and unable to expand because of land scarcity, can reduce production costs through proper range fertilization.

Prescribed fire

Keyline subsoiling with the Yeoman's plow

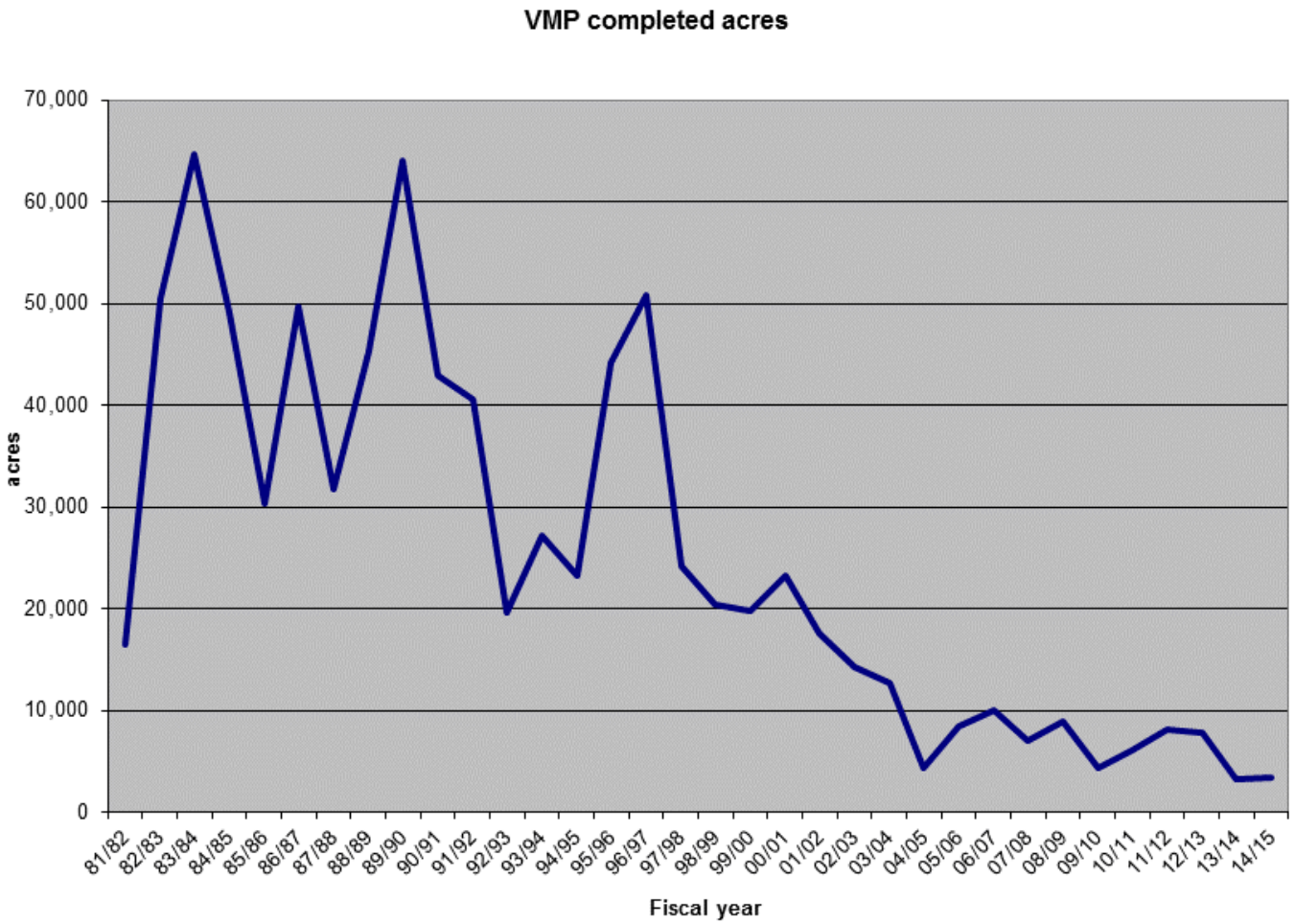
Compost on rangelands

SUMMARY OF CONTROLLED BURN STATISTICS
County of Santa Barbara

Year	Number of Permits Used	Acres Burned Under Permit	Acres Burned by Escape	Total Acres Burned
1956	18	4,775	120	4,895
1957	14	11,270	none	11,270
1958	9	35,765	none	35,765
1959	11	11,255	18	11,273
1960	10	6,860	40	6,900
1961	12	7,760	none	7,760
1962	8	16,160	1,497	17,657
1963	12	3,296	none	3,296
1964	2	6,600	none	6,600
TOTALS	96	103,741	1,675	105,416

It was also brought to the attention of The Committee that during this association's controlled burning activities, an escape factor of only 1.4 percent was recorded. By comparison, an escape factor of more than 8 percent for the State as a whole was quoted by State Forester F. H. Raymond.

Table. Statewide acres burned in CalFire VMP program, by fiscal year



Courtesy of Lenya Quinn-Davidson, UCCE Humboldt


Prescribed Fire Permitting Pathways
Vegetation Management Program (CalFire or Contract-County Fire Department)
LE-7 permit (private option)

Option	Pros	Cons
Vegetation Management Program (VMP) burn with Santa Barbara County Fire	▪ Liability covered by CalFire ▪ Low cost for landowner ▪ Experienced crews/resources ▪ Permits/air quality covered	▪ Limited agency capacity ▪ Planning time/environmental compliance ▪ Not guaranteed
Do it yourself (DIY) **LE-7 permit**	▪ You're in charge—do it when and how you want ▪ Low cost ▪ Environmental compliance	▪ Liability ▪ Manpower/resources ▪ Permits/air quality
County Range Improvement Association (RIA) **LE-7 permit**	▪ You're in charge—do it when and how you want ▪ Low cost—volunteer based ▪ Environmental compliance ▪ Equipment/labor pooled through RIA ▪ RIA can apply for grants/funding ▪ Every burn is a training opportunity	▪ Liability ▪ Permits/air quality ▪ Someone has to coordinate
Contractor, or "burn boss" **LE-7 permit**	▪ Contractor provides insurance ▪ Landowner can set expectations/timeframe ▪ Experienced crews/resources ▪ Permits/air quality covered ▪ Environmental compliance	▪ Cost! $10-20k per day for full crew $1.5-5k per day for burn boss

Prescribed fire as range improvement?

Two kinds of efforts:

1. permanent conversion
2. temporary conversion

Each practice has different costs and returns

1. Permanent conversion requires:
    1. Brush crushing
    2. Burning
    3. Re-seeding
    4. Multiple herbicide treatments
    5. Deferred grazing
    6. Fertilization?

2. Temporary conversion requires:
    1. Burning
    2. Re-seeding?

Permanent conversion (based on SLO County 1960s trial on 54 acres)

Activity	Plot #1 (54 acres)	Total (1965 dollars)	Total (2019 dollars)
Brush crushing – 1960	47 acres @$4.37	$205.39	$1,780.31
Fire line construction - 1960	54 acres @ $1.48	$79.92	$692.72
Burning - 1960	54 acres @ $1.92	$103.68	$898.68
Drill seeding - 1960	24 acres @ $14.38	$345.12	$2,991.48
Hand seeding - 1960	15 acres @ $7.57	$113.55	$984.24
Spraying - 1961	50 acres @ $9.57	$478.50	$4,147.61
Legume seeding - 1961	40 acres @ $5.47	$218.80	$1,896.55
Erosion check dams - 1961	7 each @ $9.30	$65.10	$564.28
Follow-up spraying - 1961	39 acres @ $3.67	$143.13	$1,240.64
Cleaning check dams - 1962	7 each @ $6.12	$42.84	$371.33
Fertilization - 1964	32 acres @ $9.53	$304.91	$2,642.94
Follow-up spraying - 1964	32 acres @ $3.61	$115.45	$1,000.71
	Total	**$2,216.39**	**$19,211.53**
	Total (per acre)	**$41.04**	**$355.73**

PHOTOGRAPHS OF RANCHITA RANGE STUDY
PLOT #1

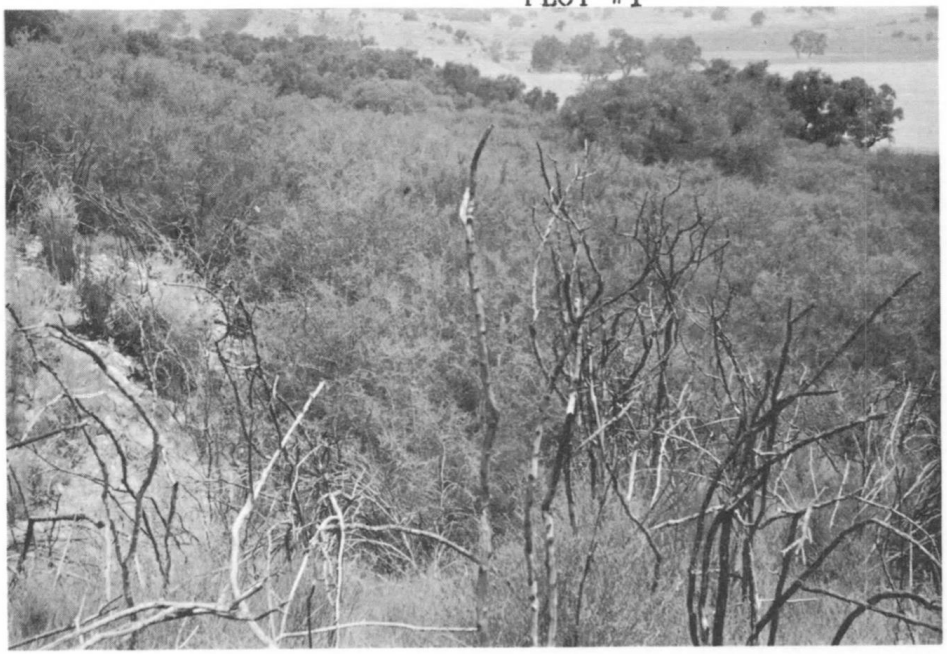


Photo #1
July 1959

Typical stand of brush on Plot #1 prior to brush removal.

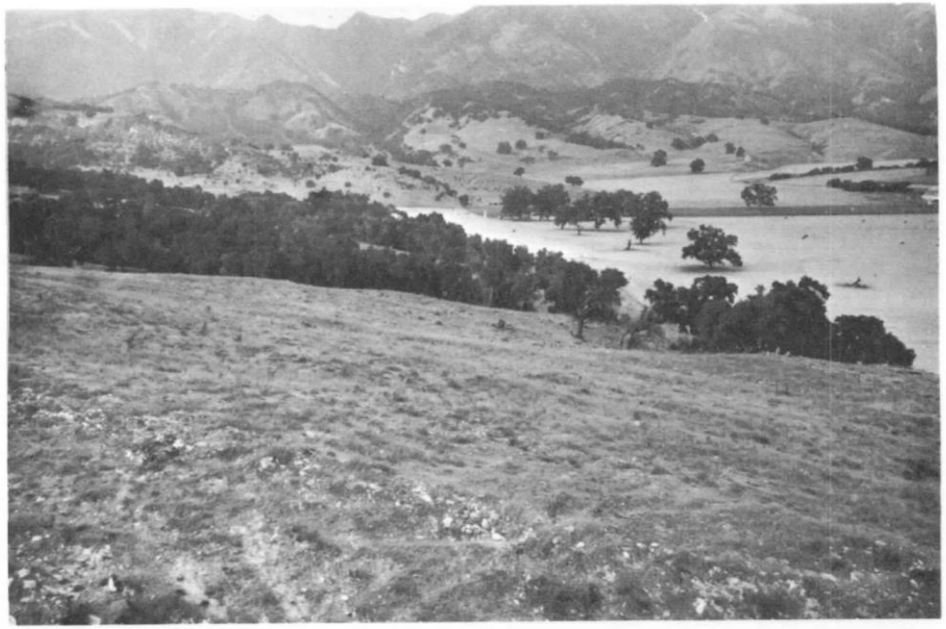


Photo #3
October 1965

Same view as Photo #1 five years after reseeding.

Grazing Management (Plot 1 – 54 acres)

Table. Grazing results, combination of steers and heifers (1961-1965)

Year	Total Pounds Beef	Pounds beef/acre
1961	No grazing	
1962	2,600	48.1
1963	3,350	62.0
1964	2,020	37.4
1965	3,620	67.0
Total	11,590	214.5

Table. Investment returns (1961-1965), assuming $0.48/lb on the gain for stockers

Year	Improvement cost/acre	Estimated return/acre	% ROI
1961	$259.17	$0	0%
1962	--	$23.12	9%
1963	--	$29.76	20%
1964	--	$17.95	27%
1965	$96.56	$32.16	29%
Total	$355.73	$102.99	--

Temporary conversion (based on 2018 SB County RIA burn on 380 acres)

Table. Costs of prescribed burn

Activity	Total	Total per acre
Fire line construction	$4,400 (40 hrs @ $110/hr)	$11.58
Insurance	$0	$0
Barbecue	$500	$1.32
RIA fee??	$0	$0
Re-seeding??	$0	$0
Total	**$4,900**	**$12.90**

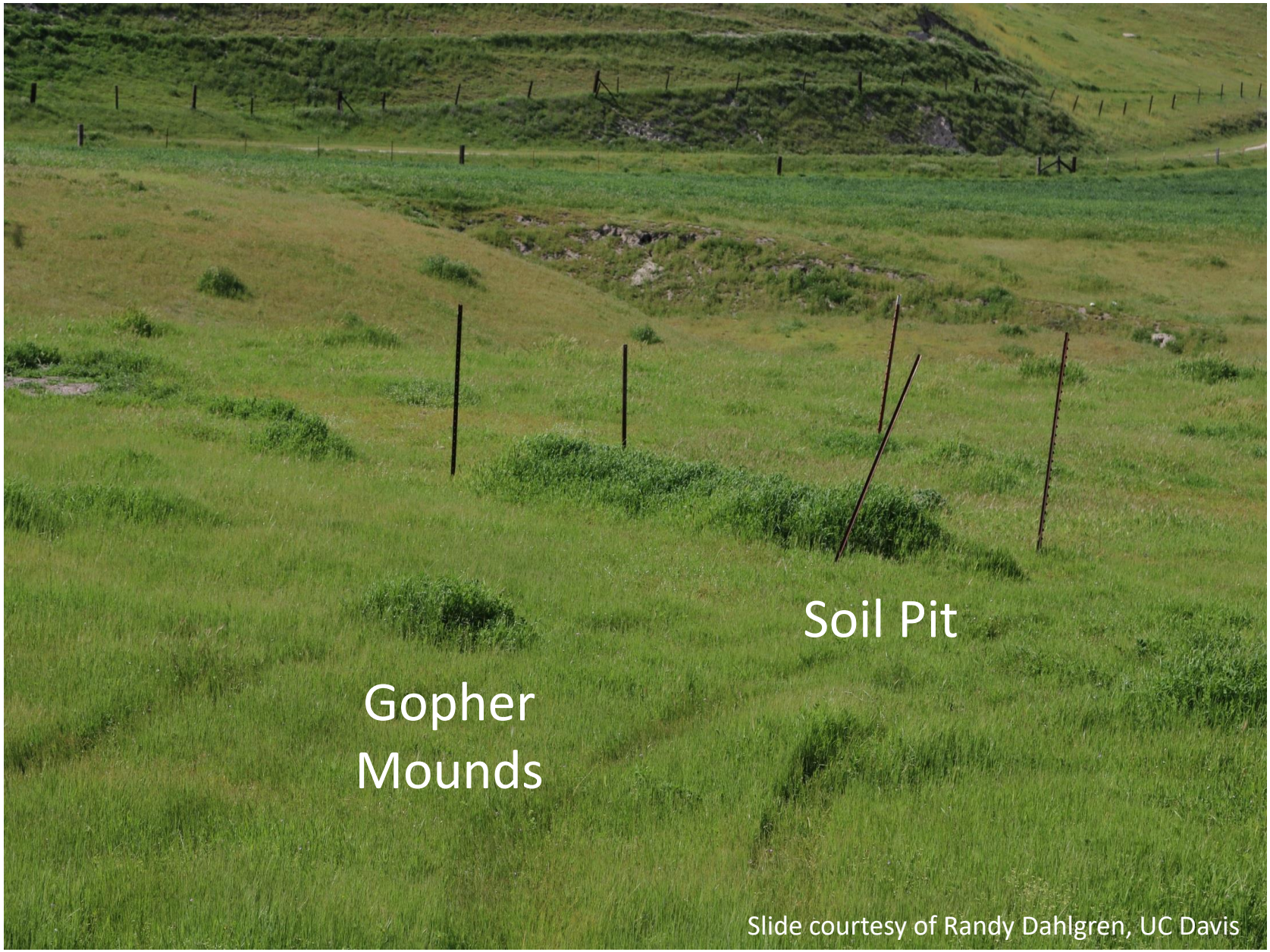
- Benefit lasts 2-5 years, 3.5 on average
- Full cost recovery would come with 27 pounds of gain, assuming $0.48/lb
- Potential return:
  Conservative gain: 25 lbs/year
  87.5 lbs of gain over 3.5 years = $42.00 gross return

Cost per acre is highly sensitive to number of acres burned

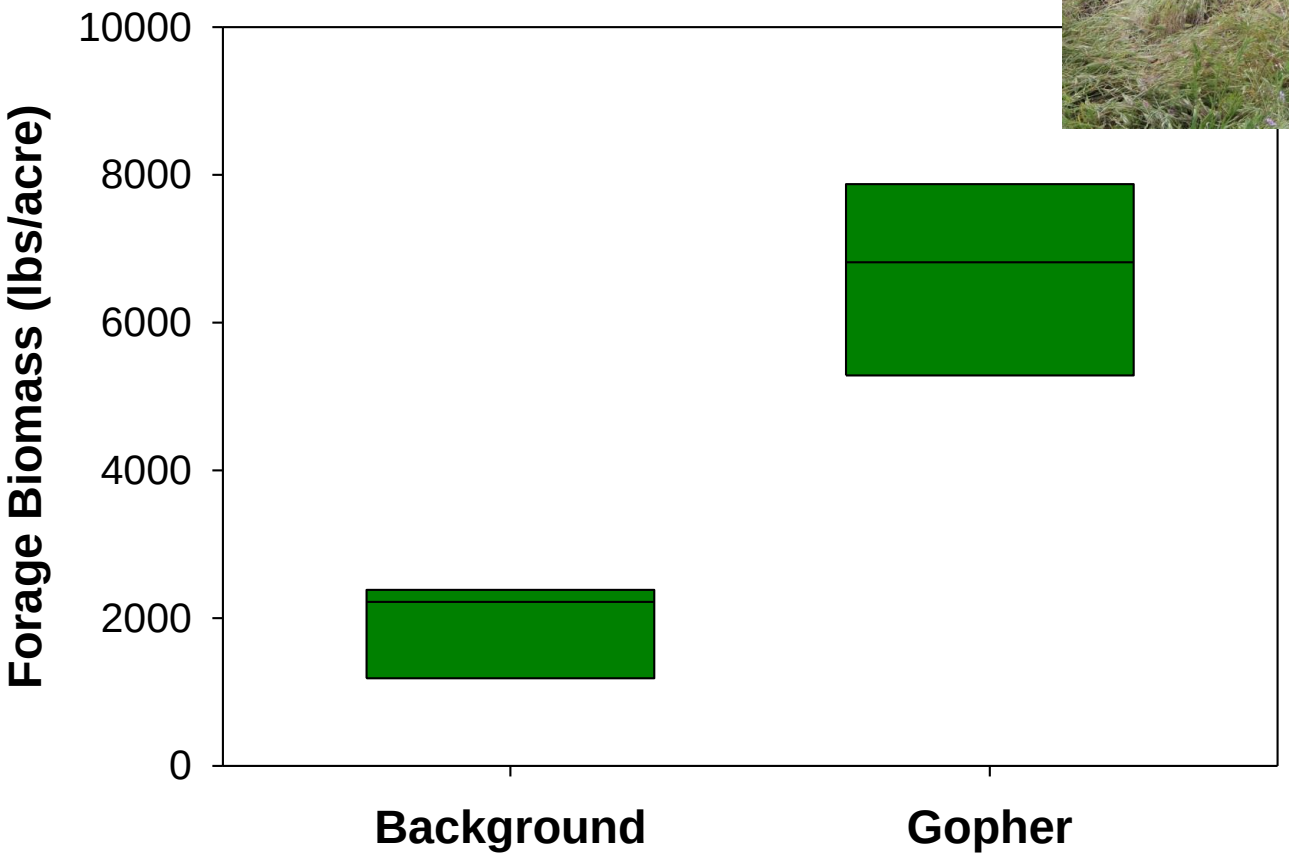
In summary: prescribed fire as range improvement

- Preliminary figures are promising; need more corroborating evidence/research

Keyline subsoiling with the Yeoman's plow


Soil Pit
Gopher Mounds
Slide courtesy of Randy Dahlgren, UC Davis

Forage Biomass
Gophers vs Background



Soil Nutrients

↑P, ↑Fe, ↑Mn

Forage Nutrients

No Differences

Bulk density

Significant differences

Slide courtesy of Randy Dahlgren, UC Davis

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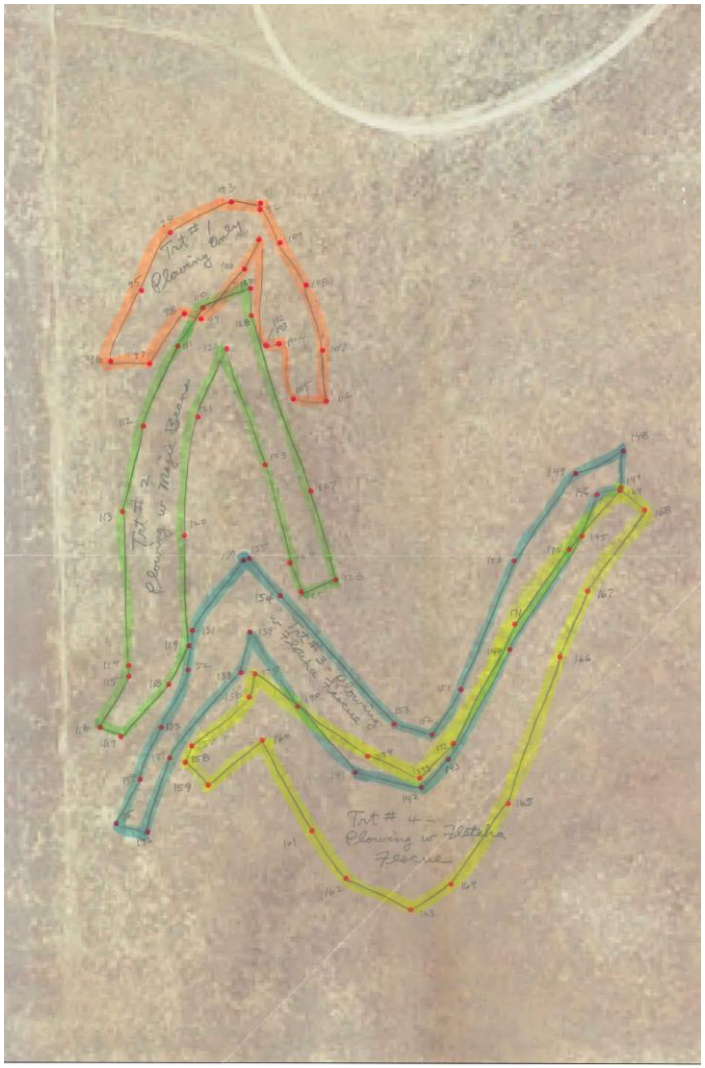
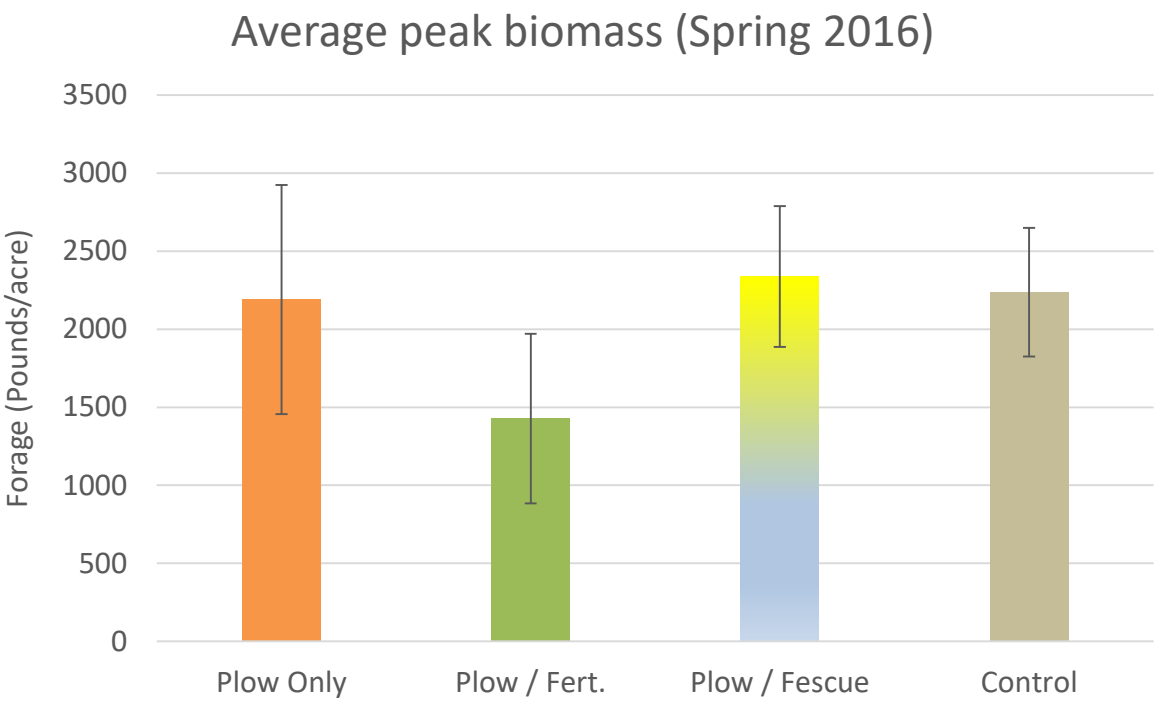
YEOMANS
PLOW CO

SLO County Yeoman's Plow trial (2015-2016)



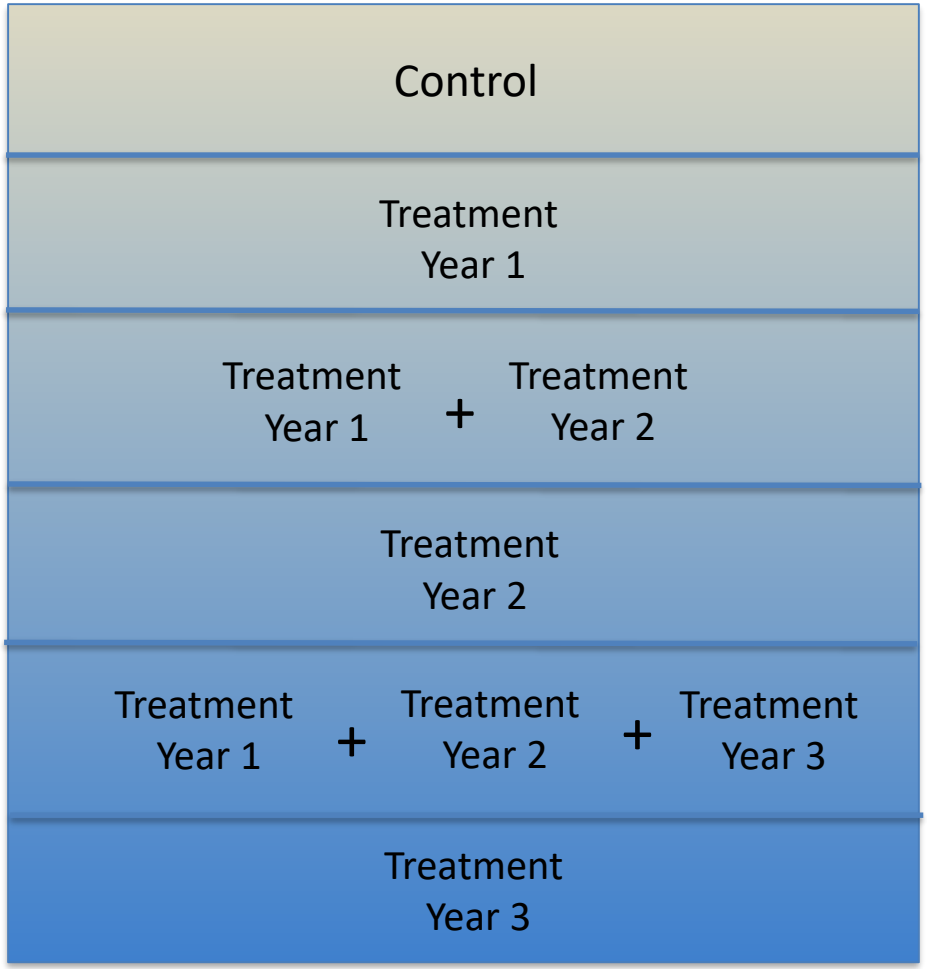


2015-2016 rainfall: 8.7 inches

Site average: 8.2 inches

Proposed SB County research trial (3 years)

6-acre exclusion

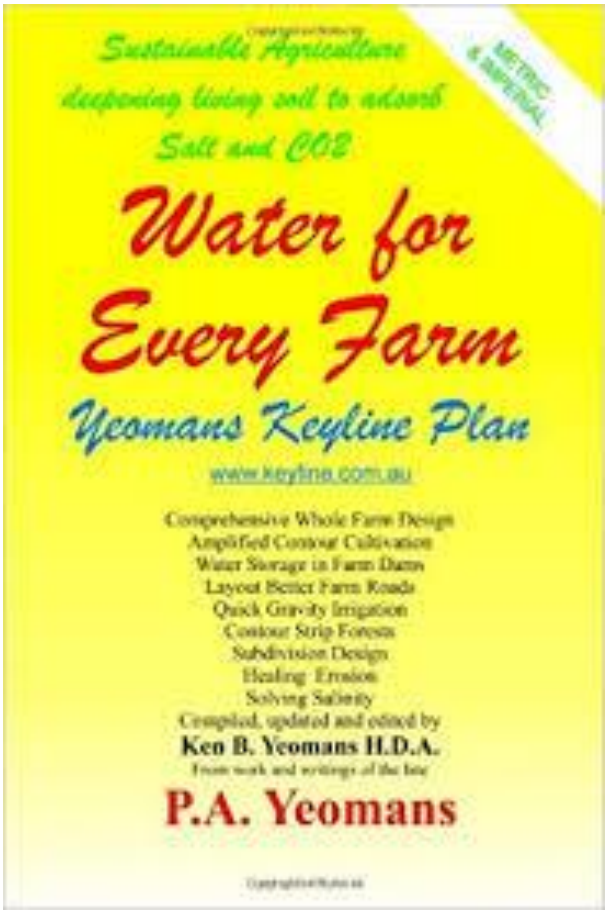


- Forage production
- Soil carbon
- Soil moisture

Economics:

- **12-15ft plow** hits “economic sweet spot” (Chris Gill, TX) (lower purchase price, reduced maintenance cost)
- **~$12,000** for 12ft. plow
- **7 HP** per shank
- Variable cost is **~$10/acre** on ranch in West Texas (labor, maintenance, etc.)
- **20 acres/day**

- In SB County, we’re expecting to accomplish **1 acre/hour**



In summary: keyline subsoiling for range improvement

- Interesting concept, but requires further research

Compost on rangelands

Effects of organic matter amendments on net primary productivity and greenhouse gas emissions in annual grasslands

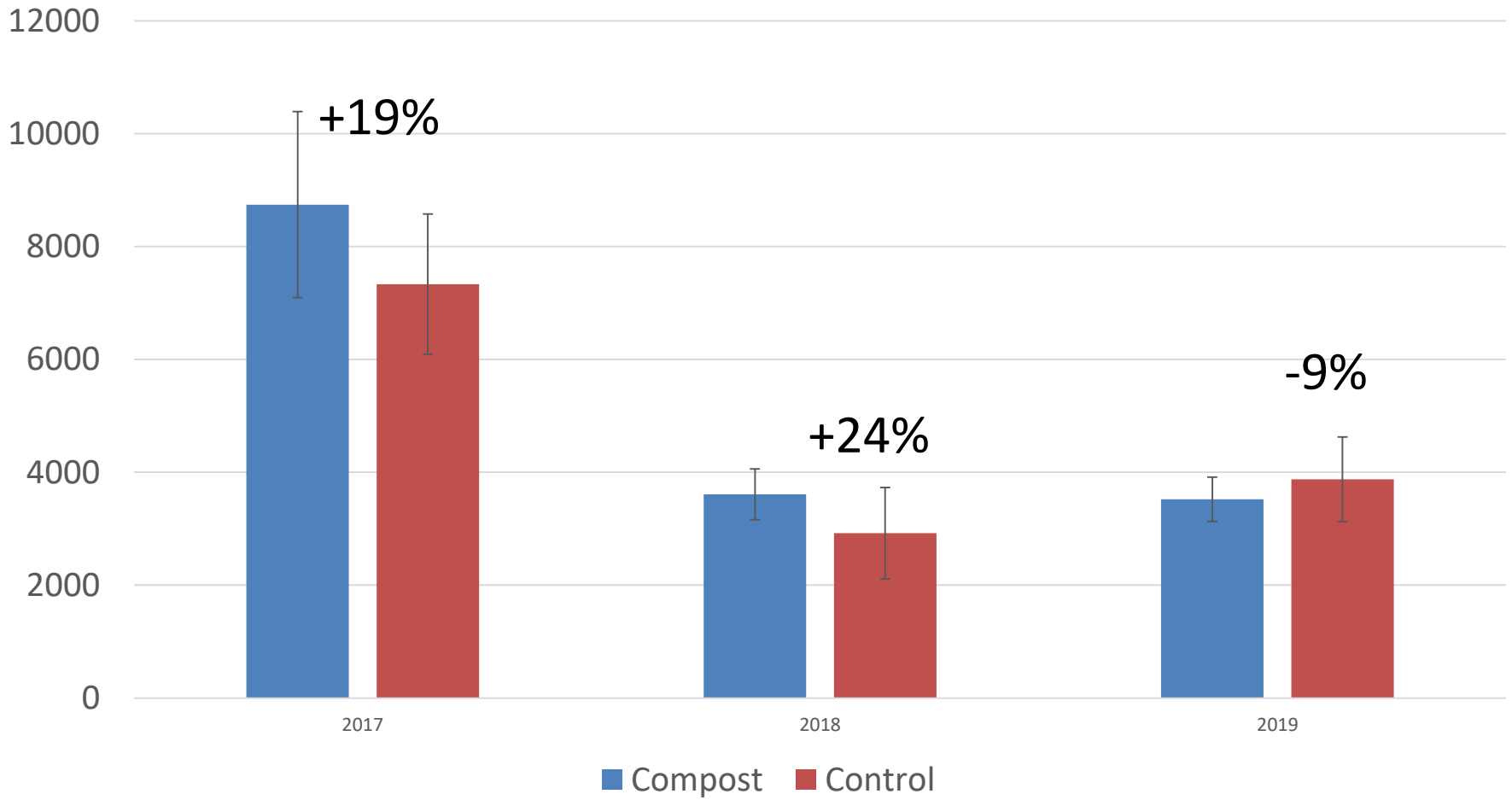
REBECCA RYALS[1] AND WHENDEE L. SILVER

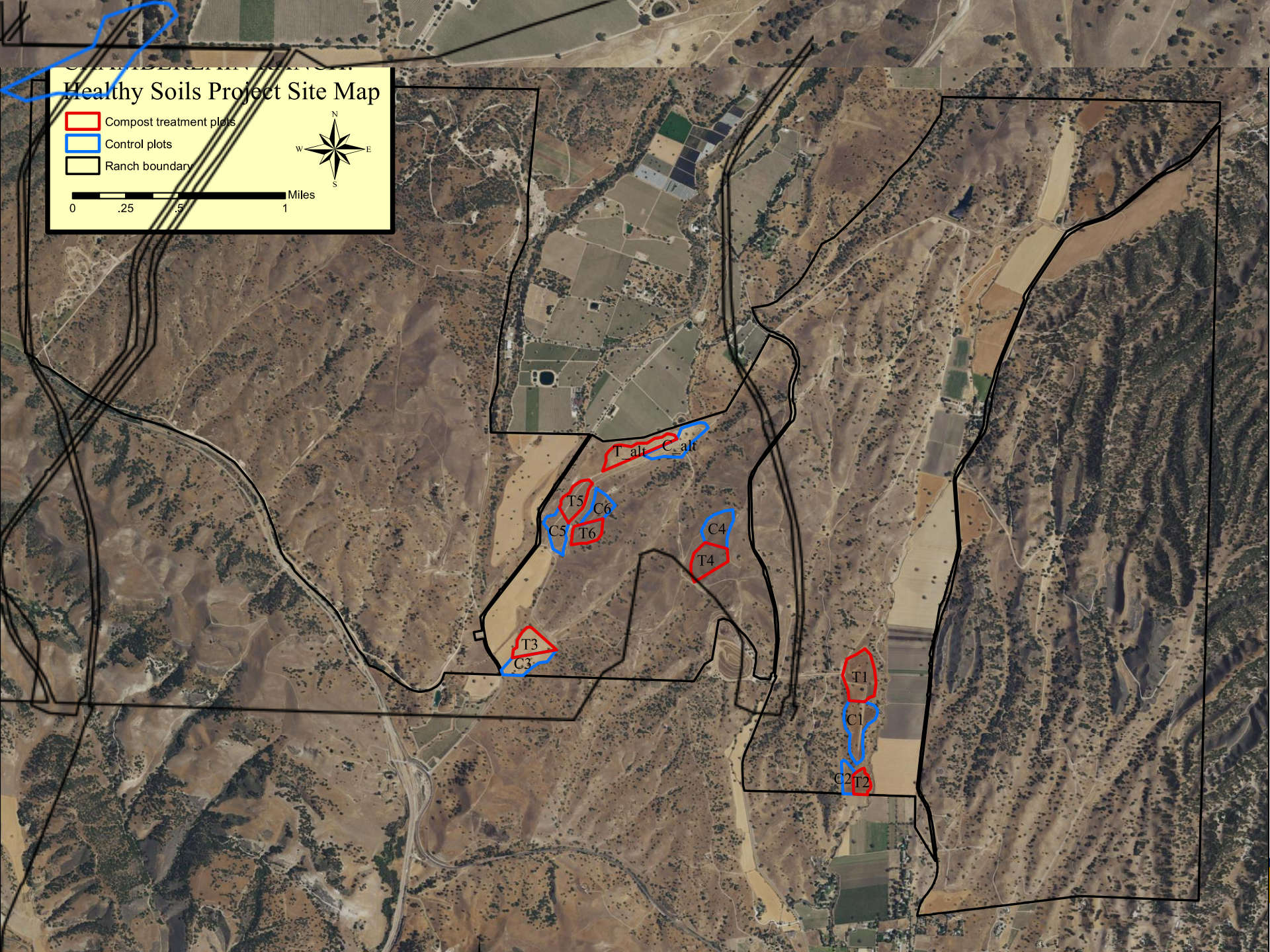
University of California, Berkeley, Department of Environmental Science, Policy, and Management, 130 Mulford Hall No. 3114, Berkeley, California 94720 USA

Key findings:

- Increased forage production
- Carbon sequestration
- No impacts on species composition
- Increased water holding capacity→extend Spring season

Zaca Station compost forage production (2017-2019)




Healthy Soils Project Site Map
Compost treatment plots
Control plots
Ranch boundary
N
W
E
S
Miles
0
.25
.5
1
T_alt
C_alt
T5
C6
C5
T6
C4
T4
T3
C3
T1
C1
C2
T2

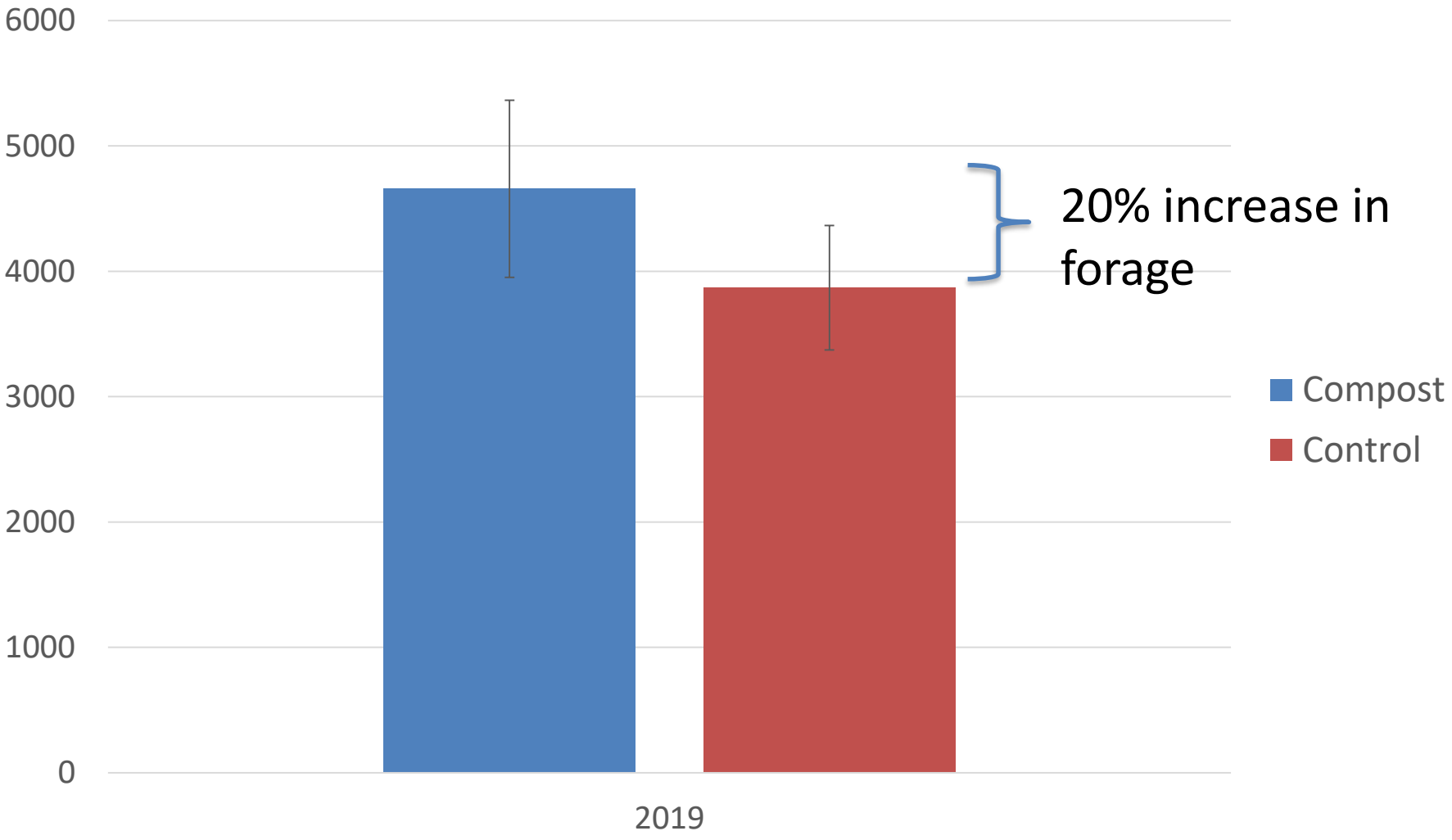
Healthy Soils Project: Chamberlain Ranch

- Three (3) annual applications of compost
  - 2018: 6.5 tons/acre on 63 acres = **410 tons**

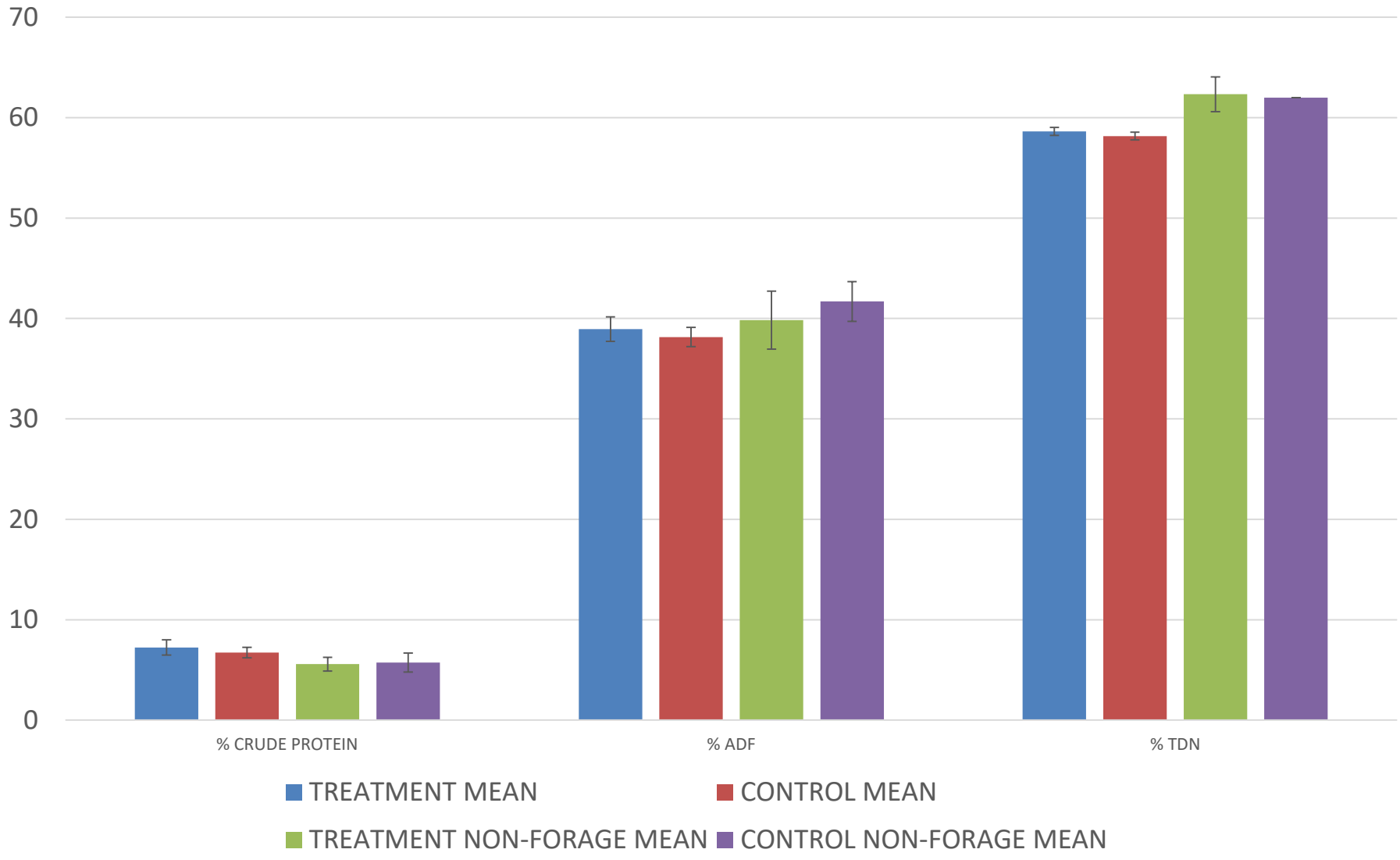
- Cost
  - Compost per ton: $29.50 per ton
  - Compost spreading: $90/acre
  - Total: **$281.75/acre**

- Current cost-share
  - **$325/acre** ($50/ton @ 6.5 tons/acre)

Healthy Soils Project, Spring forage production (2019)



HSP FORAGE QUALITY: CP, ADF, TDN



Economics:

- with CDFA cost-share, current cost/acre is **$0**
- Assuming one-time application of compost on 200 acres in Fall 2016:
  - 2017: 281,600 lbs more forage→ +80 6-mo stockers
  - 2018: 137,800 lbs more forage→ +39 6-mo stockers
  - 2019: no increase

In summary: compost on rangelands as range improvment

- CDFA cost-share makes compost pencil out
- while forage increases are not statistically significant, positive signal

In conclusion…

- anecdotal evidence and preliminary data suggest these three range practices have promise to increase production per acre
- more research and data is needed


Questions?