



# RANGE SCIENCE REPORT

Agricultural Experiment Station

Cooperative Extension

No. 6

September 1986

## COMPARISON OF ANIMAL YIELDS ON ANNUAL GRASSLANDS-STOCKING RATES AND IMPROVEMENT PRACTICES

A. H. Murphy, M. B. Jones, and R. M. Love<sup>1</sup>

Most dryland annual range pastures are producing livestock products much below their potential. Production and quality of range forage can be increased by seeding clovers and fertilizing with phosphorus and sulphur.

To demonstrate how these improvements may be implemented, an area of 285 acres at the Hopland Field Station of the University of California was divided into four pastures--Figtree (FT), Cattleguard (CG), Upper Horse (UH), Lower Horse (LH)--where sheep grazing could be controlled and seeding with fertilization would be feasible (Vaughn and Murphy, 1982).

The pastures have a southerly exposure and an elevation range of 800 to 1500 feet. The soil series are Laughlin and Sutherland and they do not exceed 24" depth, with slopes varying from steep to very steep, and with occasional outcroppings of fractured sandstone and shale rocks (Gowans 1958). Frequent drainage channels bisect the pastures, and the deeper channels are generally covered with oak, madrone, and laurel trees. All of the drainage channels have intermittent water flow characteristics, being dry at least six months of the year. Water for livestock is available from natural year-around flowing springs. Forage is composed of annual grasses, legumes and forbs that normally initiate growth by mid-October and are mostly dry by the end of April; for the balance of the season, livestock are maintained on dry forage.

Pastures were standardized (Table 1) for grazing forage potential by determining acreage for each vegetation type then assigning a percentage production starting with open grassland as 100% to dense tree canopy as 0%. By this method the actual 285 acres had an adjusted forage potential of 131 acres equivalent of open grassland.

<sup>1</sup>Specialist, Agronomy and Range Science and Superintendent, Hopland Field Station; Agronomist; and Professor Emeritus, Agronomy and Range Science Department.

	Acres	
	<u>Actual</u>	<u>Adjusted</u>
FT	85	39
UH	68	42
CG	60	25
UH	72	25

The plan for treating the fields consisted of two pastures which were seeded and fertilized (UH & LH), and two which received no treatment (except by sheep), (FT & CG). The improvement of UH began in the Fall 1967 and LH in 1972 (Table 2). Stocking rates varied from 1.0 to 4.0 AUMs per acre during various stages of the study.

The pastures were grazed during the growing season, October to May, from 1962 to 1972, but from 1973 to 1982 use was on a year-long basis. Grazing animals were sheep, ewes and lambs, yearling ewes or wethers. Deer had free access to the fields. At the start of the study, higher stocking rates were only used during rapid spring growth stage, February to April (with grazing at equal rates). Starting in 1973, when ewes and lambs were used on a year-long basis, stocking rate was heavier from January to June. The ewes were weighed at three intervals: breeding, prior to lambing and weaning while lamb weights were at birth, and weaning. When yearling ewes were used they were weighed at start of grazing, before start of heavy grazing in February, at the end of rapid spring growth in April, and at end of grazing season in May or June.

The open grassland areas, were seeded to inoculated lime-pellet subterranean clover at 12 lbs./acre with a rangeland drill where equipment could be used. The cultivars Dinninup, Geraldton, Mt. Barker, and Woogenellup were included in the mixture.

The soils were deficient in phosphorous and sulphur (Murphy, et al., 1973), thus at seeding time single superphosphate was applied at 400-500 pounds per acre. Approximately every second year a follow-up application of 150 to 200 pounds of SSP or 100 pounds soil S per acre was made (Table 2).

Forage composition was measured by the step-point method (Evans and Love, 1957) annually in April, recording percentage stand of all species of annual grasses, legumes, filaree, other forbs, seeded legumes, and perennial grasses as well as an estimate of vegetative ground cover. (Table 3) The major change was in seeded pastures where the planted legumes increased after improvement in 1968 and 1973 while forbs decreased, but annual grasses and native legumes remained unchanged. (Vaughn and Murphy 1982)

Yield of forage was determined at two stages of the growing season: 1) fall-winter yield to early February; and 2) spring yield at

the end of the green period in late April or early May. Forage yield was determined by clipping a square foot sample from an enclosure cage and from an adjacent grazed area. The stucco wire enclosure cages were approximately 30 inches in diameter and height. Winter yields were as low as 220 lb/a and as high as 2300 lb/a, while the spring yields had a low of 600 lb/a and a high of 4370 lb/a (Table 4). Weather, seeding and fertilizer application were major factors accounting for the variation in yield.

Response to the improvement practices was measured by AUM (animal unit months) and pounds gain of sheep per acre before and after treatment. The seeded-fertilized pastures resulted in a gain of 53 pounds of sheep per acre due to treatment while the pastures without improvement resulted in a loss of 10 pounds per acre. The improvement resulted in an increase of 1.08 AUM per acre for sheep while the pastures without treatment increased 0.05 AUM per acre (Table 5).

It can be concluded that pastures of the type studied have the potential for considerable increase in grazing capacity and yield of meat with the judicious seeding of subclover and use of phosphorus and sulphur fertilizers.

#### LITERATURE CITED

- Evans, R. A. and R. M Love. 1957. The step-point method of sampling--a practical tool in range research. *J. Range Manage.* 10(5) 208-212.
- Gowans, K. D. 1958. Soil Survey of the Hopland Field Station. California Agricultural Experiment Station. 34 p.
- Murphy, A. H., M. B. Jones, J. W. Clawson, J. E. Street. 1973. Management of Clovers on California Annual Grasslands. Circ. 564. Calif. Agric. Exper. Sta., University of California. 20 p.
- Vaughn, C. E. and A. H. Murphy. 1982. Long-term effects of fertilization and subclover seeding on northern California annual range. *J. Range Manage.* 35(1) 92-95.

Table 1. Native Pasture Cover Types - Forage Potential

Type	K*
1. Grass	100
2. Grass, Valley White Oak, opened	86
3. Woodland, Blue Oak, opened formerly more dense	72
4. Woodland, Blue Oak	57
5. Woodland, Blue Oak, Valley Oak	43
6. Woodland, mixed deciduous evergreen hardwood	29
7. Woodland, evergreen hardwood	14
8. Forest, mixed deciduous, Live Oak, Laurel	0

\* K = relative forage producing value of grass

Table 2. Fertilizer application dates, sources, and rates used to improve pastures.

Date applied	Fertilizer source	Application rates (lbs/ac)			
		Pasture (UH)		Pasture (LH)	
		P 05	S	P 05	S
10/67	SSP <sup>1</sup>	28	54	--	--
9/68	SSP	34	60	--	--
10/69	Soil S	--	100	--	--
9/72	SSP	--	--	25	60
10/72	GTP <sup>2</sup> + NaP <sup>3</sup> + Soil S	15	100	--	--
9/74	SSP	--	--	16	18
9/76	SSP	8	24	18	24
10/78	TSP <sup>4</sup> + Soil S	16	100	17	150
10/80	SSP	13	18	13	18

<sup>1</sup>Single superphosphate 0-20-0-12

<sup>2</sup>"Golden treble" (sulfur-fortified treble superphosphate) 0-35-0-20

<sup>3</sup>Trisodium phosphate

<sup>4</sup>Treble superphosphate 0-45-0-0

Table 3. Forage species composition (%) for cattleguard, fig tree, upper and lower horse pastures for 24 years.

	DAG	UAG	MISC FORBS	EBO	ANNUAL LEGUMES	PLANTED LEGUMES	PEREN	PLANT COVER DENSITY
CATTLEGUARD								
1959	32	12	9	40	5	-	2	23
1960	21	8	25	20	25	-	1	32
1961	18	16	38	13	14	-	1	40
1962	35	13	30	8	13	-	1	30
1963	20	13	33	25	9	-	T	29
1964	27	28	21	17	7	-	T	38
1965	16	22	30	18	14	-	-	37
1966	17	24	33	13	13	-	-	33
1967	19	14	39	9	19	-	T	31
1968	26	22	28	17	7	-	-	36
1969	18	23	30	12	17	-	T	34
1970	28	16	28	18	10	-	-	35
1971	11	17	46	16	10	-	-	33
1972	15	25	35	20	5	-	T	28
1973	21	20	28	18	13	-	-	38
1974	24	25	21	14	16	-	-	53
1975	26	23	17	22	12	-	-	36
1976	38	23	13	19	6	-	1	70
1977	33	18	28	13	8	-	T	35
1978	18	19	35	20	8	-	-	35
1979	14	29	40	10	7	-	-	38
1980	24	23	26	12	15	-	-	37
1981	37	26	16	17	4	-	-	37
1982	31	26	13	21	9	-	-	45
FIGTREE								
1959	36	6	8	44	6	-	T	38
1960	30	11	18	19	22	-	-	44
1961	21	21	28	14	16	-	T	62
1962	31	12	29	18	10	-	-	39
1963	11	15	34	26	14	-	-	40
1964	28	31	14	15	12	-	-	56
1965	14	21	21	22	22	-	-	62
1966	16	18	23	23	20	-	T	42
1967	14	13	32	12	28	-	1	56
1968	26	30	23	14	7	-	-	47
1969	17	27	20	16	20	-	-	54
1970	25	26	16	23	9	-	1	38
1971	14	18	27	23	18	-	-	52
1972	21	36	23	16	4	-	T	46
1973	26	20	26	13	14	-	1	46
1974	21	31	20	13	15	-	-	46
1975	23	28	17	22	10	-	-	55
1976	20	35	16	25	4	-	T	70
1977	29	18	27	11	13	-	2	35
1978	23	17	36	16	8	-	1	42
1979	17	29	38	7	9	-	-	49
1980	26	30	26	13	5	-	-	55
1981	30	37	17	14	2	-	-	49
1982	32	26	17	17	8	-	-	46

(Continued)

Table 3 (cont.)

	DAG	UAG	MISC FORBS	EBO	ANNUAL LEGUMES	PLANTED LEGUMES	PEREN	PLANT COVER DENSITY
UPPER HORSE								
1959	45	14	5	29	6	-	1	47
1960	27	10	15	31	17	-	T	39
1961	28	14	21	17	20	-	T	64
1962	49	6	17	16	12	-	-	39
1963	22	9	20	36	13	-	-	41
1964	45	19	11	15	9	-	1	56
1965	30	15	16	22	17	-	-	68
1966	32	18	14	20	16	-	T	52
1967	22	11	29	14	24	-	T	60
1968*	20	22	14	4	27	13	-	60
1969	16	21	12	5	41	5	-	77
1970	31	21	6	17	24	1	-	63
1971	12	19	18	9	40	2	-	80
1972	30	33	9	11	14	3	-	77
1973	24	29	10	7	28	2	-	71
1974	21	25	5	8	31	10	-	79
1975	25	30	7	12	14	12	-	73
1976	28	28	8	13	13	10	-	80
1977	21	30	12	16	16	5	-	54
1978	14	27	17	11	16	15	-	84
1979	12	32	20	10	14	9	-	75
1980	21	18	7	5	20	29	-	94
1981	21	21	8	12	10	28	-	93
1982	19	12	4	7	14	44	-	86
LOWER HORSE								
1959	39	10	8	41	3	-	T	39
1960	19	9	22	33	17	-	-	34
1961	24	13	31	19	12	-	1	42
1962	29	11	24	24	12	-	-	27
1963	15	11	33	32	9	-	-	36
1964	39	19	18	15	9	-	-	37
1965	12	13	42	17	16	-	-	33
1966	10	16	49	15	10	-	-	18
1967	10	19	47	6	18	-	-	21
1968	23	21	35	17	4	-	-	26
1969	15	19	31	18	17	-	-	31
1970	29	12	28	26	5	-	-	24
1971	18	26	35	12	9	-	-	33
1972	17	21	43	13	5	-	1	36
1973*	7	6	13	6	17	51	T	81
1974	26	11	13	6	16	28	-	73
1975	18	12	6	6	11	47	-	81
1976	26	15	8	10	6	35	-	80
1977	14	15	19	9	12	31	-	35
1978	12	14	13	13	11	37	-	71
1979	11	30	15	13	11	20	-	64
1980	14	19	9	8	10	40	-	75
1981	17	19	8	11	4	41	-	81
1982	14	14	11	10	7	44	-	71

DAG - Desirable annual grass (Bromus mollis, Avena, Lolium)

UAG - Undesirable annual grass (Bromus, Festuca, Aira, Briza,  
Gastridicum, Taeniatherum, Aegilops, Hordeum)

MISCELLANEOUS FORBS - herbaceous plants other than those listed above

EBO - Erodium sp.

ANNUAL LEGUMES - Trifolium, Lotus, Medicago, Vicia, Lupinus (not  
planted)

PLANTED LEGUMES - subclover and rose clover

PEREN - Perennials

\* Pasture planted to rose and subclover and fertilized with SSP.

Table 4. Winter and spring forage yield for 21 years on Cattleguard, Figtree, Upper and Lower Horse pastures at the U.C. Hopland Field Station.

SR Year	1.5 Cattleguard		1. Figtree		2. Upper Horse		3.2 Lower Horse	
	Winter	Spring	Winter	Spring	Winter	Spring	Winter	Spring
1962	921	759	1536	999	1274	1200	1187	845
1963	816	1364	1152	1584	1364	1997	1210	1689
1964	1316	1036	1969	1506	2122	1487	1594	2044
1965	950	1305	1411	1258	1450	1344	1142	1651
1966	240	960	432	1046	490	1363	221	1036
1967	422	1076	806	1225	653	1995	394	1677
1968*	687	1017	1185	1065	880	4011	796	1306
1969	490	1449	893	1354	4512**		480	1738
1970	677	744	950	909	1670	1709	614	1242
1971	332	1226	680	1368	1296	2709	507	1138
1972	814	605	1370	746	1102	1894	791	659
1973*	365	1142	586	1402	1046	2342	998	3754
1974	605	1670	826	2141	1526	3062	1162	2486
1975	778	1743	883	1820	1526	3062	1421	3744
1976	761	1119	973	1225	1704	2820	1354	2138
1977	720	605	221	1086	614	2208	691	1603
1978	461	1507	883	1939	1315	3398	1555	3187
1979	221	1171	451	1238	1191	2955	923	2227
1980	970	1699	1229	1901	1881	4368	1939	3139
1981	538	1265	970	1130	1536	3263	1488	2533
1982	541	1307	920	1674	2289	3543	2297	2779

SR = Stocking Rate.

\*Year of seeding: Upper Horse, 1968; Lower Horse, 1973.

\*\*Total for year.



Table 5. Stocking rate (AUM) and animal productivity (lb/a) of Cattleguard, Figtree, and Upper and Lower Horse pastures before and after improvement.

Year	Cattleguard		Figtree		Upper Horse		Lower Horse	
	AUM	Lbs/a	AUM	Lbs/a	AUM	Lbs/a	AUM	Lbs/a
1962	1.59	32.7	1.38	23.1	1.58	36.1	2.42	52.7
1963	1.94	58.0	1.33	35.6	1.52	54.8	2.01	70.9
1964	1.86	46.3	1.09	31.3	1.58	48.7	2.43	112.6
1965	1.66	54.7	0.90	18.3	1.75	55.3	2.97	70.7
1966	1.77	48.5	0.66	12.3	1.52	36.2	3.07	44.3
1967	1.38	59.5	0.79	27.7	2.19	79.6	2.80	52.7
1968	1.51	54.5	0.71		0.71*		2.78	82.2
1969	1.77	60.1	0.81	33.0	2.12	110.9	2.95	64.2
1970	1.41	55.6	0.78	23.5	2.17	77.7	2.90	76.6
1971	1.39	50.4	0.72	20.9	1.33	68.5	3.07	59.8
1972	1.05	39.4	0.66	16.7	1.49	35.7	2.01	71.4
1973	1.03		1.07	16.7	2.37	77.5	0.90*	
1974	1.42	21.9	1.41	38.0	2.27	67.4	3.49	139.4
1975	1.47	23.4	1.29	22.5	3.10	67.5	3.32	99.6
1976	1.07	28.6	1.24	58.6	3.34	125.8	4.88	161.6
1977	1.90	47.5	1.13	22.7	2.64	101.8	3.83	177.3
1978	2.01	66.9	1.10	43.5	2.82	103.0	3.88	176.3
1979	1.80	38.9	1.24	35.6	2.77	81.2	4.04	113.5
1980	2.06	66.4	1.31	39.2	2.59	88.7	4.23	131.4
1981	1.71	30.5	1.06	35.1	2.47	87.0	4.04	112.4
1982	1.49	59.7	1.21	27.1	3.01	103.7	4.35	155.5
Average Yields:								
Pre-T	1.58	56.0	1.03	24.7	1.69	51.8	2.67	68.9
Post-T	1.66	42.6	1.07	30.9	2.46	85.5	4.01	140.8

\*Treatment year for Upper Horse and Lower Horse (wts. N/A).  
 Cattleguard and Figtree were not improved.  
 Pre-T = Pre-treatment.  
 Post-T = Post-treatment.

Table 6. Significance of main effects and interactions in sheep performance parameters on grass-woodland and improved grassland annual range at three stocking rates for five years in coastal northern California.

Source of Variation	Performance Variable <sup>a</sup>					
	WW	FW	LC	EM	TFL	TGW
Range Subtype (RS)	NS	NS	NS	NS	***	**
Stocking Rate (SR)	NS	NS	NS	NS	NS	NS
Year (Y)	**	NS	****	**	**	NS
RS x SR	****	NS	NS	**	NS	***
Y x RS	NS	NS	NS	NS	NS	NS
Y x SR	NS	NS	NS	NS	NS	NS
Y x RS x SR	****	****				
Sheep/Pasture	****	****				

<sup>a</sup>Weaning weight of lambs (WW), fleece weight of ewes (FW), lamb crop percentage (LC), ewe mortality rate (EM), turnoff of feeder lambs (TFL) and turnoff of grease wool (TGW).

NS = Nonsignificant  
 \* = P < .05  
 \*\* = P < .025  
 \*\*\* = P < .01  
 \*\*\*\* = P < .005