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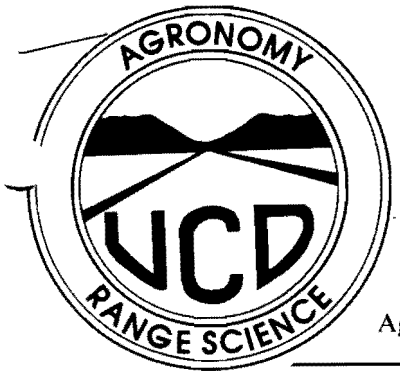

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PERFORMANCE OF SHEEP GRAZING CALIFORNIA ANNUAL RANGE

California Agricultural Experiment Station

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SUMMARY

A sheep grazing trial was conducted in coastal northern California on two subtypes of annual range. Grassland that was improved by fertilization and seeding to subterranean clover and grass-woodland were grazed continuously for five years by dual purpose ewes at moderate, moderately heavy and heaving grazing treatments (stock rates of .25, .75 and 1.3 and 2.1, 3.2 and 4.0 ewes/a on woodland and grassland range). Responses in lamb weaning weight, ewe fleece weight, lamb crop percentage, ewe mortality and turnoff of feeder lambs and grease wool were measured. Lamb and wool production was about six-fold greater on improved grassland than on grass-woodland range (146 versus 26 lb of lambs/a; 19.7 versus 3.4 lb of wool/a). Stocking rate had no significant effect on any performance parameter, but weaning weights tended to decrease as stocking increased on woodland and appeared heaviest under heavy grazing on grassland. Lamb crops weaned from woodland ranges tended to decline at stocking rates above moderate grazing. There was a trend for increasing wool and feeder lamb yield/a with rising stocking rates on grassland. On woodland, turnoff increased only at the highest stocking rate. Increasing turnoff from grass-woodland range by raising stocking rates required supplementation. This prevented ewe mortality and reductions in lamb crop from exceeding those under moderate grazing. Moderate stocking of woodland range (1.5 - 2.5 ewe/a under yearlong grazing) was suggested for sheep operations with less intensive management. Heavy stocking (25 ewes/a yearlong) was recommended for grassland seeded to subterranean clover.

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INTRODUCTION

California ranks second in the USA in production of sheep and wool (McGregor and Tucker, 1982). A major portion of these commodities are produced from forage growing on annual range. This grazing type covers approximately 25 million acres (Forest and Range Task Force, 1972) occurring as several subtypes (e.g., open grassland, grass-woodland). Annual range is the basis of many ewe/lamb operations. It can be managed under yearlong grazing (Heady, 1961) and improved by fertilization (Jones, 1974) and legume seeding (Murphy et al., 1973).

For California to maintain a vigorous sheep industry in face of land base shrinkage to urbanization, it is imperative that remaining land produce lambs and wool profitably at increasingly higher yields. Increasing turnoff (yield of animal products) from annual ranges by grazing management has been studied infrequently. There have been no investigations to appraise impacts of stocking rate on performance of sheep grazing annual range in California. The following trial was conducted to determine yearlong stocking rates which optimize individual animal performance, lamb/wool turnoff and flock productivity on grass-woodland and improved grassland subtypes of annual range. Management inputs included labor and supplemental feeding that are typical for sheep ranches in coastal California.

EXPERIMENTAL PROCEDURE

This study was one component of an integrated experiment which also examined effects of stocking rate on nutritive value of sheep diets (Rosiere and Torell, 1985), and botanical composition of range plant communities (Rosiere, in preparation). It was conducted from 1979-1984 in coastal northern California on the University of California Hopland Field Station in Mendocino County. Average annual rainfall is 35 in., but totaled 43, 27, 54, 68 and 40 in. during the five years of study.

Two annual range subtypes were studied: (1) improved grassland comprised of cool-season naturalized Eruasian and native annual grasses and forbs overseeded to subterranean clover (Trifolium subterraneum), and (2) grass-woodland, a patchwork of annual grassland and savannah of blue oak (Quercus douglasii), interior live oak (Q. wislizenii) and madrone (Arbutus menziesii) trees with an understory of herbaceous species and sclerophyllus shrubs such as manzanita (Arctostaphylos spp.) and chamise (Adenostoma fasciculatum). Species composition of herbaceous communities as determined by step point procedure (Evans and Love, 1957) at peak standing crop is given in Table 1. Soils of woodland range were Josephine, Sutherlin, Laughlin, and Los Gatos series. Those of grassland range were Soquel and Pleasanton.

Improved grassland range was established in fall 1979 by overseeding Mt. Barker and Woogenellup varieties of subterranean clover into annual grass sod (20 lb seed/a) and applying elemental sulfur (100 lb/a) and triple superphosphate (50 lb/a; 10 lb P/a) with a rangeland drill. In fall 1980 and 1983, grassland range was top-

dressed with single superphosphate (150 lb/a). The grass-woodland field boundaries were established 20 years prior to the current experiment. They were managed since then at stocking rates similar to those currently tested.

Both range subtypes were gazed continuously by flocks of dual-purpose ewes at moderate, moderately heavy and heaving grazing intensities. Grazing treatments were determined from past management and calibration studies (Hooper and Heady, 1970; Pitt and Heady, 1979) in which moderate use served as a base that was intermediate between light and heavy grazing. The grass-woodland ranges used to evaluate moderate, moderately heavy and heavy grazing were Pastures S3 (54 a), S1 (38 a) and D1 (6 a) grazed over the five year period by a mean of 11, 13 and 8 ewes, respectively. Improved grassland range units used for the grazing treatments were Pastures LM1 (3.7 a), LM3 (2.5 a) and LM2 (2.0 a) each grazed by eight ewes. Mean stocking rates of woodland and grassland range for respective grazing treatments were 0.25, 0.75 and 1.3 and 2.1, 3.2 and 4.0 ewes/grazable acre, plus their lambs for 110 days and one ram for six weeks. In all years but 1981, periodic addition of sheep to improved grassland was used in early portions of the growing season to keep annual grasses from crowding out subterranean clover. Put and take stocking was consistent with relative grazing pressure. Herbage productivity (recorded as peak standing crop), residue remaining prior to fall germination and degree of use in range pastures are presented in Table 2.

Ewe flocks were primarily of Targhee breeding and of mixed ages. Over the course of the trial, ages of individual ewes varied from one to nine years. The mean flock age was five years. Mixed-age flocks were maintained to simulate typical management by replacing ewes that died with ones of corresponding ages. In the third year of study, older ewes with unsound mouths and udders were replaced by long-yearling ewes from the second lamb crop. Hence, only a small proportion (7%) of ewes were present for the duration of the experiment. To insure replacement ewes, Targhee rams were used to sire the first three lamb crops. The last two crops were sired by Suffolk rams so that traditional "black-faced" lambs would be represented.

Ewes were exposed to rams in pasture for a six to eight week breeding period commencing in late August. Lamb production was thus coordinated with period of most plentiful and nutritious feed supply (February through May). Lambs were born on range without artificial shelter. Four to six weeks after birth they were paired with their mothers, eartagged, docked and castrated. Lambs were weaned and weighed at about 110 days of age. Ewes were weighed at weaning and just prior to the breeding period. They were wormed (thiabendazole and levamisole in rotation), sheared at weaning, and tagged (crutched) prior to lambing.

Supplemental feeding of ewes in moderately heavy and heavy grazed woodland ranges was necessary to prevent starvation. during the first two years, flocks were supplemented with 7.7 lb of alfalfa hay/ewe/week from mid September to mid November. The same feeding program was followed the third year except that ewes at heavy grazing received

17.7 lb alfalfa/ewe/week during the last month. In the fourth year, rates of feeding for the September to November period were 5.5 and 9.4 lb alfalfa/ewe weekly at moderately heavy and heavy grazing regimens. In the final year there was a drought in January and supplementation of ewes in the heavy grazing treatment was required. Weekly feeding rates per ewe were 17.6 lb from mid February through March and 9.4 lb during April. Supplementation was a practice inherent to this experiment because unimproved annual range was grazed continuously under moderately heavy and heavy grazing treatments. This obviously confounded effect of stocking rate on some performance parameters (e.g., ewe mortality; ewes in these two treatments on woodland range would have died without supplemental feeding). Other parameters such as lamb weaning weight were probably unaffected by ewe supplementation. Feeding was done only to prevent death of ewes. It was not a flushing procedure because range diets were supplemented at level of maintenance (NRC, 1975), and during the last year under heavy grazing, lactation (NRC, 1975).

Lamb weaning weights, ewe grease fleece weights, turnoff of lambs and grease wool, lamb crop percentage and ewe mortality rates were analyzed in this factorial experiment by split plot analysis of variance (Steel and Torrie, 1980) using range subtypes and stocking rates (fixed effects) as main plots and years (random effects) as subplots. F values for range subtype and stocking rate effects were determined by dividing mean squares of these main effects by mean squares of their first order interaction. For F ratios of year effect and its first-order interactions; numerators were mean squares of each and the denominator was the second-order interaction Since there were multiple numbers of observations per pasture each year for weaning and fleece weights, an F was determined to test variation among animals within pasture by dividing this mean square by that for year by animal within pasture. Such values could not be determined for lamb and wool turnoff, lamb crop or ewe mortality because there was only one observation (calculation) per pasture annually. Treatment means were not tested further since there were only two range subtype treatments and no significant F values for stocking rate treatments.

RESULTS

Sheep performance and flock productivity are presented as lamb weaning weights and ewe fleece weights (Table 3), lamb crop and ewe mortality (Table 4) and lamb and wool turnoff (Table 5). Significance of stocking rate, range subtype, year and interactions on production variables is summarized in Table 6. Effects of these factors on sheep performance were not definitive in this trial. Though different means in sheep responses existed among treatments, most of these were nonsignificant. Differences among individual animals within treatments accounted for most of the variation in weaning and fleece weights. Stocking rate had no significant effect on any of the sheep performance variables. By comparison, there was a significant influence of years on all sheep attributes except grease fleece weight and wool turnoff. Turnoff of feeder lambs and grease wool was significantly greater on the more productive and heavier stocked grassland range

than on woodland range (146 versus 26 lb of lambs/a, 19.7 versus 3.4 lb of wool/a).

There were significant interactions between range subtype and stocking rate on weaning weight and wool turnoff. On woodland range, weaning weight tended to decline with increasing rates of stocking while on grassland range average weaning weights were not significantly greater under highest stocking (table 3). Wool and lamb turnoff increased nonsignificantly as stocking rate increased on grassland range while on woodland range, turnoff of these commodities was four times greater under the heaviest grazing treatment (Table 5). Significant second order interactions of range subtype, stocking rate and year occurred for weaning and fleece weights. Year effects did not interact with those of range subtype or stocking ate on a first-order level.

Discussion

There were relatively few U.S. investigations of sheep responses to stocking rates on range with which to compare these results. A review of stocking rate studies has indicated that performance of individual animals declined while total yield from animals per area of land grazed rose, as stocking rate was increased (Heady, 1975). Malecheck et al. (1978) reported that on Intermountain range, ewe and lamb weight gains were greater under moderate grazing while lamb production per unit of rangeland was higher with heavy stocking. On improved hill pasture in Oregon, which was similar to improved California annual grassland, Sharrow et al. (1981) found that lamb weaning weights were lighter at the lowest than at the highest stocking rate evaluated. Turnoff of lamb per acre increased with increasing rates of stocking. Woolfolk (1949) grazed yearling ewes on Great Plains range and detected a significantly greater final weight under light stocking than with heavy stocking. All of these trials involved seasonal grazing in which pronounced differences in sheep performance were more likely than under the continuous grazing of the present trial where stocking rates were low enough to insure adequate forage during plant dormancy. Perhaps this was why current findings indicated trends rather than distinct differences.

Some of the most obvious results of sheep performance on annual range were low weaned lamb crop percentages which averaged 76% (80% on woodland and 75% on grassland range). This level of production was less than three-fourths of the birth rate of lambs on Pacific hill pastures when flushing and shed lambing were practiced (Sharrow et al., 1981). It was well above the 30-50% lamb crop reported by Squires (1981) for sheep in Australia's arid zone and slightly below those recorded for subterranean clover/annual grass pasture in Australia (Brown, 1977; White et al., 1980). Low lamb crops were consequences of several factors including: still born lambs, neonatal death loss, poor ewe maternal ability, limited shelter from rain, coyote and dog predation and an inexperienced ram. Lack of significant effect of stocking rate on lamb crops weaned from annual range was consistent with other findings of sheep grazing annual grass and subterranean clover pastures (Russell and Blackburn, 1973; Fitzgerald,

1976; Brown, 1977; Robards et al., 1979). There was no evident cause for this lack of lamb crop response to stocking rate. It was possible that lamb crop performance was low enough that effect of stocking rate could not be detected. It was also likely that lamb crop was influenced by so many factors independent of the grazing treatments that any influence of stocking rate was masked.

Absence of influence on ewe mortality by stocking rate indicated that supplemental feeding prevented death rates under moderately heavy and heavy grazing on woodland from exceeding those on grassland and moderately grazed woodland. Although supplementary feeding was the major equalizer of mortality on woodland range it was probably not the only factor involved. Death rates also did not differ among stocking rates on grassland range where supplementation was not practiced. This showed that annual ranges with large populations of subterranean clover could be grazed heavily without reliance on supplemental feeding because dry matter and nutrients were not reduced below ewe maintenance requirements. It further suggested that dry ewes are well-adapted for survival on closely grazed range. Australian workers (Brown, 1977; White et al., 1980) also determined that mortality of ewes grazing subterranean clover and annual grass was not affected by stocking rates.

Since timing of supplementation coincided with the breeding season, it was likely a factor in preventing reduction of lamb crops below those for moderate woodland grazing. Because ewe diets were supplemented only to maintenance level, lamb crops were not increased beyond those under moderate use. This was substantiated by nonsignificance among grazing treatments. There was a trend for higher lamb crops under moderate grazing of woodland range (mean of trend for higher lamb crops under moderate grazing of woodland range (mean of 87 versus 75 and 77% for moderate and the two heavy use treatments; Table 4). Given this trend and an average fall feeding of 72 and 91 lb of alfalfa/ewe for moderately heavy and heavy grazing, stocking of sheep on unimproved annual range beyond moderate rates was an expensive practice that involved both economic and biological considerations. Supplemental feeding was not only more labor-intensive management, but based on hay expense alone, it costs an average of $4.01 and $5.11/ewe or $2.92 and $6.63/a under moderately heavy and heavy grazing of woodland range. In turn, supplementation did not increase performance of individual ewes but it did increase lamb and wool yield per acre under the heavy grazing treatment.

Increased turnoff from woodland range was apparent only with heavy grazing which resulted in about four times greater feeder lamb and grease wool production per acre than with moderate and moderately heavy grazing (Table 5). Average cash receipts from combined sale of lambs and wool were $40.65/a under heavy grazing compared to $10.12/a under moderate and moderately heavy grazing. Thus, stocking woodland range at greater than moderate rates to increase sheep production was feasible only at a concentration of animals dense enough to show high yields (i.e., increasing production per acre by increasing number of ewes per acre became increasingly more feasible as larger portions of ewe diets were provided by supplement). By investing extra labor and

$6.63 in alfalfa, an additional $30.52/a was received. But investing only $2.92/a resulted in no more turnoff or income than with moderate grazing and no supplementation. Attendant in this scheme was cost of hay storage and the increased risk of insufficient forage under higher stocking rates. During a short drought in winter 1984, for example, it was necessary under heavy grazing on woodland to feed a total of 143 lb of alfalfa/ewe over a period of two and a half months at a cost of $8.02/ewe. Furthermore, there was always the possibility that stocking rate might not be high enough to offset cost of supplement (e.g., investing $2.92/a for hay and getting nc increased income).

Forage shortage did not result from higher stocking rates on improved grassland range where quantities of available herbage remained adequate yearlong (Table 2) and always included some residue of subterranean clover. Turnoff of wool and lambs apparently increased with successively increasing rates of stocking (Table 5) and, as production per animal did not differ or trend downward, there was an apparent advantage to heavy grazing on grassland range. Several grazing trials on subterranean clover documented greater total production of lambs and wool with heavier stocking rates while wool clip per sheep usually declined (White and McConchie, 1976; Brown, 1977) and lamb growth rate either decreased (Fitzgerald, 1976; Brown, 1977) or was unaffected (Robards et al., 1979; White et al., 1980). Robards et al. (1979) and Reeve and Sharkey (1980) noted that reductions in wool produced per sheep under heavy grazing on annual range and subterranean clover were so slight that wool produced per unit of land increased linearly with rising stocking rates. An approximate situation existed in the present experiment on improved grassland but not on grass-woodland range.

Comparable levels of sheep performance between grassland and woodland range for parameters other than turnoff was probably not unusual. Major forage species except subterranean clover were common to both subtypes (Table 1) and there was more difference between subtypes in amount of forage than in nutritional value of forage (Rosiere and Torell, 1985). Campbell et al. (1973) and Robards et al. (1979) learned that sheep performance did not differ between annual and perennial range in Australia.

The difference in lamb and wool turnoff between the two range subtypes was the most conspicuous outcome of the present investigation. Grassland range had more production potential which was effectively utilized to produce three times more herbage than that on grass-woodland range (Table 2). This in turn yielded almost six times more feeder lamb and grease wool per acre of range (Table 5). The two-fold greater production efficiency of improved grassland range was attributed to more thorough utilization of range herbage by better animal distribution on smaller pastures and to selection of nutritionally superior diets (Rosiere and Torell, 1985). High levels of pasture efficiency and sheep production from grassland range were costly (approximately $40/a to initially fertilize and seed subterranean cover) but produced almost six times more cash income than woodland range (sales of lambs and wool averaged over the three grazing treat-

ments were, on a per acre basis, $117.00 from improved grassland range versus $20.29 from woodland range).

Significant year effects on performance parameters except wool production may have indicated important management considerations. Most Australian studies cited above (Fitzgerald, 1976; Robards et al, 1979; Reeve and Sharkey, 1980; White et al., 1980) revealed yearly variation in sheep performance. In the present experiment some fluctuation in performance over years was expected because it was necessary to raise Targhee- and Suffolk-sired lambs in different years. This could have accounted for much of the yearly variability in weaning weight but probably not in lamb crop where environmental factors (e.g., winter storms and predation) and ewe mothering ability were more influential. Although mixed-age flocks were kept throughout the trial, it was reasonable that year differences would also occur in wool production since many older ewes were replaced by yearling and two-year-old ewes in the fourth and fifth years. Comparison of grease fleece weights (Table 3) to weaned lamb crop percentages (Table 4) during the five years of study indicated that wool was, over time, a more stable commodity to produce than feeder lambs. As such, wool production would be critical to commercial sheep operations on coastal annual range, especially those with less intensive management.

Another implication of year effects was the limited importance of stocking rate relative to fluctuations in weather and forage growing conditions. Yearly variations in herbage production and botanical composition of annual range were documented by Pitt and Heady (1978) and found to exceed those induced by grazing intensity (Pitt and Heady, 1989). A parallel existed in performance of sheep grazing annual ranges which, in conjunction with significant variation among individual sheep, largely negated influences of stocking rate. Stocking rates were thus important primarily as long-term influences on sheep production per acre rather than on individual sheep performance.

Conclusions

Stocking rate is a notable management factor in sheep production on California annual range because it may affect yield of lambs and wool per area of land. However, at moderate to heavy stocking rates there is little influence on performance of individual sheep. Yearly fluctuations in environmental and managerial factors affect individual animal performance more than do differences in botanical composition and herbage production of annual ranges. Development and proper management of annual grass/subterranean clover range is an effective way to increase turnoff of lambs and wool. To get full advantage of subterranean clover grassland it should be grazed heavily (4 ewes/a with yearlong use in northern California). Moderate grazing of grass-woodland range (.25 to .4 ewe/a yearlong depending on range site) is a minimal, but economically and biologically sound, management. Sheep turnoff from woodland range can be increased through more intensive management by higher rates of stocking accompanied by increased risk of forage shortage and need for supplemental feeding.

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Table 1. Species composition (%) of two subtypes of annual range grazed continuously at three stocking rates over five years[a] in coastal northern California.

	Grazing Intensity Range Subtype					
	Moderate		Moderately Heavy		Heavy	
Species	GW[b]	IG[b]	GW	IG	GW	IG
Aira caryophyllea	12		24		5	
Avena barbata/fatua	10		2		2	
Bromus mollis	33	41	33	34	53	25
Bromus rigidus	8		4		2	
Bromus rubens	1		3		T	
Elymus caput-medusae	3	1	T		0	
Festuca spp.	3	4	T	6	13	T
Hordeum spp.[c]	T	11	T	14	3	8
Misc. annuals[d]	3	T	2	T	3	T
Erodium spp.	9	2	9	4	1	6
Iris macrosiphon	T		T		T	
Lupinus spp.	1		T		0	
Medicago hispida	T		T		T	
Trifolium subterraneum		40		41		53
Other Trifolium spp.	4	T	8	T	2	T
Misc. annual forbs[e]	13	1	15	1	15	2

[a]Mean; determined by step point procedure.
[b]Grass-woodland (GW) and improved grassland (IG).
[c]Primarily H. leporinum and hystrix.
[d]Briza minor, Bromus spp. Cynosurus echinatus, Gastridium ventricosum, Poa annua.
[e]Baeria chrysostoma, Brodiaea spp. Carduus pycnocephalus, Daucus pusillus, Geranium spp., Lepidium spp., Lotus spp.
T=Trace (less than 1%).

Table 2. Peak standing crop (lb/a)[a], residue (lb/a)[b] and utilization (%)[c] of herbaceous vegetation on two subtypes of annual range grazed continuously at three stocking rates for five years in coastal northern California.

Species	Grazing Intensity / Range Subtype: Moderate GW[d]	Moderate IG[d]	Moderately Heavy GW	Moderately Heavy IG	Heavy GW	Heavy ID
Peak Standing Crop[e]	1638±270	4111±255	903±149	4486±668	1381±182	3228±373
Residue[e]	871±110	2399±132	454±123	1797±109	524±230	716±105
Utilization[e]	39±6	36±4	44±9	49±7	56±11	67±6

[a]Determined by clipping 0.09 m^2 plots at ground level at time of seed-set.
[b]Prior to first fall germinating rain.
[c]Residue (100)/peak standing crop; residue determined by clipping 0.09 m^2 plots (ground level) just prior to germinating fall rains.
[d]Grass-woodland (GW) and improved grassland (IG).
[e]Mean ± SE.

Table 3. Weaning weights (lb) of lambs[a] and fleece weights (lb) of ewes grazing grass-woodland and improved grassland annual range at three stocking rates for five years in coastal northern California.

	GRASS-WOODLAND RANGE					
Intensity:	MG[b]		MHG		HG	
Year	WW[c]	FW	WW	FW	WW	FW
1980	75	8.6	77	7.3	59	6.4
1981	73	6.6	55	5.1	48	4.8
1982	77	7.7	64	6.4	57	7.1
1983	73	5.7	9	5.5	20	5.1
1984	79	6.2	66	6.2	57	5.7
Mean ± SE	75±2	7±.4	68±4	6.2±4	57±2	5.7±.4
(CV)	(4)	(17)	(13)	(14)	(10)	(16)

	IMPROVED GRASSLAND RANGE					
Intensity:	MG		MHG		HG	
Year	WW	FW	WW	FW	WW	FW
1980	77	7.5	86	7.7	79	6.8
1981	68	7.1	79	7.5	70	5.7
1982	75	6.6	68	7.5	84	6.8
1983	90	6.4	79	7.1	101	7.5
1984	86	6.2	77	5.9	90	5.9
Mean ± SE	79±4	6.8±.2	77±2	7±.2	59±4	6.6±.2
(CV)	(11)	(8)	(8)	(10)	(14)	(11)

[a]Singles only; approximately 110 days of age.
[b]Moderate grazing (MG), moderately heavy grazing (MHG), and heavy grazing (HG).
[c]Weaning weight (WW) and fleece weight (FW).

Table 4. Lamb crop (%)[a] and ewe mortality (%) in flocks of Targhee-type sheep grazing grass-woodland and improved grassland annual range at three stocking rates for five years in coastal northern California.

	GRASS-WOODLAND RANGE					
Intensity:	MG[b]		MHG		HG	
Year	LC[c]	EM	LC	EM	LC	EM
1980	92	0	92	17	90	0
1981	85	7	92	23	86	25
1982	92	8	71	30	0	17
1983	67	0	22	0	5	0
1984	100	0	100	33	100	12
Mean ± SE	87±6	3±2	75±14	21±6	77±9	11±5
(CV)	(14)	(137)	(42)	(64)	(27)	(101)

	IMPROVED GRASSLAND RANGE					
Intensity:	MG		MHG		HG	
Year	LC	EM	LC	EM	LC	EM
1980	67	11	100	0	88	0
1981	63	0	71	13	100	22
1982	86	13	13	13	29	13
1983	87	12	50	0	57	0
1984	87	12	87	0	100	0
Mean ± SE	78±5	109±2	64±15	5±3	75±14	7±5
(CV)	(15)	(56)	(53)	(137)	(42)	(144)

[a]Lambs weaned/ewe exposed to ram.
[b]Moderate grazing (MG), moderately heavy grazing (MHG), and heavy grazing (HG).
[c]Lamb crop (LC) and ewe mortality (EM).

Table 5. Turnoff of feeder lambs (lb/a) and grease wool (lb/a) from grass-woodland and improved grassland annual range at three stocking rates for five years in coastal northern California.

	GRASS-WOODLAND RANGE					
Intensity:	MG[a]		MHG		HG	
Year	TL[b]	TW	TL	TW	TL	TW
1980	15	2.2	21	2.1	84	9.2
1981	14	1.6	16	1.6	45	5.6
1982	12	1.7	8	1.5	28	6.9
1983	11	1.6	4	1.3	31	6.6
1984	15	1.6	12	1.0	65	6.4
Mean ± SE	13±1	1.8±.1	12±3	1.5±.2	51±11	6.9±1.3
(CV)	(14)	(16)	(56)	(28)	(47)	(19)

	IMPROVED GRASSLAND RANGE					
Intensity:	MG		MHG		HG	
Year	TL	TW	TL	TW	TL	TW
1980	123	16.0	258	25.0	171	15.2
1981	85	15.3	144	20.9	195	17.0
1982	61	12.5	28	21.5	85	27.9
1983	123	12.1	65	22.8	205	22.6
1984	160	13.4	215	19.2	272	24.5
Mean ± SE	110+17	13.9+.8	142+44	23.7+1	186+30	23+1.8
(CV)	(35)	(12)	(69)	(10)	(36)	(17)

[a]Moderate grazing (MG), moderately heavy grazing (MHG) and heavy grazing (HG).
[b]Turnoff of feeder lambs (TL) and turnof of grease wool (TW)..pa

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.

	Performance Variable[a]					
Source of Variation	WW	FW	LC	EM	TFL	TGW
Range Subtype (RS)	NS	NS	NS	NS	***	**
Stocking Rage (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	****	****				

[a]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
* = $P < .05$
** = $P < .025$
*** = $P < .01$
**** = $P < .005$