

# The Effects of Grazing Intensity on Annual Vegetation

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## Abstract

Pastures grazed by sheep at moderate and 1½-, 2-, and 2½-times the moderate stocking rate from 1969-1973 were analyzed for relative changes in cover, herbage productivity, and botanical composition. All four pastures were less productive in 1973 than in 1969, but exhibited similar trends in cover and botanical composition regardless of grazing intensity. Only grazing at 2½ times the moderate stocking rate produced a residual decline in productivity following 1 year of rest from the grazing treatment. However, this decline in productivity was managerially negligible compared to other stocking rates, and would probably disappear within 2-3 years in response to the overriding influence of annual weather, especially precipitation, patterns.

Hormay (1944) suggested that moderate stocking rates provided the best grazing technique in the annual type. Old vegetation left on the ground at the end of each grazing season would enhance soil fertility, provide progressively improved range condition, and ultimately promote high livestock weight gains. Grazing either greater or less than this moderate level would produce changes in both total herbage productivity and relative botanical composition. Heady (1958) postulated that grazing occurred first on taller plant species, thereby increasing the relative proportion of shorter plant species. Alternatively, complete elimination of grazing animals encouraged taller annual plants relative to short plant species. Talbot et al. (1939), Talbot and Biswell (1942), and Jones and Evans (1960) all found that exclusion of grazing animals quickly led to grass dominance, particularly taller species, such as ripgut (*Bromus rigidus*). Biswell (1956) held the opinion that this increase in ripgut occurred at the expense of true clovers (*Trifolium* spp.) and bur-clover (*Medicago hispida*), with plant succession proceeding from forbs to soft chess (*Bromus mollis*), to wild oats (*Avena* spp.) to ripgut.

Biswell (1956) hypothesized that the impact of grazing on botanical composition in the annual type operated primarily by altering the accumulation of mulch. Heady (1958, 1961) supported Biswell's hypothesis by demonstrating that mulch exceeding 700 pounds per acre in Northern California encouraged taller grasses such as soft chess and ripgut. With no mulch accumulation small, unpalatable forbs such as goldfields (*Baeria chrysostoma*), smooth cat's ear (*Hypochoeris glabra*), and owl's clover (*Orthocarpus erianthus*) proliferated. With small amounts of mulch, diminutive, low-forage-value grasses such as little quaking grass (*Briza minor*) and silver hairgrass (*Aira caryophyllea*) abounded. Annual fescues (*Festuca* spp.)

and nitgrass (*Gastridium ventricosum*) peaked in percent botanical composition with intermediate amounts of mulch, while filaree (*Erodium* spp.) was not significantly influenced by varying amounts of mulch.

The amount of mulch present during germination exerts a major influence on total herbage productivity as well as botanical composition. Hooper and Heady (1970), at the Hopland Field Station in Northern California, discovered that removing all mulch prior to germination drastically reduced subsequent forage production compared to sites where mulch was not removed. Importantly, a single manipulation stimulated this response, and a moderate amount of mulch produced maximum herbage productivity.

Although mulch influences botanical composition and herbage productivity of the annual type within a particular growing season, these differences are temporary and tend to persist only so long as the grazing and/or clipping treatments are maintained. At the San Joaquin Experimental Range, both Talbot and Biswell (1942) and Bentley and Talbot (1951) noted no pronounced, long-term effects in total yield as a result of grazing at both light and heavy stocking rates. However, these results cannot be readily applied to other areas in the annual type where forage production potentials are confounded by local seasonal variability and/or microsite differences (Biswell 1956; Heady 1961; Smith 1970). Rossiter (1966) concluded that such microsite variabilities accounted for the lack of quantitative data describing the long-term impact of stocking rates on productivity and botanical composition throughout much of the annual type. This paper provides data describing the residual impact of grazing on annual vegetation occurring in the coastal mountain ranges of Northern California.

## Location and Methods of Study

The study was conducted at the Hopland Field Station located in Mendocino County in the central portion of the coast mountain ranges. The climate of the area is subhumid to humid mesothermal. The winters are mild with occasional frost in valley bottoms, and infrequent, light snow at higher elevations. The average annual rainfall is 89 cm with virtually no rain falling between June and September. Fog occurs frequently in valley bottoms during late fall, winter, and early spring, and occasionally during the summer. Average summer and fall temperatures range from 20-25°C (Pitt 1975).

The pastures used in this study were initially fenced in 1953 to investigate the impact of continuous versus rotational grazing on both animal performance and vegetational response (Pitt 1975). Beginning in 1961, these pastures enclosing approximately 11 ha each were calibrated to equalize grazing intensity. Equal grazing intensity among pastures S1, S2, S3, and S7 occurred when: (1) lamb weights at 120

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days were similar in all pastures, and (2) equal ewe weight loss at the end of the dry period occurred in all pastures.

The following grazing treatments existed in the summer of 1962: S1, S3, and S7 contained 13 sheep, while S2 supported 20 sheep. These pastures operated on a yearlong basis throughout the calibration period during which time numbers of animals were adjusted in each pasture to obtain as near equal gains and losses as possible per individual among all pastures. This grazing intensity was on the heavy side of stocking so that animals were under stress and their weights reflected pasture effects rather than effects due to inherent properties of individual animals. The number of sheep in each pasture at the end of the calibration period in the summer of 1964 constituted a standard stocking intensity for all future experiments.

The study investigating effects of different grazing intensities on annual vegetation began in the 1968-1969 grazing season. The calibrated stocking rate continued in pasture S3, while 1½-, 2-, and 2½-times the previous calibrated stocking rates were introduced into pastures S1, S7, and S2, respectively. All pastures were grazed on a continuous yearlong basis with the same animals, insofar as possible.

Vegetation was sampled twice each year: once at the beginning of the growing season in the fall of each year, and again at the end of the growing season in June. Each pasture contained 24 sampling locations consisting of a 1-m diameter wire mesh enclosure and an outside stake. Each enclosure occurred in a homogeneous sampling unit approximately 8 m in diameter. Enclosure and associated outside stakes were moved prior to each fall sampling date to a different but vegetationally similar spot within this sampling unit. Changes noted in botanical composition or herbage productivity throughout the course of the study were therefore not the result of repeated sampling of the same location.

Herbage productivity of each pasture was estimated by clipping a square plot 0.099 m<sup>2</sup> in size (1 ft<sup>2</sup>) to ground level at each sampling location, while botanical composition, cover, and height of annual vegetation were estimated with 30 points taken with a 10-point frame. All of these parameters, both inside and outside the enclosures, were estimated at the June sampling date, while only outside herbage productivity was measured at the fall sampling date.

Tables 1, 2, 3, and 4 summarize data collected in pastures S3, S1, S7, and S2, respectively. Only those values for ungrazed June vegetation are listed. Vegetational parameters measured in June, the end of the growing season, characterize the yearly response of annual vegetation to each associated animal stocking rate. Measurements in ungrazed vegetation characterize the carryover effect of stocking rate from one year to the next. Since the cages are moved each year, ungrazed vegetation reflects the residual impact of stocking rate 1 year following removal of grazing. Alternatively, measurements in grazed vegetation primarily reflect vegetational variability within a single growing or grazing season and may not indicate the impact of stocking rate over time. Ungrazed June vegetation in 1969 represents baseline values and not the result of any stocking rate treatments. Ungrazed June vegetation in 1973 represents values resulting from 4 years of stocking rate treatment followed by 1 year of rest.

Table 5 summarizes results from a two-way analysis of variance analyzing the impacts of stocking rate and yearly variability on herbage productivity, cover, and botanical composition. Ungrazed June vegetation in 1969 was not subjected to any grazing treatment. Therefore, only 4 years of data, ungrazed June vegetation for the years 1970 through 1973 inclusive, were used in this analysis. Many researchers have described the dramatic impact of yearly weather patterns on annual vegetation (Talbot et al. 1939; Bentley and Talbot 1951; Heady 1956; Heady 1958; Naveh 1967; McNaughton 1968; Hooper and Heady 1970; Murphy 1970; Duncan and Woodmansee 1975; Pitt 1975). These studies all indicate that observed trends in standing crop, cover, and botanical composition in annual vegetation may be the result of annual weather patterns as well as stocking rate treatments. Therefore, the impacts of stocking rate, yearly variability, and particularly the

**Table 1. Average percent botanical composition, cover (%), and standing crop (g/m<sup>2</sup>) on pasture S3, 1969-1973. Grazed at the moderate stocking rate.**

Plant species	1969	1970	1971	1972	1973
<i>Aira caryophylla</i>	10.5	10.9	13.6	28.4	29.5
<i>Avena barbata</i>	3.1	3.8	5.0	5.6	0.3
<i>Bromus mollis</i>	18.3	19.6	14.9	19.4	30.9
<i>Bromus rigidus</i>	1.3	3.1	0.0	2.1	3.7
<i>Bromus rubens</i>	1.8	1.5	0.0	1.3	0.5
<i>Festuca</i> spp.	3.5	6.9	2.5	7.4	4.4
<i>Gastridium ventricosum</i>	0.4	1.4	1.3	0.6	0.5
<i>Hordeum</i> spp.	1.3	0.0	0.0	0.0	0.0
Other annual grasses	0.4	2.8	2.6	1.4	1.7
Perennial grasses and grasslike plants	2.2	0.0	4.3	1.7	0.0
<i>Medicago hispida</i>	0.0	0.0	0.0	0.0	0.0
<i>Trifolium</i> spp.	12.7	7.2	12.6	3.8	12.1
<i>Vicia</i> spp.	0.0	0.0	0.0	0.0	0.0
Other legumes	1.8	5.3	4.0	2.6	2.9
<i>Baeria chrysostoma</i>	0.4	0.7	0.0	0.5	1.3
<i>Carduus pycnocephalus</i>	0.0	0.0	0.0	0.0	0.5
<i>Daucus pusillus</i>	5.7	1.5	3.6	4.1	2.2
<i>Erodium</i> spp.	20.0	18.3	11.7	8.5	3.0
<i>Geranium</i> spp.	0.9	0.6	0.5	0.3	0.0
<i>Hypochoeris glabra</i>	2.6	4.0	2.8	3.0	2.0
Perennial forbs	3.9	6.2	1.8	2.6	0.5
Other early annual forbs	6.6	2.3	10.2	6.7	3.7
Other late annual forbs	2.6	2.7	2.2	0.0	0.3
Cover	31.8	36.2	40.1	66.9	75.3
Standing crop	226.0	168.9	201.2	167.9	202.3

**Table 2. Average percent botanical composition, cover (%), and standing crop (g/m<sup>2</sup>) on pasture S1, 1969-1973. Grazed at 1½ times the moderate stocking rate.**

Plant species	1969	1970	1971	1972	1973
<i>Aira caryophylla</i>	14.5	0.6	13.8	41.1	31.4
<i>Avena barbata</i>	0.8	0.0	0.4	1.3	0.0
<i>Bromus mollis</i>	20.0	33.2	12.2	19.2	22.4
<i>Bromus rigidus</i>	0.0	1.4	0.0	0.0	0.2
<i>Bromus rubens</i>	3.4	10.3	8.4	7.4	2.7
<i>Festuca</i> spp.	1.3	2.2	3.0	6.2	2.3
<i>Gastridium ventricosum</i>	0.4	1.3	2.4	1.6	0.7
<i>Hordeum</i> spp.	0.0	0.0	0.0	0.0	0.0
Other annual grasses	0.4	0.0	0.0	0.3	0.0
Perennial grasses and grasslike plants	0.0	0.0	0.0	0.0	0.0
<i>Medicago hispida</i>	1.7	1.4	1.0	0.0	1.9
<i>Trifolium</i> spp.	23.8	17.2	17.2	5.3	13.9
<i>Vicia</i> spp.	0.0	0.0	0.0	0.0	0.0
Other legumes	4.3	2.8	7.7	2.7	4.7
<i>Baeria chrysostoma</i>	0.0	0.0	0.0	0.0	0.0
<i>Carduus pycnocephalus</i>	0.0	0.0	0.0	0.0	0.0
<i>Daucus pusillus</i>	4.3	2.2	6.3	5.9	2.5
<i>Erodium</i> spp.	16.6	16.1	8.8	1.6	5.6
<i>Geranium</i> spp.	0.4	0.0	1.6	1.2	1.0
<i>Hypochoeris glabra</i>	0.8	1.7	2.6	1.0	2.0
Perennial forbs	0.0	0.0	0.0	0.0	0.0
Other early annual forbs	5.1	3.9	13.5	5.3	8.5
Other late annual forbs	0.4	0.0	0.0	0.0	0.0
Cover	32.6	32.1	34.8	57.2	66.4
Standing crop	119.4	108.7	122.7	83.9	92.5

interaction of stocking rate and yearly variability must be evaluated carefully. Stocking rates were calibrated in terms of animal response. Tables 1 through 4 indicate that standing crop and botanical composition at the beginning of the study in 1969 varied tremendously among pastures. Therefore, a statistically

significant result for the main effect of stocking rate may reflect inherent pasture differences rather than variable responses to stocking rate. Indeed, only statistically significant interactions between stocking rate and year suggest a long-term response of annual vegetation to stocking rates. This response has truly

**Table 3. Average percent botanical composition, cover (%), and standing crop (g/m<sup>2</sup>) on pasture S7, 1969-1973. Grazed at 2 times the moderate stocking rate.**

Plant species	1969	1970	1971	1972	1973
<i>Aira caryophylla</i>	10.9	4.2	18.1	37.7	28.3
<i>Avena barbata</i>	0.3	0.0	0.3	0.4	0.0
<i>Bromus mollis</i>	11.3	18.7	3.9	11.0	12.7
<i>Bromus rigidus</i>	0.7	1.2	0.0	0.0	0.0
<i>Bromus rubens</i>	1.0	0.3	0.4	0.0	0.2
<i>Festuca</i> spp.	9.6	10.9	11.3	10.2	13.1
<i>Gastridium ventricosum</i>	2.0	0.8	4.4	6.6	1.0
<i>Hordeum</i> spp.	0.7	0.3	0.0	0.0	0.0
Other annual grasses	1.3	0.7	0.8	0.2	0.6
Perennial grasses and grasslike plants	0.3	0.0	0.7	0.5	0.5
<i>Medicago hispida</i>	2.6	1.3	4.8	0.2	1.3
<i>Trifolium</i> spp.	8.9	5.8	6.7	2.6	12.8
<i>Vicia</i> spp.	0.0	0.0	0.0	0.0	0.0
Other legumes	0.3	0.7	0.5	1.5	0.4
<i>Baeria chrysostoma</i>	3.3	1.8	0.8	4.3	4.2
<i>Carduus pycnocephalus</i>	0.0	0.0	0.3	0.0	0.0
<i>Daucus pusillus</i>	2.6	0.6	2.7	0.5	0.9
<i>Erodium</i> spp.	31.1	37.5	11.9	12.1	11.5
<i>Geranium</i> spp.	0.7	0.0	0.9	0.0	0.9
<i>Hypochoeris glabra</i>	5.6	4.0	6.3	6.1	4.0
Perennial forbs	0.7	0.0	0.0	0.2	0.2
Other early annual forbs	4.6	11.1	15.1	5.6	7.2
Other late annual forbs	1.3	0.0	0.5	0.2	0.0
Cover	41.9	39.3	38.7	73.6	83.5
Standing crop	361.6	260.4	274.4	182.9	198.0

**Table 4. Average percent botanical composition, cover (%), and standing crop (g/m<sup>2</sup>) on pasture S2, 1969-1973. Grazed at 2½ times the moderate stocking rate.**

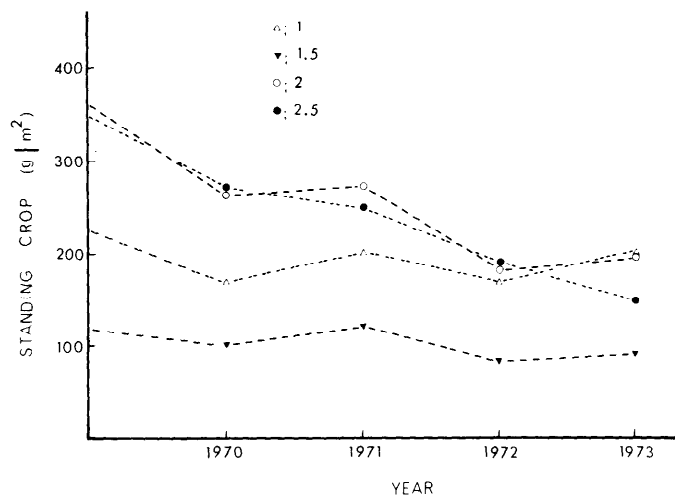
Plant species	1969	1970	1971	1972	1973
<i>Aira caryophylla</i>	4.1	12.6	22.6	45.8	34.5
<i>Avena barbata</i>	16.4	3.5	0.3	0.0	0.0
<i>Bromus mollis</i>	15.4	21.2	10.3	24.2	18.2
<i>Bromus rigidus</i>	2.7	0.2	0.7	0.0	0.0
<i>Bromus rubens</i>	6.5	0.0	0.6	0.3	1.0
<i>Festuca</i> spp.	6.5	11.5	12.9	11.0	7.5
<i>Gastridium ventricosum</i>	0.0	0.2	1.5	0.7	0.5
<i>Hordeum</i> spp.	0.0	0.0	0.0	0.0	0.0
Other annual grasses	2.4	1.4	2.1	0.4	0.7
Perennial grasses and grasslike plants	0.0	0.0	0.0	0.2	0.2
<i>Medicago hispida</i>	2.0	0.0	0.0	0.2	0.0
<i>Trifolium</i> spp.	15.7	12.9	12.8	3.3	10.6
<i>Vicia</i> spp.	0.0	0.0	0.0	0.0	0.0
Other legumes	3.8	8.8	5.2	1.2	3.2
<i>Baeria chrysostoma</i>	0.0	0.0	0.0	0.0	2.1
<i>Carduus pycnocephalus</i>	0.0	0.0	0.3	0.0	0.0
<i>Daucus pusillus</i>	5.1	0.2	4.3	0.9	3.5
<i>Erodium</i> spp.	14.0	22.7	9.5	3.5	7.7
<i>Geranium</i> spp.	0.7	0.0	0.9	1.4	1.3
<i>Hypochoeris glabra</i>	0.3	0.5	2.1	1.3	3.3
Perennial forbs	1.0	0.0	0.0	0.2	0.0
Other early annual forbs	2.7	3.3	11.9	4.0	5.8
Other late annual forbs	0.7	0.7	1.2	0.5	0.0
Cover	40.7	53.2	44.2	77.8	81.5
Standing crop	349.8	273.4	251.8	193.7	149.6

occurred only if the trends in ungrazed June vegetation differ among pastures throughout the course of the study.

### Grazing Effects

Only five plant groups including standing crop, cover, nitgrass, burclover, and filaree produced interactions between grazing levels and year of treatment that were significant at  $p < 0.10$ . All other plant groups responded similarly to each grazing treatment throughout the study period.

Fig. 1 illustrates the impact of grazing intensity on total standing crop attained in June following 1 year of rest. Herbage productivity in pastures grazed at the moderate level (S3) and 1½ (S1), and 2 (S7) times the moderate stocking rate followed virtually identical patterns during each year of the study.



**Fig. 1. Influence of moderate (1), 1½- 2-, and 2½-times the moderate stocking rate on standing crop (g/m<sup>2</sup>), 1969-1973.**

Standing crop in all 3 pastures decreased from 1969 to 1970, increased the following year, declined from 1971-1972, and increased again following the final year of treatment. Only the grazing treatment at 2½ (S2) times the moderate stocking rate produced a downward trend in standing crop during all years of the grazing treatment. Pasture S2 was the most productive (394 g/m<sup>2</sup>) pasture in 1969, but supported only 149.6 g/m<sup>2</sup> in 1973. Pasture S7, grazed at twice the moderate stocking rate, experienced a smaller decline in productivity, falling from 361.0 g/m<sup>2</sup> in 1969 to 198.0 g/m<sup>2</sup> in 1973. Standing crop in the pastures grazed at both the moderate and 1½ times the moderate stocking rate remained approximately equal at the beginning and the end of the study. Herbage productivity in pasture S3 equaled 226.0 and 202.3 g/m<sup>2</sup> in 1969 and 1973, respectively, while pasture S1 supported 119.4 g/m<sup>2</sup> in 1969 and 92.5 g/m<sup>2</sup> in 1973. All four pastures were less productive in 1973 than they were in 1969. However, much of this decline in productivity probably resulted from poorer growing conditions at the end than at the beginning of the study. Pastures S3, S1 and S7 exhibited identical trends in standing crop regardless of grazing intensity, suggesting an overriding influence of changing weather patterns. Apparently only the very heavy grazing in Pasture S2, stocked at 2½ times the moderate stocking rate, produced a residual decline in standing crop following 1 year of rest from the grazing treatment.

Changes in herbage cover (Fig. 2) support this conclusion that only very heavy grazing produces residual impacts on annual vegetation. Yearly trends in percent cover, although significant at  $p < 0.01$ , were remarkably similar in pastures S3, S1, S7, and S2. Again, only pasture S2, grazed at 2½ times the moderate stocking rate, produced any relative reduction ( $p < 0.05$ ) in percent cover as a result of grazing intensity. However, even this decline was unimportant in absolute terms

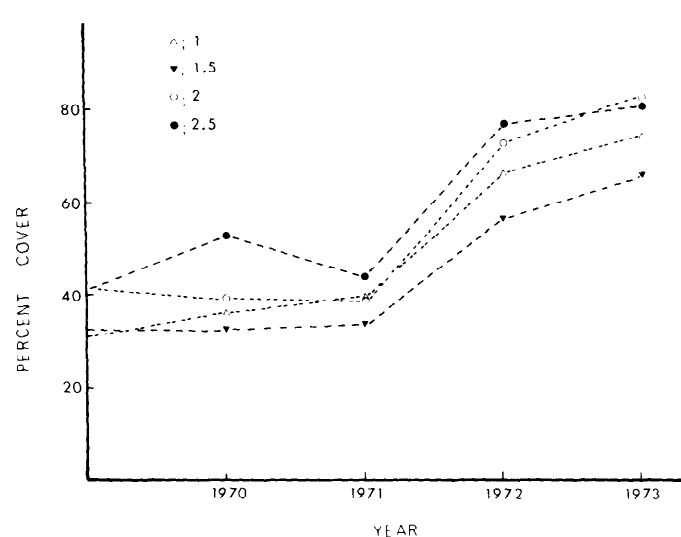


Fig. 2. Influence of moderate (1), 1½-, 2-, and 2½-times the moderate stocking rate on percent cover, 1969-1973.

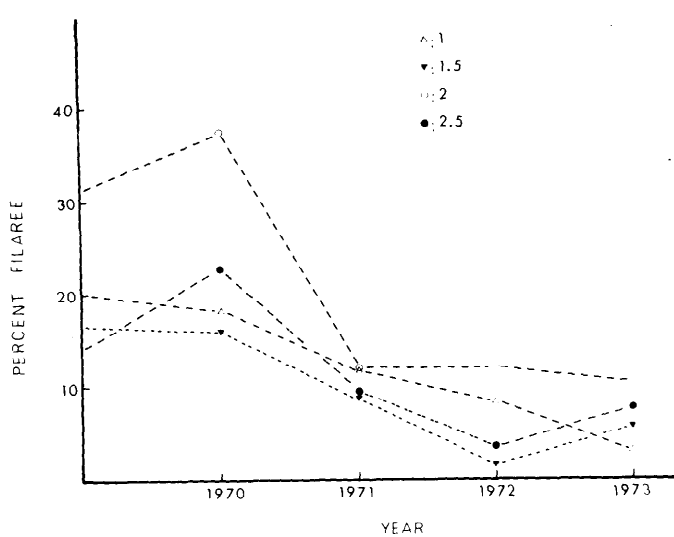


Fig. 3. Influence of moderate (1), 1½-, 2-, and 2½-times the moderate stocking rate on proportion of filaree (*Erodium spp.*), 1969-1973.

as cover in S2 increased from 40.7 to 85.5% during the study period.

Any changes in standing crop and percent cover must be associated with corresponding changes in botanical composition. Both nitgrass ( $p < 0.01$ ) and bur-clover ( $p < 0.10$  in Table 5) produced significant interactions between grazing intensity and yearly variability. However, nitgrass comprised only a very small portion of the vegetative cover, averaging 0.5, 0.7, 1.0, and 0.5% in June 1973, in pastures S3, S1, S7 and S2, respectively. The significant interaction for nitgrass resulted primarily from the exceptionally high value of 6.6% botanical composition in pasture S7 in June of 1972. However, this unique value for nitgrass probably arose from some factor other than grazing intensity, as all pastures supported small proportions of nitgrass both at the beginning and the end of the study.

Bur-clover, like nitgrass, comprised only small proportions of the vegetative cover in all pastures throughout the study period (Tables 1-4). Therefore, statistically significant interactions for these two plant species between grazing and year of treatment cannot explain the relative changes in herbage productivity and cover observed in pasture S2. These changes can be explained only by associated changes for plant species such

as filaree and soft chess, which composed significant portions of the total vegetative cover on the sheep/deer pastures.

Filaree, a successional plant species, commonly occupies disturbed or heavily grazed sites. Conversely, this plant species declines on undisturbed or lightly grazed areas where taller annual plant species are favored. These relationships are illustrated by Figure 3 ( $p < 0.05$  in Table 5). Percent botanical composition for filaree declined in all four pastures from 1970-1972, indicating that filaree probably responded more to changing weather patterns than to different grazing intensities. From 1972 to 1973, however, filaree increased in all pastures except S3, which was grazed at the lightest stocking rate. Apparently, weather patterns during the last year of study initiated an increase in percent composition for filaree except in areas (pasture S3) where moderate grazing and relatively undisturbed conditions discouraged the growth of filaree.

In contrast to filaree, soft chess typically increases in response to undisturbed conditions and subsequent accumulating mulch. From 1970-1972, percent botanical composition of soft chess followed identical directional trends in all four pastures (Fig. 4). Like filaree, however, soft chess displayed different trends among grazing treatments during the last year of study. Only the heaviest stocking rate (pasture S2) produced a

Table 5. Summary of the impact of grazing intensity on botanical composition and standing crop at the Hopland Field Station, 1970-1973.

	Ai Ca <sup>1</sup>	Av Ba	Br Mo	Br Ri	Br Ru	Fes	Ga Ve	Hor
Stocking Rate (S)	***2	****	****	****	****	****	****	
Year (Y)	****		****	*			****	
S × Y			*		*		****	
	Ann G	Per G	Me Hi	Tri	Leg.	Ba Ch	Ca Py	Da Pu
Stocking Rate (S)	****	*	****	****	****	****		****
Year (Y)			*	****	*	***		***
S × Y			**		*			
	Ero.	Ger	Hy Gl	P Fbs	E A Fb	L A Fb	Cover	S. Crop
Stocking Rate (S)	****		****	****	***	****	****	****
Year (Y)	****	**			****	**	****	****
S × Y	***						***	***

<sup>1</sup> Symbols for plants and plant categories as given in Tables 1-4.

<sup>2</sup> \*\*\*\* = significant at  $p < 0.01$ .

\*\*\* = significant at  $p < 0.05$ .

\*\* = significant at  $p < 0.10$ .

\* = significant at  $p < 0.20$ .

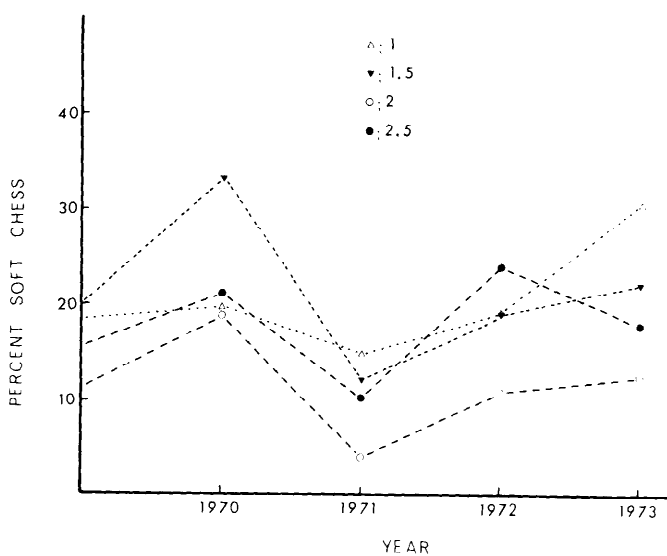


Fig. 4. Influence of moderate (1), 1½-, 2-, and 2½-times the moderate stocking rate on proportion of soft ches (*Bromus mollis*), 1969-1973.

decline in botanical composition for soft ches, which increased in all other pastures. Moreover, the most dramatic increase for soft ches for the period 1972-1973 occurred in the moderately grazed pasture S3, which produced the only observed decline for filaree during this same year.

### Conclusions

Soft ches and filaree occupy climax and intermediate stages of plant succession, respectively. From 1972-1973 these two plant species displayed opposite trends in botanical composition as a function of earlier grazing intensity. Soft ches increased in response to moderate grazing pressure (pasture S3) but decreased in response to heavy grazing pressure (pasture S2). Conversely, filaree declined under moderate stocking while increasing under heavy stocking rates. These results indicate that extremes of grazing intensity can produce residual impacts on botanical composition of soft ches and filaree for at least 1 year following removal of grazing animals. These residual impacts are consistent with the successional stages of soft ches and filaree and may result from the influence of different levels of mulch on germination and subsequent growth. However, mulch accumulation as a function of grazing intensity does not exert as much influence on botanical composition as do variable weather patterns. From 1970-1972, both filaree and soft ches responded similarly among all four pastures regardless of grazing treatment. Thus, grazing intensity only infrequently exerted a 1-year residual impact on botanical composition. Even this residual impact, because of the more significant influence of annual weather patterns on botanical composition of annual vegetation, would rarely last 2 or 3 years.

These same conclusions also apply to cover and herbage productivity, which responded similarly among all four pastures throughout the study period. Although very heavy grazing apparently depressed forage production during the final year of study, absolute productivity differences between moderate and heavy grazing pressures remained managerially insignificant. Moreover, annual variability for both cover and productivity within each stocking rate was more pronounced than the relative differences between stocking rates. Therefore, the residual influences of grazing on cover and total forage production are negligible when compared to these same influences of annual weather patterns. Indeed, following only a single year of rest from grazing animals, both cover and forage production in all four pastures generally responded to annual growing conditions as if no previous grazing treatments existed. Finally, results from this study give further confirmation that the California annual grassland is tolerant to a wide range of stocking rates and degrees of herbage utilization.

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