Seasonal Forage Preferences of Grazing Cattle and Sheep in Western Oregon[1]

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Highlight

On perennial ryegrass–subclover and tall fescue–subclover forage mixtures, grazing cattle preferred grass to clover during the spring–summer period. Sheep selected a consistently high amount of subclover in both pasture mixtures during spring. In summer, sheep preferred tall fescue to subclover but on ryegrass–subclover pastures retained or increased dietary preferences for dry subclover over ryegrass. Light and heavy stocking induced no large differences in forage selection patterns for either cattle or sheep.

The most important forage species for dryland pasture improvement in western Oregon is subclover (*Trifolium subterraneum*). It possesses characteristics of rapid growth, high yielding ability, and superior nutritive value. Although an annual plant, it grows well with perennial grasses such as perennial ryegrass (*Lolium perenne*) and tall fescue (*Festuca arundinacea*), both of which are standard grass species used in pasture improvement in the western Oregon–Washington area.

Knowledge of management of improved forages for grazing by domestic animals logically follows research to determine establishment techniques. Data on animal preferences as related to type of pasture, season, stocking rate, and class of livestock should be collected so that subsequent management decisions are based on sound knowledge of the forage resource.

Both cattle and sheep may express different selectivity patterns while grazing the same forage mixture in common. For example, Meyer et al. (1957) reported that sheep were apparently more selective than cattle on orchardgrass (*Dactylis glomerata*)–trefoil (*Lotus* sp.) and on pure alfalfa (*Medicago sativa*) as attested by the higher total digestible nutrient (TDN) content of sheep diets. Sheep diets contained 3 and 10% more TDN than cattle diets on orchardgrass–trefoil and alfalfa, respectively. The degree of selection between sheep and cattle apparently decreased as forage density increased but sheep selectivity tended to be greater.

Studies of sheep diets in Australia on subclover-type forage indicate no clear-cut preference patterns. Davis (1964) found that subclover was preferred over annual ryegrass (*Lolium multiflorum*) during summer but not during spring. Wilson (1963) reported that sheep preferred grass over subclover with diets apparently more nutritious than total available forage.

Arnold et al. (1966) have conducted dietary evaluation studies on hardinggrass (*Phalaris tuberosa*)-subclover forages in Australia. Sheep tended to select more subclover than available to them in early spring, but on the whole, dietary and forage botanical composition were similar over a two-year period. For annual ryegrass–subclover grazed by sheep, Hodge and Doyle (1967) also found no preference for or against subclover. However, sheep would select up to 50% of the diet as white clover (*Trifolium repens*) when grazing a perennial ryegrass–white clover sward containing only 15% clover.

Grimes et al. (1967) studying sheep preferences when grazing perennial ryegrass, tall fescue, and orchardgrass, with and without white clover, found a slight preference for clover during late spring. On the average, however, diets and forage were similar botanically. During spring, sheep preferred in increasing order these species grown alone: orchardgrass, perennial ryegrass, tall fescue.

Forage species selection patterns for sheep may vary depending upon the grass species growing with subclover. Arnold (1964) stated that sheep

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prefer green material to dry. Grimes et al. (1967) found this to be more true for tall fescue than for perennial ryegrass and orchardgrass. Grazing intensity and the level of soil fertility may have marked effects on the species selected by grazing sheep (Davis, 1964).

In the work reported herein, seasonal (spring–summer) forage preferences were determined for sheep and cattle separately grazing perennial ryegrass–subclover and tall fescue–subclover pasture mixtures in 1964, 1965, and 1966. Dietary crude protein levels and estimates of dietary digestibility as a part of this study are reported elsewhere (Bedell, 1967a; 1967b).

Materials and Methods

The experimental site near Corvallis, Oregon faces northwest on a gentle slope of less than 5%. Two soil series occur on the pasture area, Abiqua-like silt loam upslope from McAlpin-like silt loam. The Abiqua series is relatively shallow (< 24 inches) and well drained, whereas the McAlpin series is deeper and moderately to imperfectly drained. Soil pH is 6.0. Available phosphorous is low; annually 200 lb/acre of single superphosphate (24 lb sulfur and 17 lb phosphorous) have been broadcast applied in fall.

Adjacent 5-acre blocks of Nangeela subclover–Oregon perennial ryegrass (C-R) and subclover–Alta tall fescue (C-F) were each divided into two 2.5-acre pastures in spring 1964. The resulting four 2.5-acre blocks were grazed from April through August with either cattle or sheep. In 1965, each block was split laterally to introduce a change in intensity of grazing. Fresh water and trace-mineralized salt were continuously available.

Pastures were sampled eight times in 1964 and 1966 and seven times in 1965. Sampling occurred at approximately bi-weekly intervals until late June and at monthly intervals during the summer dry period.

Botanical composition of available forage was determined using several techniques. Forage was obtained by clipping randomly-located 2.4 ft^2 sampling rings in each pasture. On the 1st, 5th, 6th, 7th, and 8th sampling dates in 1964, forage was hand-separated, while being clipped, into (1) ryegrass or tall fescue, (2) subclover, and (3) other forage. Botanical composition was determined on each clipped sample in percent by dry weight. On the 2nd, 3rd, and 4th sampling dates when species were growing in intimate mixture, the constituent differential method of determining percent of legume in the mixture using percent dry matter was used (Cooper et al., 1957). Data for the 1965 season were derived from weight estimates, one of four methods used by Pessot (1966) who evaluated four techniques of estimating forage production and botanical composition on the pastures. Weight estimates of production by species were obtained from 25 randomly-located 2.4 ft^2 plots. In 1966, on 10 randomly-located plots per pasture, botanical composition was estimated using the constituent differential method for the first six sampling dates until forage became dry and using the dry weight rank method (Mannetze and Haydock, 1963), one of the methods tested by Pessot (1966), for the July and August dates on 50 randomly-located plots per pasture. All forage botanical composition data are on a percent by dry weight basis. An attempt was made to utilize a laboratory method using microscopic analysis (Heady and Van Dyne, 1965) on clipped forage samples but was unsuccessful due to the large size of the species.

Amount of available forage was determined by weighing clipped samples used in determining botanical composition.

Dietary samples were obtained from esophageal-fistulated yearling beef cattle (Hereford and Hereford X Angus) and mature Willamette and Suffolk ewes. Surgical and sample collection procedures utilizing screen-bottomed canvas bags as outlined by Van Dyne and Torell (1964) were followed. Dietary samples were frozen until analyzed.

Van Dyne and Heady (1965) indicated that cattle and sheep tended to be more selective in the afternoon than in the morning on mature California annual-type range forage composed of many species. Kothmann (1966) suggested the same pattern for certain nutritive characteristics of sheep grazing sagebrush-grass range in Utah. Preliminary work on these pastures suggested little, if any, difference occurring between morning and evening sampling times. Late afternoon-evening sampling patterns were followed.

Length of sampling period was at least three days in all years as suggested by Arnold et al. (1964). Two to four animals were sampled per pasture.

Upon thawing, dietary samples were washed lightly, squeezed between two layers of cheesecloth, and subjected to botanical analysis with a microscopic method adapted from that reported by Heady and Torell (1959) and more recently discussed by Harker et al. (1964); Heady and Van Dyne (1965); and Van Dyne and Heady (1965). Each dietary sample was mixed thoroughly, spread and pressed down in a sheet metal tray and passed beneath a binocular microscope with a cross-hair in one eyepiece. Ingested material was identified by plant species and parts of species after head development. Two hundred observations (points) per sample were recorded and percent species composition, on a point basis, computed. Because of the simple botanical makeup of the available forage, all ingested material was identified.

Differences between forage and dietary percent subclover in 1964 and 1966 and forage and dietary percent perennial ryegrass and/or tall fescue in 1965 were assessed using the paired "T" test (Steel and Torrie, 1960). Analysis of variance of percent subclover or percent grass data in a factorial design determined among-forage and among-dietary differences. Sources of variation were intensity of grazing (not in 1964), class of livestock, pasture mixture, and sampling periods.

Results and Discussion

Although subclover is an annual plant, favorable moisture and temperature most years assures good growing conditions. Subclover germinates following approximately one inch of precipitation in the fall, grows slowly during winter and makes most of its growth in April and May. It flowers in late April after petiole elongation has occurred. Tall fescue remains green year around and growth occurs through the fall months until low temperatures prevail. In contrast, perennial ryegrass is dormant from early July until both moisture and temperature conditions become favorable in September and October. Growth rate of perennial

Table 1. Amount of available forage (lb/acre, ovendry) by grazing treatment, mid-June 1964, 1965, 1966.

Item	1964	1965	1966
C-F, Sheep, Light	6200 (65)[1]	4580 (74)	5800 (121)
C-F, Sheep, Heavy		1550 (190)	4410 (222)
C-F, Cattle, Light	5300 (67)	4830 (36)	3650 (141)
C-F, Cattle, Heavy		1000 (190)	1080 (223)
C-R, Sheep, Light	5560 (62)	1610 (40)	3420 (150)
C-R, Sheep, Heavy		800 (165)	2070 (223)
C-R, Cattle, Light	4270 (64)	2940 (42)	1800 (141)
C-R, Cattle, Heavy		1470 (147)	1190 (200)

[1] Total stocking rate in animal unit days per acre, April–August.

ryegrass effectively terminates after flowering, whereas tall fescue continues at a reduced rate. Tall fescue grows more rapidly than perennial ryegrass and initiates rapid growth earlier in spring. Also, perennial ryegrass in the mature state loses almost one-half of its weight as shattered leaves and seed whereas the comparable loss with tall fescue is approximately one-third.

Precipitation at the study site averages 40 inches annually, the bulk of which occurs as rainfall during October through March. Soils remain near field capacity during April and May; July and August are dry with no appreciable occurrence of moisture.

Growing season conditions differed in each of the three years, however, 1964 and 1966 were more alike than different. Weather during spring 1964 was relatively moist and cool resulting in a normal forage crop. Subclover germination was late in fall 1964 and accompanying low temperatures either killed or frost-heaved germinating clover seeds. An extremely dry spring in 1965 seriously limited growth of surviving clover plants which resulted in a forage crop composed almost entirely of annual grasses and the two seeded perennial grasses. Sufficient hard-seeded subclover remained ungerminated after 1964 to insure adequate clover populations when moisture occurred. Spring precipitation in 1966 was less than normal, which resulted in satisfactory, but not optimum conditions for the two pasture mixtures.

The amount of forage available to grazing animals in the various treatments and the stocking rates were different among years and among treatments (Table 1). The forage crop in 1965 contained virtually no clover and with inadequate spring moisture, production was much less than either 1964 or 1966. Also, the forage growth within ryegrass pastures was more severely limited by subclover absence and spring drought than within tall fescue pastures in 1965.

1964 Season

The seasonal pattern of subclover present in forage is shown in Fig. 1. Analysis of variance of

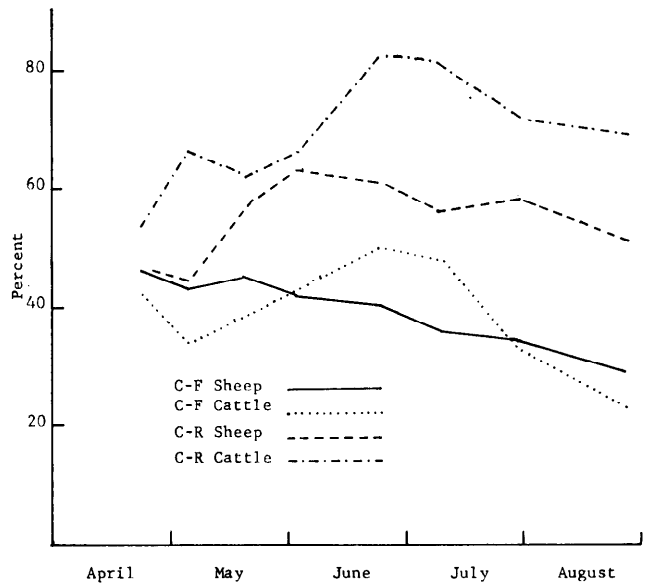

FIG. 1. Percent subclover occurring in forage available to grazing animals, 1964.

percent subclover data revealed significant differences for cattle vs. sheep (.01), pasture mixtures (.01), sampling periods (.05), class of stock X pasture mixture (.01), and pasture mixture X sampling period (.05).

Cattle-grazed pastures contained significantly more (.01) subclover than sheep-grazed pastures. Ryegrass pasture forage contained 22% more (.01) subclover than fescue forage. The average subclover content in all pastures increased from 47% in April to 61% in mid-June and then declined to 43% in August. All pastures had significantly different (.01) percentages of subclover, explaining the class of stock X pasture mixture interaction; the pasture mixture X sampling period (.05) interaction is shown in Fig. 1 by the relative seasonal increase in subclover in ryegrass pastures as opposed to the corresponding decrease in fescue pastures.

Seasonal patterns of dietary subclover are shown in Fig. 2. Sheep on tall fescue pasture selected significantly more (.01) subclover during May and early June than sheep on ryegrass pastures. By early July sheep preferences on tall fescue forage had strongly shifted to the still-green fescue as opposed to an increase in dietary subclover percentage for ryegrass–clover sheep. Seed heads of tall fescue were selected by sheep in late May and by early July had increased to 50% of the diet. However, by early August fescue seed percentage dropped to 6; the high dietary fescue component was largely green leaves. Sheep on dry mature ryegrass–subclover in summer exhibited preferences for dry clover burrs and seed. They did not strongly reject ryegrass until it had matured at

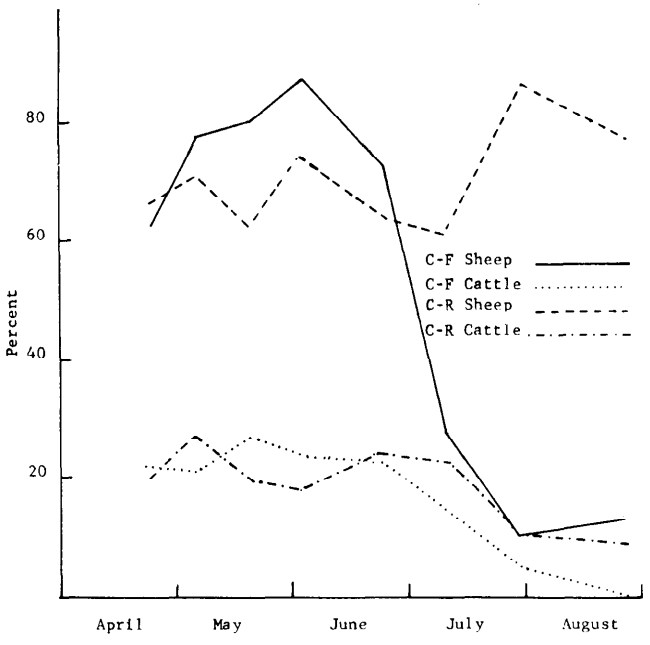

FIG. 2. Percent subclover in diets of cattle and sheep grazing tall fescue–subclover (C-F) and perennial ryegrass–subclover (C-R) pastures, 1964.

which time their preference for dry subclover intensified. Tall fescue did compose about 30% of sheep diets in early April before subclover had started rapid growth. During March and early April tall fescue grows more rapidly than either perennial ryegrass or subclover.

Cattle showed no preference for subclover at any time during the season (Fig. 2 and Table 2). Either tall fescue or perennial ryegrass made up in excess of 75% of the diet during spring and 85 to 95% in summer. Although the stocking rate was low, it is possible that the effect of cattle rejection of subclover contributed to significantly more (.01) subclover in cattle-grazed than in sheep-grazed forage (Fig. 1). Contrarily, sheep on both mixtures preferred more subclover than available to them in the April–June period. This was also true in summer for sheep on ryegrass but not for those on fescue. Arnold (1964) indicated that sheep almost always prefer a green to a dry forage. Apparently, relative succulence of available species plays a large role in sheep preferences.

Table 2. Percent subclover in diets as compared to forage, 1964.

Item	April–June	July–August
C-F Sheep	More**	Less**
C-R Sheep	More*	More**
C-F Cattle	Less**	Less**
C-R Cattle	Less**	Less**

** $P < .01$.
* $P < .05$.

1965 Season

Unfavorable climatic conditions limited subclover to less than 4% of available forage except in the lightly-grazed cattle ryegrass pasture (10%). Data for 1965 show dietary preferences in the relative absence of subclover, as this situation does occur periodically and has practical significance. Annual fescue (*Festuca myuros*) and ripgut brome (*Bromus rigidus*) composed up to 22% of available forage in fescue pastures but increased in ryegrass pastures to as much as 82%. Perennial ryegrass appeared to be in a less favorable competitive position with annual grasses than tall fescue.

Sheep diets on heavily-grazed tall fescue contained significantly more (.05) fescue than those under light grazing during May and early June. Sheep preferred the small amount of subclover and annual grasses to tall fescue but due to stocking rate were forced to consume tall fescue to a significantly greater (.05) extent under heavy grazing. However, during July and August, sheep under both stocking rates selected 90% of their diets as tall fescue.

For cattle grazing tall fescue pastures, few differences occurred in dietary composition between grazing intensities. Tall fescue composed 79 to 98% of the diet under heavy grazing, except that mid-May diets contained 34% annual grasses and 61% fescue. At this same time cattle under light grazing consumed 33% of their diets as fescue; invader perennial ryegrass accounted for 50% of the diet. During summer, no difference existed due to grazing intensity. Tall fescue composed 90 to 98% of diets. The two pastures were greatly different in appearance; under heavy grazing few seed heads appeared and growth was mostly vegetative.

Sheep grazing ryegrass forage exhibited no consistent preference pattern between ryegrass and annual grasses until mid-June. Annual grasses constituted 30 to 50% of diets through mid-June. As annual grasses dried in late June, perennial ryegrass preferences increased to more than 80% of the diets in July. Resident velvet grass (*Holcus lanatus*) made up 19 to 28% of diets in heavily and lightly-grazed pastures, respectively, in early August. This plant retains some greenness in lower leaves during the summer.

Dietary preferences of cattle grazing ryegrass were similar for both grazing intensities. Percentage ratios of ryegrass to annual grass under heavy grazing were 87 : 12 in late April, 68 : 36 in mid-May; 46 : 52 in mid-June, and 85 : 3 in early August. Comparable percentage ratios for light grazing were 94 : 5, 83 : 13, 70 : 22, and 88 : 7. Cattle grazed proportionately more perennial ryegrass than that available to them which contributed to

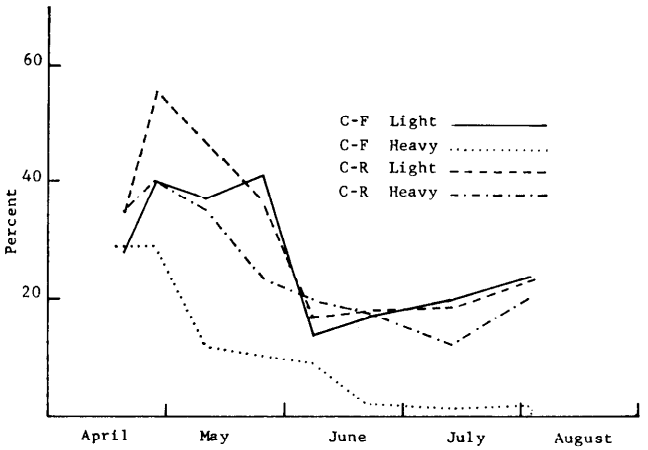

FIG. 3. Percent subclover occurring in forage available to sheep, 1966. LSD_{05} = 11.5% subclover on any one sampling date between any two treatments.

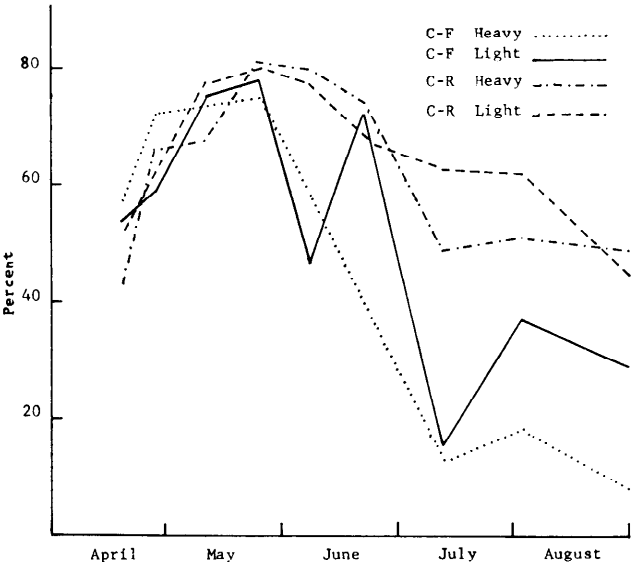

FIG. 4. Percent subclover in diets of sheep, 1966.

relatively high percentages of annual grasses in the total forage, especially during summer.

To compare dietary botanical composition among grazing treatments, percentage dietary perennial grass was tested in analysis of variance. Both sheep and cattle selected a significantly greater (.05) percentage of the major species under heavy as compared to light grazing. Cattle preferences for major perennial grass species exceeded those of sheep on both pasture mixtures (.01). Significantly more (.05) tall fescue than ryegrass occurred in diets. Much of this effect was due to heavy grazing in tall fescue pastures during summer when less opportunity for selection existed (intensity of grazing X pasture mixture; .05).

1966 Season

Favorable conditions occurred for subclover germination and early growth in fall 1965. Most seedlings occurred from hard seed lain over from 1964; the initial clover population for the 1966 season may be considered less than optimum for this reason. Also, low spring 1966 moisture partially accounted for all forage species not achieving maximum production.

Sheep-Grazed Pastures.—Initial forage subclover percentage at the start of the grazing season averaged 31% (Fig. 3). Clover populations in all pastures except fescue heavily-grazed were relatively high until early June. Strong preferences for clover by sheep grazing fescue heavily during April, May and early June accounted for the decline in clover available (Fig. 4). Clover shatters severely when dry to partially account for the percentage decline in early June in the lightly-grazed pastures. However, sheep on ryegrass maintained a relatively high dietary percentage of dry subclover during this time. The relatively high preference for tall fescue by sheep grazing fescue lightly in early June is unexplainable as the same sheep selected 72% of their diet as subclover two weeks later before changing to the summer selection pattern for fescue which was observed in 1964 and 1965. Lessened availability of subclover in the heavily-grazed fescue pasture due to early utilization of this species accounted for the earlier shift to tall fescue. Even so, during summer when in excess of 20% of available forage was dry subclover in the lightly-grazed fescue pasture, sheep expressed a strong preference for fescue leaves.

Sheep on ryegrass pastures preferred significantly more (.01) subclover than available to them throughout the season. This pattern was also observed in 1964 (Table 2). Sheep on both fescue treatments selected significantly more (.01) subclover than contained in forage. This interpretation should be viewed in a practical sense, however, in that limited availability of clover in the heavily-grazed pasture would account for much of this. Statistical interpretation shows that lightly-grazed fescue sheep diets contained similar amounts of clover to that found in the forage during early July and significantly more (.05) during early August. The practical significance, however, is that ryegrass sheep prefer dry subclover to dry ryegrass during summer regardless of grazing intensity, and that sheep on tall fescue will select fescue leaves in preference to dry subclover. Approximately one-half of the summer diet of sheep on heavily grazed ryegrass was perennial ryegrass. The trampling and fouling effect on clover by intensive stocking may have lowered its acceptability.

Cattle-Grazed Pastures.—Forage in cattle-grazed pastures contained similar amounts of subclover as sheep pastures; over the season no significant

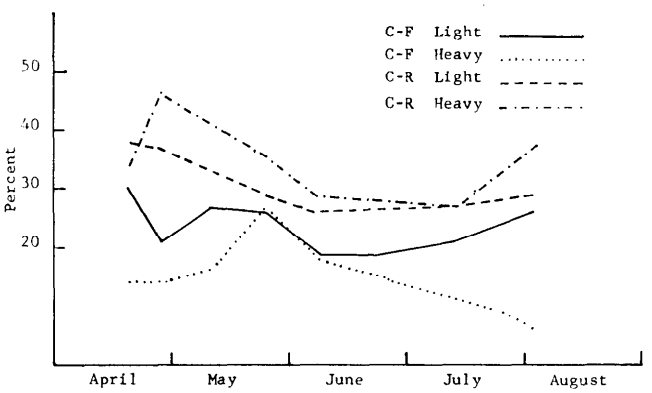

FIG. 5. Percent subclover in forage available to grazing cattle, 1966. LSD_{05} = 11.5% subclover at any one sampling date between any two treatments.

difference occurred in percent forage subclover due to class of stock grazing the forage (Fig. 5). Forage percent subclover in heavily grazed fescue was significantly less (.05) than in other cattle pastures during summer primarily due to cattle grazing pressure although cattle grazing fescue heavily selected less than 20% of their diets as clover from May onward (Fig. 6). Cattle diets were grass-dominant throughout the grazing season. This tended to maintain the subclover portion of the forage near 30%, especially on ryegrass pastures.

Tall fescue plants appear as more discrete entities than do perennial ryegrass plants when both are in mixture with subclover. Thus, when cattle are selecting against subclover in favor of grass it may be expected that diets on ryegrass could contain more clover than those on fescue with a similar degree of selection pressure (Fig. 6). Averaged over the season, percent dietary subclover was 17, 23, 27, and 32 for fescue heavily-grazed and lightly-grazed and ryegrass heavily-grazed and lightly-grazed, respectively. The data seem to suggest relatively easier selection for grass by cattle in fescue–clover as opposed to ryegrass–clover mixtures.

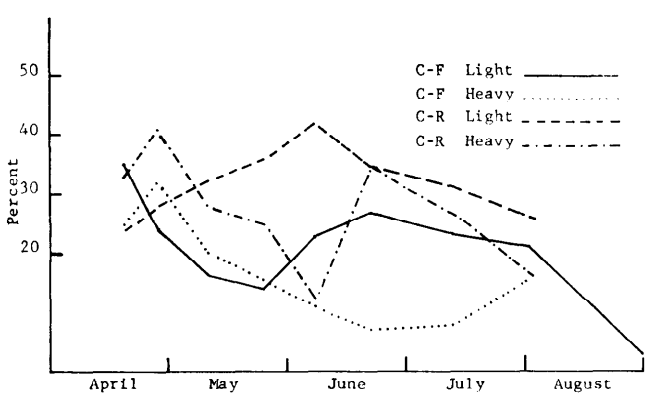

FIG. 6. Percent subclover in diets of cattle, 1966.

Conclusions

When subclover was present with perennial ryegrass or with tall fescue in amounts such that selection for or against it might be exhibited, as in 1964 and in 1966, sheep preferred clover to grass. The single exception existed with tall fescue–subclover during summer when sheep behaved similarly to cattle and selected fescue leaves in preference to dry subclover in 1964 and 1966. When subclover was not available, as in 1965, sheep expressed preferences for annual grasses until plant maturity and then selected for either dry perennial ryegrass or green tall fescue during summer. Cattle preferences remained constant for the major perennial grasses.

More clover was found in dietary samples from ryegrass pastures than from fescue pastures, on the average. However, seasonal differences occurred such that clover preferences by sheep on both pasture mixtures were similar in the spring but different in the summer as explained above. Clover percentage contained in cattle dietary samples was never high but those from ryegrass pastures exceeded those from fescue pastures.

Stocking rate affected dietary preferences relativly more for sheep than for cattle. More clover existed in dietary samples under light stocking than under heavy stocking. For sheep, this appeared to be largely as a result of more rapid early-season depletion of the clover supply in both pasture mixtures. Higher dietary clover preferences existed from late April to late June for sheep; early spring sheep diets contained up to 50% tall fescue or perennial ryegrass. An exception to this occurred under light sheep grazing on ryegrass in 1964 when summer preferences for clover exceeded spring preferences.

Utilization of perennial ryegrass–subclover and tall fescue–subclover forage differs when grazed by sheep or by cattle. Whether grazing animals should be manipulated to best suit the forage conditions or whether the forage should be manipulated to suit animal grazing behavior has not been studied here. Management considerations, however, should be different for sheep and cattle on these two forage mixtures.

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