cows received an average of 15.4 lbs daily of the herd mix concentrate, on the basis of individual cow size and potential production. Milk produced was weighed daily and a two-day composite sample taken weekly for milk fat and solids-not-fat determinations.

No significant differences were found in crude protein, crude fiber, carotene, ash and ether extract in the hay offered (table 1). The C-wafers and the baled hay offered and refused contained approximately the same amount of dry matter during the trial.

Both Jerseys and Holsteins readily accepted the different wafers even when abrupt changes were made at the beginning of each period. The cows were observed to select wafers over fines when both were available.

The crude protein content was higher and the crude fiber content lower in the wafered hay refusals than in that offered, whereas the opposite was true for baled hay—indicating that cows had less tendency to reject the stems in favor of leaves with wafers than with baled hay.

Daily dry matter intake of the wafered alfalfa hay averaged 3½ lbs more per cow than baled hay. As shown in table 2, a significant difference amounting to 2 lbs per cow, was found in daily production of 4% FCM between cows fed A-wafers and baled hay. For C-wafers, a difference of 0.6 lb was not significant. C-wafers were consumed as well as A-wafers, but production was not increased accordingly, compared with baled hay. This indicates that some nutrients may have been lost due to heating which may even have been more obvious in a larger storage volume, where the natural surface drying would have been proportionately less.

There were no effects upon milk fat and average daily gains. The significant difference of the solids-not-fat percentage for the cows receiving A-wafers compared to the other forms of alfalfa hay was obviously too small to be of any importance.

In the last period, when cows fed wafers for three weeks were changed to baled hay, there was a significant drop in daily dry matter intake and FCM yield (table 3). Part of this drop in yield could be attributed to advancing lactation, as indicated in the group receiving baled hay for both three-week periods.

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SOIL ANALYSIS Aids Grazing In Humboldt

D. W. COOPER • H. F. HEADY

ANIMAL GRAZING preferences, soil nitrogen, soil moisture, and herbage production were studied over a seven-year period in Humboldt County in an attempt to explain differential grazing. Animals obviously were selecting and sometimes overgrazing forages on certain soil series more than others. The less preferred areas frequently were undergrazed.

The soil-vegetation survey (the first ecological inventory of wildlands in Humboldt County) served as the guide to soils and locations used in this study. As a basic inventory, it was found indispensable for the range and forest field studies and for implementation of intensive wildland management. This mapped inventory describes the soil series with their variations, associated species in order of abundance, and timber or grass productivity.

Herbage clippings representing total yield were made on nine major grassland soil types once a year in September. These groups of three plots each were protected from grazing by small round wire cages. Sampling points extended across the county in two transects from south to north and from east to west (allowing recognition of changing climatic effects with increasing distance inland from the coast). The yield data are expressed as average oven-dry weights of herbage for the seven-year period, 1957 to 1963 (see graph).

Although many factors contribute to productive capacity of grassland soils, the only two discussed here are: 1. total nitrogen in tons per acre and 2. water storage capacity expressed as the difference between the field capacity and the permanent wilting point converted to inches of water—both to a depth of 4 feet. Corrections were made for density and stoniness of the soil.

Productive capacities of the Humboldt County grassland soils vary considerably. The Zanone, Mattole, and McMahon soil series averaged over 5 tons of herbage per acre. Wilder produced less than a ton per acre. Many of these soils occur locally within areas of similar climate and topography. For example, Wilder and Kinman soils are often found adjacent to each other. Kinman, McMahon, Yorkville, and Laughlin soils may occur in a mosaic of types on the same ridge.

Annual rainfall ranges from 35 to 85 inches and occurs from November to May. Water for growing forage between May and November must be supplied by stored soil moisture. In general, a greater moisture storage capacity was associated with more herbage production. Yorkville and Weitchpec were exceptions. The former is a heavy clay that holds more water than any of the other soils measured. It is intermediate in both herbage production and in total nitrogen in the soil. Weitchpec has a moderately high water-holding capacity and very low nitrogen content.

Total nitrogen content is also indicative of productive capacity. The very high-producing soils have more than 24,000 lbs total nitrogen per acre to a depth of 4 feet. The lowest production was found generally on soils with the least nitrogen. Tyson was one exception with lower production than six other soils, although it had more nitrogen than two of them. Wilder was another exception found to be higher in nitrogen but lower in production than Weitchpec. Low forage production on Wilder was related to very acid conditions and unbalance among other minerals as

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Management County

High forage production occurs on McMahon soil in the foreground, and woodland is shown on Tyson to the right. Ridge in background is on Kinman soil series and has intermediate production.

well as to its low water-holding capacity. Reasons other than nitrogen content and water-holding capacity may also cause a soil to be high or low in forage production. However, knowledge of these two factors permits increased efficiency in the management of grass-producing soils in Humboldt County.

Extensive observation showed that these soils have widely varying grazing preference by cattle and sheep—in decreasing order of preference as follows: Yorkville, Laughlin, Kinman, McMahon, Mattole, Zanone, Tyson, Weitchpec, and Wilder. Deer appear to have about the same preference, except that they select plants on Tyson soil above all others. Cattle and sheep rarely graze on this soil until late autumn if forage is available on others. Quail tend to congregate around or in areas of Wilder soils. This may be related to the opportunity for dusting afforded by the fine texture and dusty nature of this soil.

The three highest-producing soils, Mattole, Zanone, and McMahon, are seldom grazed by deer, and cattle and sheep do not stay on them by choice. When fenced onto these soils and forced to graze them, both cattle and sheep do well. This presents a management problem to the rancher. Fencing is required to keep the animals on some of the high-producing soils without overgrazing preferred types.

Soil series boundaries are irregular, and, as mentioned above, mosaics of several series frequently occur. Fencing and management of each landscape type, therefore, is not economically feasible. However, relatively large blocks of a single soil series do occur and similar soils may be grouped together for pastures of practical sizes. Fencing such units separately gives better opportunity to manage each acre according to its productivity. Management includes grazing control and establishment of various other improvement practices. The soil-vegetation map is a valuable aid in ranch planning.

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HERBAGE PRODUCTION, WATER STORAGE AND NITROGEN DATA FOR NINE SOIL SERIES IN HUMBOLDT COUNTY, 1957 TO 1963.