

THE EFFECT OF THE LEVEL OF WINTERING
UPON THE SUBSEQUENT GRAZING PERFORMANCE OF STEERS

By

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INTRODUCTION

The trend in beef production at the present time is toward fattening and marketing cattle at a younger age. A large portion of the slaughter cattle in the United States are two and three years old and are fattened on grass. These cattle seldom obtain sufficient finish on pasture to grade choice or prime without supplemental summer feeding. These cattle originate primarily in the Appalachian Region, the sandhills of Nebraska, Oklahoma, and other sections of the Great Plains.

In these areas of abundant grass, the greatest expense in the production of beef, excluding the initial cost, is the outlay of cash for winter feed. Obviously, the most economical method of wintering is desirable. However, efficient meat production and efficient use of range involves supplemental feeds. These are supplied during the winter to furnish specific essential nutrients that become deficient in natural vegetation. Thus a plane of nutrition can be obtained that will promote continuous growth and development, a consideration especially important in young animals at the time when the growth rate is potentially greatest and when live weight gains are most economical. In view of these principles, the determination of a satisfactory system of wintering should not be based entirely on dollars spent during the winter period. An important consideration is the level of wintering as it affects the subsequent grazing performance of cattle on pasture during the summer months.

It was with this thought that workers at the Oklahoma Agricultural Experiment Station initiated this experiment. The work was designed to determine: (1) the effect of level of wintering three successive winters upon the performance of three-year-old steers fattened on grass, (2) the

effect of level of wintering two successive winters upon the performance of two-year-old steers fed a limited amount of corn on grass during the second summer grazing season, and (3) the effect of confinement of steers to a relatively small lot during the winter upon the subsequent summer gains on grass.

REVIEW OF LITERATURE

The effect of the level of wintering steers upon their subsequent summer gains has been a subject of investigation of research workers for more than a half century. Studies have been made by personnel at a large number of the Agricultural Experiment Stations and the United States Department of Agriculture. In view of this fact, only the more pertinent experiments conducted with calves, yearlings, two- and three-year-old steers are being reported in this review of literature.

One of the early experiments on this subject was reported by Mumford (1911) who made the following statements after conducting 36 trials with cattle of all ages:

"No one fact is more completely shown in the records of these experiments covering five years with different rations and with cattle of different ages than the condition of the animals at the beginning of the feeding period has a very important influence upon the final result.

"In every case where accurate comparisons could be made, the fatter the animal at the beginning of the feeding period the more grain was required to make a pound of gain.

"Not only was this true but in every single experiment as an animal improved in condition the cost of gains became greater. It seems reasonable to conclude from the results of these investigations that thin animals fed on a ration which will cause rapid gains will, other things being equal, be the most profitable.

"No very great important differences have been discovered between shelled corn and shelled corn supplemented with nitrogenous supplements when fed to cattle grazing on good blue grass pasture for the first three or four months of feeding.

"Age as a factor in beef production--Other things being equal the younger the animal the larger will be the gains in weight from a given amount of food. Two or three year old cattle in thin condition may make gains in live weight from the same or smaller amounts of feed than yearlings or calves in a fat or half-fat condition."

Steer Calves

Ruby and co-workers (1948) made a study to determine the relationship between initial weight and subsequent weights and gains of weaning calves. These data were collected over 28 seasons and represent a total of 959 calves. Results of this study indicated that large winter gains were followed by small summer gains; the regression coefficient of summer gain upon winter gain was -0.22 pound. The variation in total gain was small, indicating that the variations in winter gains were balanced by variations in gains made during the subsequent summer grazing season.

Connell, Wheeler, and Tom (1947) conducted an experiment at the Colorado station to determine the effect of adding 1.0 pound of protein supplement to a roughage ration for wintering calves. The addition of protein concentrate produced an added gain of 85 pounds per head over a non-supplemented group of steers. At the end of the following grazing season the advantage was reduced to 37 pounds. The advantage was further reduced to 30 pounds during the fattening period. They concluded that under conditions of their experiment supplementation was of questionable value if calves were to be carried through a grazing and fattening period.

In three years of experiments with wintering and grazing calves, Brouse (1944) found that the combined winter and summer gain was most profitable when the winter supplements were adjusted to produce from 0.75 to 1.0 pound daily gain per head. A level of wintering which produced gains in excess of these figures was not profitable unless calves were marketed in the spring or early summer.

Black, Quesenberry, and Baker (1936) published data on the effects of wintering calves on different roughages. Cattle that were fed on a high plane of nutrition went into the summer grazing season with a 33 pound weight advantage over calves fed on a low plane of nutrition, but by the end of the summer the advantage had been reduced to 26 pounds. The cost of feed for the two periods was \$0.84 per hundredweight cheaper for the low level of wintering.

Dyer (1950), at the Missouri station, found that the lowest level of wintering used in his experiment was the most satisfactory and economical for calves that were grazed during the summer on grass without supplement and then full fed in the feed lot. This group of calves gained 137 pounds during the winter while other groups of calves made winter gains of 163, 175, and 191 pounds. Cattle in this trial made between 60 and 65 per cent of the total gain on roughage and pasture.

In a series of wintering trials conducted by Arnett and co-workers (1926) the average daily gain of calves during the wintering period was 0.77 and 0.66 pound per day for the calves on a high and low level of feeding, respectively. During the summer the calves on the low level of feeding made greater gains than those on the high level of feeding. The final average daily gain of both groups at the end of the wintering and summer grazing period was 1.01 pounds per day. They concluded that the gains made during the winter rather than the rations fed affect the summer and total gains.

Branaman and co-workers (1942) found that calves wintered to gain 1.87 pounds per head daily followed by grazing until the latter part of August were more profitable than calves wintered to gain 2.22 pounds per head daily and full fed in dry lot or on pasture.

Ross et al. (1947) reported that steer calves wintered at a level to gain 0.96 pound per day made 0.19 pound more daily gain during the first 112 days of the summer grazing season than those steers wintered with an average daily gain of 1.34 pounds. The steers wintered at the lower level made an average daily gain of 0.50 pound during the late summer grazing season as compared to a daily gain of 0.46 pound for those wintered at the higher level. Observations indicated that calves wintered on grass and cottonseed meal so as to gain between 0.50 and 0.75 pound per day produced desirable feeder yearlings at a greater profit than those gaining 1.0 to 1.5 pounds per head daily.

N ✓ Darlow, Taylor, and Campbell (1945) found that calves which were wintered at a medium level (1.0 pound daily gain) were almost as heavy at the end of the summer grazing season as calves which were wintered to gain 1.5 pounds daily. Total winter gains for the two groups of steers were 263 pounds for the well-wintered steers and 190 pounds for the steers in the medium-wintered group. By the end of the grazing season, the well-wintered steers were only 7 pounds heavier than those wintered on the lower plane of nutrition. [Steers that had gained the least during the winter made 32 per cent of their yearly gain during the first 95 days of the grazing period while the high-wintered steers made 21 per cent of their annual gain during this period.] By the end of the grazing season, the medium-wintered steers had made 55 per cent of their total gain on pasture while the high-wintered steers had made 39 per cent of their total annual gain on pasture. Although the well-wintered steers sold for \$0.50 per hundredweight more than the medium-wintered steers, the returns per head were \$4.64 in favor of steers wintered to gain 1.0 pound per day.

Sheets and Tuckwiller (1922) pointed out that the annual profit from feeding calves was determined largely by the winter feed cost as the most economical gains were made on pasture. The calves wintered on the low level made 81 per cent of their total gain on pasture as compared to 69 per cent for the calves wintered on a high level. The total cost per pound of gain was \$0.07 and \$0.09, respectively, for the low and high plane of nutrition.

Waters (1907), at the Missouri station, concluded that gains made on grass were inversely proportional to the amount of fat an animal carried when going on pasture. He also concluded that different methods of wintering should be used for cattle of different ages. Cattle 6 to 18 months of age should be fed a ration above maintenance at all times; after 24 months, maintenance or sub-maintenance rations do not affect them to any great extent.

Guilbert and associates (1944) studied the effectiveness of supplemental feed given at different stages of development. Results indicated that 200 to 300 pounds of supplement per head at early ages produced 100 pounds additional gain. The additional feed during the early period saved about 500 pounds of concentrates and 400 to 500 pounds of harvested roughages which were necessary to make up the differences later in the feed lot.

Taylor (1944) compared two groups of calves that had been wintered to gain 1.0 pound and 1.5 pounds per day. Calves in this experiment attained about the same weight by the following fall irrespective of the level of wintering. At the close of the experiment, the medium-wintered calves that were grazed the entire season weighed 7 pounds less than the well-wintered cattle treated in the same manner during the

summer. The medium-wintered steers that were finally fed in the dry lot after grazing 90 days weighed about 77 pounds less per head when they went to pasture but only 27 pounds less per head than the well-wintered steers when marketed. Results indicated that calves wintered to gain 1.0 pound per day made better use of grass and returned a greater profit than well-wintered steers whether they were grazed throughout the summer or grazed for a short time and then fattened in dry lot.

In a similar experiment, Stephens et al. (1948) found that steer calves wintered to gain 0.48 pound per day made an average daily gain of 1.52 pounds during the first 104 days of the grazing season while calves wintered to gain 1.11 pounds per day gained 1.37 pounds during the same period. Gains for the two groups of steers during the latter part of the grazing period were 0.77 pound daily for the low-wintered steers and 0.31 pound per day for those on the high level of wintering. Total gain for the year was 44 pounds in favor of the steers wintered on the high level. All steers in this trial that were wintered in dry lot lost weight when first turned to pasture regardless of level of wintering. The steers wintered on the range outgained those wintered in the dry lot during the early part of the grazing season, even though the winter rations had been practically the same. Results of this experiment indicated that yearling steers, whether wintered at a high, medium, or low level, reached about the same weight by the end of the grazing season. To produce the most profitable feeder yearlings, a gain of approximately 0.75 pound per head daily was most desirable. Yearling steers that were full fed following the early summer grazing were most profitable when wintered on a high plane of nutrition (average daily winter gain, 1.32 pounds).

Stephens et al. (1949), in a related experiment, made a study of the gains calves should make during the winter to get maximum use of summer pasture. Results indicated that if calves were to be sold in the spring the winter gain should be 1.0 to 1.5 pounds daily. When yearling steers were grazed during the early part of the summer, winter gains of 0.50 to 0.75 pound per day were most satisfactory. When yearling steers were full fed following early summer grazing, winter gains appeared to have little influence on gains made in the feed lot although steers wintered at a high level usually carried more finish.

Wintering calves to gain 1.6 pounds daily and grazing 58 days on grass followed by a full feeding period proved the most satisfactory system of handling calves to get maximum utilization of roughage and pasture in an experiment conducted at the Michigan station by Branaman and Harrison (1947). The second best system in this trial was wintering on a low level and feeding grain on pasture during the entire grazing season.

Smith and Pickett (1949) reported the same average daily gain for all lots of steers although feeding and management varied considerably over a period of more than two years. The carcasses of steers which were wintered at a low level of feeding in their experiment, however, failed to grade as high as those from steers in the well-wintered groups. This indicated that the plane of nutrition over a long period of time had an important influence on the grade of beef produced. Calves wintered to gain 0.75 pound per day and destined to full feeding following the grazing season were found to be more profitable if a protein supplement was supplied the latter part of the pasture season.

Potter and Withycombe (1926) reported the results of ten years of wintering trials with calves and yearlings at the Oregon station. In comparison with the control lot of calves which gained 21 pounds during the winter period, the winter advantage lost during the summer grazing season was 59, 56, 55, and 54 per cent for the lots of calves which gained 63, 115, 162, and 187 pounds, respectively, during the winter period. By the end of the summer period, the winter advantage lost by yearling steers which had gained 48 and 106 pounds was 62 and 60 per cent, respectively, when compared to the control lot of yearlings which had gained 21 pounds during the winter period. They concluded:

"If stock steers are so fed as to make large gains in the winter, they will make smaller gains the following summer on grass. For every extra pound that a steer gains in winter, he will make at least one-half pound less gain the following summer on grass.

"When extra feed is available, it should be given to older steers that will go to the feed lot instead of pasture."

In another comparison of calves and yearlings, McCampbell, Anderson, and Marston (1928) noted that yearlings wintered more efficiently and gained 48 pounds more during the winter than calves when both were fed on a high level, but calves carried over as yearlings on pasture gained 31 pounds more during the summer than the two-year-old steers. During full feeding, both yearlings and two-year-old steers made a greater profit in dry lot than on pasture. Yearlings full fed in dry lot or on pasture made greater average daily gains than two-year-olds fed similarly, which was probably due to the fact that yearlings were not as fat when full feeding started.

Yearling Steers

Black and Mathews (1930) reported a five-year experiment in which the winter gains of high- and low-wintered yearling steers were 190

and 75 pounds, respectively. The total yearly gain made on pasture was 62 per cent for the steers on the low level and 31 per cent for steers on the high level of wintering. The high level steers were 85 pounds heavier at the end of the year, but the cost of the feed for the year was \$12.66 greater for the high-level steers. They concluded that steers making the most winter gains made the smallest summer gains but the greatest total gain for winter and summer. The most economical gains were those made during the summer on pasture.

Black and Clark (1944) conducted a feeding trial in which four lots of steers were wintered. Two of the lots of steers on a high plane of nutrition in a dry lot gained 95 and 125 pounds, respectively, and two wintered on the range lost 29 and 6 pounds, respectively. When turned to summer pasture, the steers which lost the most weight during the winter made the most summer gain and also made 1.0 pound more total gain for the year than the steers wintered to gain 125 pounds and 7 pounds more than the steers wintered to gain 95 pounds. The cost of wintering was 61 per cent and 66 per cent more for the two lots of steers wintered on the high level than for the steers wintered on the range.

Sheets and Tuckwiller (1920) showed that pasture is best utilized by yearling steers wintered on a relatively low plane of nutrition. Steers in this trial that had been wintered to make no gain made 0.34 pound more daily gain during the 160-day grazing season than steers wintered with an average daily gain of 0.48 pound. Although the summer gain of the low-wintered steers was 55 pounds greater, they were 8 pounds lighter at the end of the grazing season than the steers which gained 0.48 pound daily during the winter. Total gain for the year for the high and low level of wintering was 326 and 316 pounds, respectively.

The cost per pound of gain for the year was \$0.07 for both the high and low level of wintering. The cost of wintering a steer was approximately two-thirds the total cost for the year.

McC Campbell and Horlacker (1924) found that different levels of wintering had little effect upon total yearly gains. They concluded that the amount of gain a steer made on pasture during the summer depended on the amount of fat he carried when he went on pasture rather than the kind of feed he had consumed during the winter months. Cattle in this trial made almost as much gain on bluestem pasture during May and June as they did the remainder of the grazing season.

McC Campbell, Anderson, and Marston (1926) pointed out that a high level of wintering (2 1/3 pounds daily) was the most efficient method of wintering lightweight yearling steers that were to be grazed during early summer and full fed in dry lot prior to marketing.

Savage and Heller (1947) made a study of yearling Hereford steers wintered and grazed on the experimental range at Woodward, Oklahoma. The four-year average gain per head was 52 pounds during the winter and 364 pounds during the summer period of 170 days. They pointed out that cattle made their greatest gains during the months of April and May when the grass was young.

Shiple and Headley (1948) published data at the Nevada station on the effects of wintering yearling steers on high and low quality roughages. The cattle wintered on high quality roughage went into the summer grazing season with a 153 pound weight advantage. After 100 days of grazing this advantage was reduced to 70 pounds. This work is additional evidence that cattle making small gains during the winter tend to make up the difference during the subsequent grazing season.

Black et al. (1940) reported a study conducted over a three year period to determine the most efficient methods of feeding a supplement on grass and the effect of supplementation on the quality of beef produced. Yearling steers which graded good as feeders were wintered to gain approximately 0.89 pound per day and divided into equal lots for summer treatment. Results of this work indicated that, under conditions of their experiment, grazing $4\frac{1}{2}$ months followed by feeding $8\frac{1}{3}$ pounds of grain per head daily for 79 days was the most profitable and produced carcasses which graded low good. Supplementing during the entire 135 day period produced carcasses that graded high medium while grazing on grass alone for 135 days produced medium carcasses.

Blizzard and Taylor (1942) conducted an experiment with yearlings that had been wintered to gain approximately 1.30 pounds per day. Results of this work showed that there was only 1 pound difference in final gains of the two lots of steers, one of which was full fed in dry lot immediately after wintering and the other full fed on grass after grazing 90 days. Steers that were grazed 90 days and then full fed made 50 pounds more total gain for both winter and summer but sold for \$0.25 per hundredweight less than full fed steers. All cattle in this experiment returned a profit for the winter and summer periods but steers full fed in dry lot immediately after wintering returned \$1.65 per head more than steers full fed in dry lot after a short grazing season and \$5.74 per head more than the steers full fed on pasture during late summer.

Smith and Pickett (1950) studied the value of supplementing blue-stem pasture with various protein supplements. Steers were wintered to gain from 12 to 51 pounds per head. The total gains for all lots during the grazing season did not indicate a strong response to supplementing

on pasture, but the increased selling price of \$1.00 per hundredweight for supplemented steers made it appear worthwhile.

Willson (1921) reported the results of an experiment conducted with yearlings and two-year-olds over a period of two years at the Tennessee station. He pointed out that the greatest summer gains for each class of cattle were made when there was the greatest winter loss. The greatest gains for the entire year, however, were made when the cattle were fed to make some gain during the winter months. In this experiment, stocker cattle making about 75 pounds per head gain during the winter gave the best results.

Kincaid and Hunt (1945), at the Virginia station, found that there was no significant difference in yearly gain between yearlings and two-year-old steers fed similarly but the latter were significantly fatter; the difference amounting to one-fourth of a carcass grade. Statistical analysis of their work revealed that each pound of winter gain reduced the summer gain 0.58 pound and increased the annual gain 0.42 pound.

Kincaid and Koger (1947), in a similar experiment, reported that two-year-old steers had about 1 per cent higher dressing percentage than yearling steers. Annual gain, carcass grade, and dressing percentage improved as winter gain increased. The regression of summer gain on winter gain was -0.69 pound.

Two- and Three-Year-Old Steers

Hunt (1917) conducted wintering trials with cattle weighing 1000, 1100, and 1200 pounds to determine the proper level of wintering to make the most efficient use of grass the following summer. He pointed out that heavy steers wintered to gain weight did not make the most efficient use of grass. Steers that weigh 1000 pounds should be wintered

to maintain their weight; 1100 pound steers should lose approximately 25 pounds; and 1200 pound steers should lose approximately 50 pounds during the winter period to make the most efficient use of pasture. The kinds and amounts of feeds used during the winter determine to a large extent the success or failure in handling heavy cattle.

Sheets and Tuckwiller (1924), in a wintering and grazing trial with two-year-old steers, reported that 100 pounds advantage in weight at the end of the winter was reduced to 61.6 pounds after 54 days on grass and further reduced to 40.7 pounds after 136 days on grass or a loss of 59.3 pounds of the original 100 pounds winter advantage. They concluded that steers which made greater winter gains made greater total gains for the year when fattened on grass the following summer. The correlation of winter gains on summer gains was 0.43. The steers which made only slight gains or lost weight during the winter made greater summer gains on pasture than steers which made large winter gains. The correlation between winter and summer gains of these steers was -0.57. Since differences in weight due to winter feeding were gradually minimized but not entirely overcome during the summer, it was considered advantageous to winter well the cattle that were marketed early off grass.

Curtis and Peden (1921), at the North Carolina station, conducted feeding trials for three years with two-year-old steers which were wintered on sub-maintenance rations. Average losses during the winter period in the three trials were 50, 40, 29, and 64 pounds for the various groups of steers. Summer gains of these cattle were 337, 336, 340, and 368 pounds, respectively. Cattle that lost the most weight during the winter made the greatest summer gains and produced the most economical gains

for the year. The cost of wintering was approximately one-half the total feed cost for the 12 months period.

Good (1926), at the Kentucky station, reported that two-year-old steers wintered to gain 1.70 pounds daily made 20 per cent greater pasture gains than steers wintered to gain 1.80 pounds per day. The cost of wintering the steers on the low level was 12.5 per cent less than for the steers in the high-wintered group. In an experiment with yearlings fed to gain 1.41 pounds and 0.99 pounds per day, respectively, during the wintering period, the low-wintered steers made 20 per cent more pasture gains. The total yearly gain was the same for both levels of wintering.

Black, Quesenberry, and Baker (1938) reported a three-year experiment which was conducted at Miles City, Montana. They showed that summer range was best utilized by steers wintered on a relatively low plane of nutrition. The three groups wintered at different levels showed no significant difference in weight at the close of the second summer grazing period when they were approximately $2\frac{1}{2}$ years of age. Their average final weights were 1068, 1036, and 1031 pounds per head, respectively, for the heavy, moderate, and light wintering levels. The steers carried on the low level made 94 per cent of their total gain on summer range as compared to 85 per cent for the medium level steers and 74 per cent for those wintered at the high plane. These results suggest that if steer calves are to be developed into two-year-old feeder steers by the use of summer range they should be wintered so as to gain 25 to 50 pounds each during the first winter and kept in a thrifty condition on a plane of nutrition slightly above maintenance during their second winter.

Taylor and Hobbs (1943) conducted an experiment with two-year-old steers that had been wintered to gain approximately 52 pounds per head to determine the value of supplements for fattening on grass. Gains made during April, May, and June were only 12 pounds greater for the steers fed on grass than for the non-supplemented steers. Results indicated that although supplemented steers demanded an increase of \$0.50 per hundredweight over the non-supplemented steers, there was no advantage in supplementing on grass during the entire grazing season.

Ross et al. (1947), at the same station, reported a similar experiment with two-year-old steers that had been wintered to gain 36 pounds per head. Significant differences in rates of gain between lots of steers did not occur until the last 5 weeks. Steers fed 3.2 pounds of corn on grass during the period from April 12 to August 6 were only 24 pounds heavier than the non-supplemented steers but sold for \$2.50 per hundredweight more and produced carcasses that graded approximately one-third grade higher. All steers in this trial returned a profit but steers fed corn during the grazing season returned \$16.82 per head more than the non-supplemented steers.

Three-year-old steers were used by Stephens et al. (1948) in a trial similar to the experiments conducted by Taylor and Hobbs (1943) and Ross et al. (1947). The steers in this trial had been wintered to gain approximately 20 pounds per head. They observed that the gain per steer to July 1 was about the same regardless of ration used. Steers returning the most profit were those which received a protein supplement after July 1 to the end of the period (August 13). The next most profitable steers were those which received supplement during the entire grazing season followed by the steers which were grazed during the summer without supplement.

This increased profit was due to a small additional gain but chiefly to increased selling price.

The majority of the experiments in this review of literature have been summarized by Morrison (1948) and Snapp (1949). They conclude that:

1. The amount of gain desired during the winter depends largely upon the way the cattle are to be handled the following summer.

2. Calves that are being wintered for later fattening must be fed primarily on roughage in order to keep the cost at a minimum.

3. It is seldom advisable to feed calves to gain less than 0.50 pound per head daily during the winter irrespective of their summer treatment.

4. If calves are to be pastured the following summer without grain, it is generally best to feed them so they will gain 0.50 to 1.0 pound per head daily.

5. Yearlings and older stocker cattle should be wintered so as to make some gain in weight; the most desirable amount of gain will depend on the summer treatment.

6. If the maximum profit from cattle is to be obtained from grazing, two-thirds to three-fourths of the total yearly gain should be made from grass.

7. The amount of gain made in the summer varies inversely with the amount of gain made during the winter.

EXPERIMENTAL

Objectives

This study was designed to determine: (1) the effect of level of wintering three successive winters upon the performance of three-year-old steers fattened on grass, (2) the effect of level of wintering two successive winters upon the performance of two-year-old steers fed a limited amount of corn on grass during the second summer grazing season, and (3) the effect of confinement of steers to a relatively small lot during the winter upon the subsequent summer gains on grass.

Procedure

In October of 1948, ninety choice quality Hereford steer calves were selected for this experiment. Most of the calves were purchased from the Moon Ranch owned by Mrs. Dorothy Thompson of Mill Creek, Oklahoma. The remaining calves were selected from the experimental herd at Oklahoma Agricultural and Mechanical College, Stillwater, Oklahoma.

The experiment was conducted at the Experimental Range Area which borders Lake Carl Blackwell, 13 miles west of Stillwater.

Management, Initial Experiment

On November 18, 1948, the calves were divided into nine lots of ten head each. The calves in lots 1, 2, 3, and 4 were wintered in traps at the range. Calves in lots 1 and 2 were wintered at a medium level in the same trap and calves in lots 3 and 4 were wintered at a high level in a comparable trap. These traps were adjoining areas which contained approximately two acres.

Calves in 5, 6, 7, and 8 were wintered in 200-area pastures which provided an adequate amount of dried native grass. Calves in lots 5 and

6 were wintered at a medium level in one pasture and those in lots 7 and 8 were wintered at a high level in a comparable pasture.

Calves in lot 9 were confined to a small trap which was approximately 50 feet by 50 feet.

No shelter was provided during the winter for any of the calves except for those calves in lot 9 which were confined to the small trap. This shelter provided only enough protection to insure a dry place for the calves to lie down.

During the winter period, one steer was removed from lot 2 because of urinary calculi and was replaced in the fall of 1949. The replacement steer was omitted from this study because it had not received the same treatment during the previous winter as other calves in the lot.

On April 6, 1949, all lots of steers were turned together and grazed on pasture at the range area until October 26, 1949, when they were returned to their respective lots for wintering in the traps or on the range.

After the second wintering period, which ended April 28, 1950, steers in lots 1, 3, 5, 7, and 9 were fed approximately 3 pounds of ground shelled corn on grass. One steer in lot 5 disappeared during the early part of this period and was not replaced. The remaining steers in these lots were sold August 28, 1950. The steers in lots 2, 4, 6, and 8 were grazed until October 30, 1950, at which time lots 2 and 4 were returned to the traps and steers in lots 6 and 8 were moved to their winter range. All lots of steers were given the same treatment as they had received during the previous winter.

All steers were turned to pasture on April 29, 1951, and will be sold as grass-fat three-year-old steers at the end of the summer. Results of this phase of the experiment will not be reported in this study.

Accepted managerial practices for the prevention of disease and parasite infestation were followed.

The following records were maintained:

1. Feed consumption.
2. Weight each 28-day period during the winter.
3. Weight each 28-day period during the summer.
4. Cost data.
5. Chemical composition of feeds.
6. Carcass data.

Rations

The daily rations fed to each lot of steers during the three year period are given in tables 1, 2, and 3. All lots of steers were provided, free choice, a mineral mixture which consisted of 2 parts ground rock salt and 1 part steamed bone meal during the entire experiment.

Steers that were wintered in the traps were provided all the native prairie hay that they would consume daily. Hay was provided to the calves wintered on the range only during periods of heavy snowfall.

Little bluestem was the predominating grass in the summer pastures but big bluestem, side oats gramma, buffalo grass, and blue gramma were also found in appreciable quantities. Ample shade was available and each pasture bordered on Lake Carl Blackwell from which the cattle obtained water.

The chemical composition of the various feeds used in this experiment is given in tables 4 and 5.

Management, Second Experiment

A duplication of this study was started in the fall of 1950 with the exception of the lot of calves which were wintered in the small trap.

Table 1. Average Daily Feed Allowance for Each Steer During First Year

Winter Period--November 18, 1948, to April 6, 1949									
Lot	1	2	3	4	5	6	7	8	9
Place	Trap	Trap	Trap	Trap	Range	Range	Range	Range	Small Trap
Level of Wintering	Medium	Medium	High	High	Medium	Medium	High	High	Medium
Daily Ration: (lbs.)									
Pr. Hay	13.34	13.30	12.04	12.04	.40	.40	.39	.39	11.78
Range	-	-	-	-	ad. lib.	ad. lib.	ad. lib.	ad. lib.	-
Oats	-	-	3.02	3.02	-	-	3.02	3.02	-
Cottonseed Cake	1.30	1.30	1.29	1.29	2.06	2.06	2.04	2.04	1.28

Summer Period

All lots of steers were grazed in one pasture from April 6, 1949, to October 26, 1949.

Table 2. Average Daily Feed Allowance for Each Steer During Second Year

Winter Period--October 26, 1949, to April 28, 1950									
Lot	1	2	3	4	5	6	7	8	9
Place	Trap	Trap	Trap	Trap	Range	Range	Range	Range	Small Trap
Level of Wintering	Medium	Medium	High	High	Medium	Medium	High	High	Medium
Daily Ration: (lbs.)									
Pr. Hay	15.87	15.87	15.52	15.52	-	-	-	-	18.52
Range	-	-	-	-	ad. lib.	ad. lib.	ad. lib.	ad. lib.	-
Oats	-	-	3.00	3.00	-	-	3.03	3.03	-
Cottonseed Cake	1.25	1.25	1.25	1.25	2.31	2.31	2.33	2.33	1.25

Summer Period

Steers in lots 1, 3, 5, 7, and 9 were grazed in one pasture and fed approximately 3 pounds of ground shelled corn per head daily from April 28, 1950, to August 28, 1950, at which time they were marketed. Steers in lots 2, 4, 6, and 8 were grazed in one pasture from April 28, 1950, to October 30, 1950.

Table 3. Average Daily Feed Allowance
for Each Steer During Third Year

Winter Period--October 28, 1950, to April 29, 1951				
Lot	2	4	6	8
Place	Trap	Trap	Range	Range
Level of Wintering	Medium	High	Medium	High
Daily Ration: (lbs)				
Pr. Hay	19.29	16.32	-	-
Range	-	-	ad. lib.	ad. lib.
Oats	-	2.98	-	2.98
Cottonseed Cake	1.24	1.24	2.49	2.49

Summer Period

All lots of steers were turned to pasture on April 29, 1951, for summer grazing. These steers will be marketed off grass during the latter part of August, 1951.

Table 4. Chemical Composition of Feeds

	Per cent Dry Matter	Per cent Composition of Dry Matter						
		Ash	Protein	Fat	Crude Fiber	N-free Extract	Calcium	Phosphorus
<u>Calves, 1948-1949</u>								
Cottonseed Cake	92.73	6.01	44.15	7.78	11.46	30.60	0.24	0.90
Prairie Hay	92.61	6.73	3.63	2.36	32.85	54.43	0.52	0.05
Oats	86.63	3.87	14.49	2.77	10.37	68.50	0.10	0.38
Bone Meal	96.92	89.96	-	-	-	-	33.64	14.03
<u>Calves, 1950-1951</u>								
Cottonseed Cake	92.55	6.85	38.34	5.30	9.93	32.13	0.04	0.94
Prairie Hay	94.03	6.52	4.63	2.47	30.73	49.68	0.36	0.06
Oats	88.62	4.40	11.23	3.79	10.25	58.95	0.10	0.26
Bone Meal	97.62	90.75	-	-	-	-	31.44	15.49
<u>Yearlings, 1949-1950</u>								
Cottonseed Cake	91.91	6.12	44.19	5.96	11.46	32.27	0.24	1.04
Prairie Hay	93.70	6.74	4.23	2.29	34.68	52.06	0.44	0.06
Oats	86.60	3.87	14.49	2.77	10.37	68.50	0.10	0.38
Bone Meal	94.63	91.70	-	-	-	-	32.76	15.08
<u>Two-Year-Old Steers, Summer, 1950</u>								
Shelled Corn	87.43	1.71	11.33	5.55	2.22	79.19	0.02	0.33
<u>Two-Year-Old Steers, 1950-1951</u>								
Cottonseed Cake	92.55	7.40	41.43	5.73	10.73	34.72	0.22	1.01
Prairie Hay	94.03	6.93	4.92	2.62	32.68	52.85	0.38	0.07
Oats	88.62	4.40	11.23	3.79	10.25	48.95	0.10	0.26
Bone Meal	97.62	90.75	-	-	-	-	31.44	15.49

Table 5. Chemical Composition of Grass;¹ Four Year Average
(1946-47, 1947-48, 1948-49, 1949-50)

	Per cent Composition of Dry Matter								
	Per cent Dry Matter	Ash	Protein	Fat	Crude Fiber	N-free Extract	Calcium	Phosphorus	Carotene p.p.m.
November	82.39	5.01	2.53	1.74	40.02	50.40	.25	.05	14
January	94.85	5.92	2.57	1.57	40.86	48.74	.31	.04	Trace
May	52.29	6.39	9.68	2.40	32.02	49.08	.31	.13	407
August	54.71	6.21	5.06	2.23	35.02	50.66	.35	.08	112
October	63.09	5.18	3.23	1.62	37.24	52.24	.25	.05	16

¹ Averages, by species, of the four predominant grasses: Big bluestem, little bluestem, Indian, and Switch.

Eighty head of choice quality Hereford steer calves were selected for the experiment. Sixty-four of the calves were produced in the experimental herd and sixteen head were purchased through a commission firm in Oklahoma City, Oklahoma.

The calves produced in the experimental herd were placed in their respective lots according to average daily gains from birth to weaning and weaning weights. The purchased calves were distributed as evenly as possible in the different lots according to weight as no records of birth weight or average daily gains could be obtained.

The calves were placed on the various wintering rations (table 6) on November 3, 1950, and removed from the winter quarters to pasture on April 29, 1951.

The following records were maintained:

1. Feed consumption.
2. Weight each 28-day period during the winter.
3. Cost data.
4. Chemical composition of feeds.

Results of the first winter of this experiment will be reported in this study.

Table 6. Average Daily Feed
Allowance Per Calf 1950-1951

Winter Period--November 3, 1950, to April 29, 1951

Lots	1 & 2	3 & 4	5 & 6	7 & 8
Place	Trap	Trap	Range	Range
Level of Wintering	Medium	High	Medium	High
Daily Ration: (lbs.)				
Pr. Hay	9.77	8.59	-	-
Range	-	-	ad. lib.	ad. lib.
Oats	-	2.95	-	2.95
Cottonseed Cake	1.23	1.23	1.97	1.97

Summer Period

All lots of steers were turned to pasture on April 29, 1951, for summer grazing.

RESULTS AND DISCUSSION

Wintering Steer Calves, 1948-1949

The total feed cost per head for wintering as shown in Table 7 was lowest for those calves wintered on the range and fed cottonseed cake (lots 5 and 6). These lots of calves also demanded the highest appraisal price per 100 pounds at the end of the period. The higher appraisal price was due partially to the fact that these steers were not carrying as much finish as the steers in the other lots but were in a vigorous and healthy condition that would enable them to make efficient gains on pasture.

The steers in lots 3 and 4, which were wintered in a two-acre trap and fed whole oats in addition to prairie hay and cottonseed cake, gained 35 pounds more than those calves which received cottonseed cake and prairie hay and wintered in a similar trap.

The steers in lots 7 and 8, which were fed oats in addition to range grass and cottonseed cake, made 52 pounds more gain than those steers in lots 5 and 6, which received only cottonseed cake and range grass.

The feeding of whole oats to steers on the range (lots 7 and 8) did not produce as much gain as feeding whole oats to steers wintered in the trap (lots 3 and 4).

The steers in lot 9, which were wintered in the small trap, failed to make as much gain as those wintered in the two-acre traps (lots 1 and 2).

None of the lots of steers showed a profit for this period. This was due in most cases to a drop in the price of stocker cattle. The

Table 7. Wintering of Steer Calves

1948-1949

	Lots 1&2		Lots 3&4		Lots 5&6		Lots 7&8		Lot 9	
	Prairie Hay C.S.C.	Prairie Hay C.S.C.	Prairie Hay C.S.C.	Prairie Hay C.S.C.	Range C.S.C.	Range C.S.C.	Range C.S.C.	Range C.S.C.	Prairie Hay C.S.C.	Prairie Hay S. Trap
Number per lot	19	20	19	20	19	20	20	20	10	10
Average weights (lbs.)										
Initial 11-18-48	499	497	499	497	499	497	499	497	497	497
Final 4-6-49	608	641	535	585	535	585	585	585	569	569
Total gain	109	144	36	88	36	88	88	88	72	72
Average daily gain	0.78	0.96	0.26	0.63	0.26	0.63	0.63	0.63	0.51	0.51
Average daily ration (lbs.)										
Cottonseed cake	1.30	1.29	2.06	2.04	2.06	2.04	2.04	2.04	1.28	1.28
Oats	-	3.02	-	3.02	-	3.02	3.02	3.02	-	-
Prairie hay	13.32	12.04	0.40	0.39	0.40	0.39	0.39	0.39	11.78	11.78
Range	-	-	ad. lib.	ad. lib.	ad. lib.	ad. lib.	ad. lib.	ad. lib.	-	-
Mineral	0.05	0.08	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
Feed cost per cwt. gain (dollars)	16.64	20.38	45.67	32.36	45.67	32.36	32.36	32.36	23.56	23.56
Financial results per steer (dollars)										
Initial cost @ \$30 per cwt.	149.70	149.10	149.70	149.10	149.70	149.10	149.10	149.10	149.10	149.10
Feed cost per head	18.14	29.35	16.44	28.48	16.44	28.48	28.48	28.48	16.96	16.96
Total cost (steers plus feed)	167.84	178.45	166.14	177.58	166.14	177.58	177.58	177.58	166.06	166.06
Necessary selling price per cwt. to break even	27.60	27.84	31.05	30.36	31.05	30.36	30.36	30.36	29.18	29.18
Appraised price per cwt.	25.50	25.00	26.00	25.50	26.00	25.50	25.50	25.50	25.50	25.50
Value per steer (3% shrink)	150.45	155.25	134.94	144.69	134.94	144.69	144.69	144.69	140.42	140.42
Profit or loss per steer	-17.39	-23.20	-31.20	-32.89	-31.20	-32.89	-32.89	-32.89	-25.64	-25.64

Feed Prices

Cottonseed cake	\$86.50 per ton
Oats	.93 per bushel
Prairie hay	13.00 per ton
Mineral mixture	1.97 per cwt.
Range	3.50 per head

feed cost per 100 pounds gain was less than the appraised price for lots 1 and 2, 3 and 4, and 9 but the total winter gain was not enough to compensate for the spread in initial cost and appraised price. Although the steers in lots 5 and 6 received the highest appraisal price (\$26.00 per hundredweight), the steers in lots 1 and 2, which were wintered to gain 0.78 pound per day, would have been the most profitable in this trial if all steers had been sold at the end of the wintering period.

Analysis of variance and orthogonal comparisons, (Snedecor, 1950), as given in table 8, indicate that the steers wintered in the large traps and on the range made significantly greater gains than the calves wintered in the small trap. The calves wintered in the two-acre traps made significantly greater gains than the steers wintered on the range. The gains made by the calves wintered on a high plane of nutrition in the traps or on the range were significantly greater than the gains made by the calves wintered on a medium level.

Table 8. Analysis of Variance and Orthogonal Comparisons Used To Compare Treatments and Systems of Management in Wintering Calves, 1948-1949

Source	Degrees of Freedom	Sum of Squares	Mean Square
Total	87	153375	
Treatment	(4)	123742	30935**
Large Traps and Range vs. Small Trap	1	4789	4789**
Large Traps vs. Range	1	80770	80770**
Medium Level Trap vs. High Level Trap	1	11623	11623**
Medium Level Range vs. High Level Range	1	26560	26560**
Error	83	29633	357

** Significant at .01 level of probability

Wintering Steer Calves, 1950-1951

The greatest gain (133 pounds) as shown in table 9 was made by the calves wintered in a trap and fed prairie hay, cottonseed cake and oats (lots 3 and 4). These calves made 23 pounds more gain with \$1.02 less feed cost per head than the calves in lots 7 and 8, which were fed cottonseed cake and oats on the range.

The steers in lots 3 and 4, wintered in a trap and fed prairie hay, cottonseed cake, and oats, gained an average of 41 pounds more than the steers in lots 1 and 2, which were wintered in a comparable trap and fed cottonseed cake and prairie hay. However, the higher appraisal price per hundredweight and lower feed cost per unit of gain for the steers in lots 1 and 2 resulted in a greater net return for these steers. This higher price was due to the fact that these steers carried less finish and were more likely to make good gains when turned to pasture.

The steers wintered on the range and fed oats in addition to cottonseed cake (lots 7 and 8) made 77 pounds more total gain than those fed only cottonseed cake on the range (lots 5 and 6). Although the steers in lots 7 and 8 were appraised at \$1.00 per hundredweight less than the steers in lots 5 and 6, they returned \$7.25 more profit per head for the winter period.

Wintering calves on the low plane of nutrition was the most profitable system when calves were wintered in the trap, but wintering on a high plane of nutrition was the most profitable level of wintering when calves were wintered on the range.

The calves that were wintered on a high level of nutrition in the trap (lots 3 and 4) made 56 pounds more gain per head than those calves

Table 9. Wintering of Steer Calves

1950-1951

	Lots 1&2 Lots 3&4 Lots 5&6 Lots 7&8			
	Prairie Hay C.S.C.	Prairie Hay C.S.C. Oats	Range C.S.C.	Range C.S.C. Oats
	Number per lot	20	20	20
Average weight (lbs.)				
Initial 1103050	441	447	447	446
Final 4-29-51	533	580	500	556
Total gain	92	133	53	110
Average daily gain	0.52	0.75	0.30	0.62
Average daily ration (lbs.)				
Cottonseed cake	1.23	1.23	1.97	1.97
Oats	-	2.95	-	2.95
Prairie hay	9.77	8.59	-	-
Range	-	-	ad. lib.	ad. lib.
Mineral	0.06	0.06	0.07	0.08
Feed cost per cwt. gain (dollars)	18.16	23.66	31.55	29.54
Financial results per steer (dollars)				
Initial cost @ \$34 per cwt.	149.94	151.98	151.98	151.64
Feed cost per head	16.71	31.47	16.72	32.49
Total cost (feed plus steers)	166.65	183.45	168.70	184.13
Necessary selling price per cwt. to break even	31.27	31.63	33.74	33.12
Appraised price per cwt.	41.00	37.50	42.00	41.00
Value per steer (3% shrink)	211.97	211.12	203.70	226.38
Net return per steer	45.32	27.67	35.00	42.25

Feed Prices

Cottonseed cake	\$77.50 per ton
Oats	.93 per bushel
Prairie hay	9.00 per ton
Mineral mixture	1.73 per cwt.
Range	3.00 per head

wintered on a high level of nutrition on the range (lots 7 and 8). The calves in lots 1 and 2, which were wintered on a medium plane of nutrition in the trap, gained 73 pounds more per head than the calves in lots 5 and 6, which were wintered on a medium plane of nutrition on the range.

Statistical analysis of systems of management and levels of feeding, as shown in table 10, indicates that significantly greater gains were made by the calves which were wintered in the traps. Wintering on a high plane of nutrition in the trap or on the range produced significantly greater gains than wintering on a medium level.

Table 10. Analysis of Variance and Orthogonal Comparisons Used To Compare Systems of Management and Levels of Wintering for Steer Calves, 1950-1951

Source	Degrees of Freedom	Sum of Squares	Mean Square
Total	79	178963	
Treatment	(3)	69686	23228**
Traps vs. Range	1	19688	19688**
Medium Level Traps vs. High Level Traps	1	17222	17222**
Medium Level Range vs. High Level Range	1	32776	32776**
Error	76	109277	1437

** Significant at .01 level of probability

Wintering of Steer Calves, 1948-1949 and 1950-1951

A summary of the two wintering trials, as noted in table 11, indicates that the calves making the most gains were those which were wintered in the trap on a high plane of nutrition (lots 3 and 4). These calves were appraised at a lower price and were not as profitable as those calves in lots 1 and 2, which were wintered on a medium plane of nutrition in the trap, or those calves in lots 7 and 8, which were wintered on a high plane of nutrition on the range.

Table 11. Wintering of Steer Calves; Two Year Summary
1948-1949 and 1950-1951

	Lots 1&2 Lots 3&4 Lots 5&6 Lots 7&8			
	Prairie Hay C.S.C.	Prairie Hay C.S.C. Oats	Range C.S.C.	Range C.S.C. Oats
Number per lot	39	40	39	40
Average weight (lbs.)				
Initial	469	472	473	471
Final	569	610	517	570
Total gain	100	138	44	99
Average daily gain	0.65	0.85	0.28	0.62
Average daily ration (lbs.)				
Cottonseed cake	1.26	1.26	2.02	2.96
Oats	-	2.98	-	2.98
Prairie hay	11.54	10.32	-	-
Range	-	-	ad. lib.	ad. lib.
Mineral	0.06	0.07	0.08	0.08
Feed cost per cwt. gain (dollars)	17.40	22.02	38.61	30.95
Financial results per steer (dollars)				
Initial cost	149.82	150.54	150.84	150.37
Feed cost per head	17.42	30.41	16.58	30.48
Total cost (steers plus feed)	167.24	180.95	167.42	180.85
Necessary selling price per cwt. to break even	29.44	29.74	32.40	31.74
Appraised price per cwt.	33.25	31.25	34.00	33.25
Value per steer (3% shrink)	181.21	183.18	169.32	185.53
Net return per steer	13.97	2.23	1.90	4.68

Wintering on a high plane of nutrition on the range (lots 7 and 8) was more profitable than wintering on a high plane of nutrition in the trap (lots 3 and 4).

The calves wintered on a medium plane of nutrition on the range (lots 5 and 6) were appraised at the highest price but returned the least profit because they failed to gain as much as calves in the other lots.

Wintering on a medium plane of nutrition in the trap (lots 1 and 2) was the most profitable system of management. The increased profit can be attributed largely to the economical gains made by these calves.

A statistical comparison of the two wintering trials, found in table 12, shows that there was no significant difference in the gains made by the calves during the two winter periods. There was, however, a significant difference between the gains of the steers wintered in the trap and those wintered on the range. A high level of feeding produced significantly greater gains under each system of management.

Table 12. Analysis of Variance and Orthogonal Comparisons Used To Compare Treatments in Wintering Calves, 1948-1949 and 1950-1951

Source	Degrees of Freedom	Sum of Squares	Mean Square
Total	157	446352	
Year	1	169	169
Treatment	(3)	177285	59095**
Traps vs. Range	1	89717	89717**
Medium Level Trap vs. High Level Trap	1	28881	28881**
Medium Level Range vs. High Level Range	1	58687	58687**
Year x Treatment (Interaction)	3	11354	3784
Error	150	257544	1717

** Significant at .01 level of probability

Grazing of Yearling Steers, 1949

As shown in table 13, the steers in lots 3 and 4 which were wintered to make the greatest gains (144 pounds per head) made the least summer gains (144 pounds) but the greatest total yearly gains. The total gain was 48 pounds per head greater than those for calves which were wintered to make the least gains (36 pounds per head) during the previous winter. These wintering and grazing results are in agreement with Ruby and co-workers (1948), Mumford (1911), and Black, Guesenberry, and Baker (1936). These workers concluded that steers wintered to make the greatest winter gains made the least summer gains but the largest total gains for the year.

The steers in lots 5 and 6, which were wintered to gain 36 pounds per head, made the most economical summer gains but failed to return as much profit for the combined winter and summer periods as those steers in lots 1 and 2, which were wintered to gain 109 pounds per head. This was due to the economical winter gains made by the calves in lots 1 and 2 as they made only 59 per cent of their total gain on pasture while the steers in lots 5 and 6 made 85 per cent of their total gains on pasture.

The steers which were wintered on a high plane of nutrition (lots 3 and 4, 7 and 8) returned the least profit for the winter and summer periods. The steers in these lots made 50 per cent and 67 per cent, respectively, of their total gains on pasture.

The steers in lot 9, which were confined to the small trap during the winter, gained less than those steers wintered in a large trap. It appears that confinement to the small trap did not affect the grazing ability or gains of those steers when compared to the steers allowed more area for exercise. The confined steers made 72 per cent of their annual gain on pasture.

Table 13. Effect of Winter Gain Upon Subsequent
Grazing Performance of Calves, 1948-1949

	Lots 1&2		Lots 3&4		Lots 5&6		Lots 7&8		Lot 9	
	Prairie Hay C.S.C.	Prairie Hay C.S.C.	Prairie Hay C.S.C.	Prairie Hay C.S.C.	Range C.S.C. Oats	Range C.S.C. Oats	Range C.S.C. Oats	Range C.S.C. Oats	Prairie Hay C.S.C.	Prairie Hay C.S.C.
Number in lot	19	20	19	20	19	20	20	20	10	10
<u>Winter</u>										
Average weight per steer (lbs.)										
Initial 11-8-48	499	497	499	497	499	497	497	497	497	497
Final 4-6-49	608	641	535	585	535	585	585	585	569	569
Total gain	109	144	36	88	36	88	88	88	72	72
Average daily gain	0.78	0.96	0.26	0.63	0.26	0.63	0.63	0.63	0.51	0.51
Financial (dollars)										
Initial cost per cwt.	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00	30.00
Appraised price per cwt.	25.50	25.00	26.00	25.50	26.00	25.50	25.50	25.50	25.50	25.50
Cost per cwt. gain	16.64	20.38	45.67	32.36	45.67	32.36	32.36	32.36	23.56	23.56
Return per head	-17.39	-23.20	-31.20	-32.89	-31.20	-32.89	-32.89	-32.89	-25.64	-25.64
<u>Summer Grazing</u>										
Average weight per steer (lbs.)										
Initial 4-6-49	608	641	535	585	535	585	585	585	569	569
Final 10-26-49	768	785	739	769	739	769	769	769	758	758
Total gain	160	144	204	184	204	184	184	184	189	189
Average daily gain	0.79	0.71	1.00	0.91	1.00	0.91	0.91	0.91	0.93	0.93
Financial (dollars)										
Cost of steers when turned to grass	150.45	155.25	134.94	144.69	134.94	144.69	144.69	144.69	140.42	140.42
Cost of grass per head	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00	14.00
Cost of salt and mineral	0.21	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22
Total cost (steers plus feed)	164.66	169.47	149.16	158.91	149.16	158.91	158.91	158.91	154.64	154.64
Cost per cwt. gain	8.88	9.88	6.97	7.73	6.97	7.73	7.73	7.73	7.52	7.52
Appraised price per cwt.	21.50	21.00	21.50	21.00	21.50	21.00	21.00	21.00	21.00	21.00
Value per steer (3% shrink)	160.18	159.81	154.15	156.66	154.15	156.66	156.66	156.66	154.35	154.35
Profit per steer	-4.48	-9.66	4.99	-2.25	4.99	-2.25	-2.25	-2.25	-0.29	-0.29
<u>Total Period</u>										
Total gain (lbs.)	269	288	240	272	240	272	272	272	261	261
Total feed cost (dollars)	32.35	43.57	30.66	42.70	30.66	42.70	42.70	42.70	31.18	31.18
Feed cost per cwt. gain (dollars)	12.03	15.13	12.78	15.70	12.78	15.70	15.70	15.70	11.95	11.95
Total profit per steer (dollars)	-21.87	-32.86	-26.21	-35.14	-26.21	-35.14	-35.14	-35.14	-25.93	-25.93

Results of the combined winter and summer periods indicate that the feeding of approximately 3 pounds of oats to steer calves wintered in the trap or on the range (high level of nutrition) was not as profitable as wintering on a medium level. Wintering steer calves in a two-acre trap and feeding approximately 1.25 pounds of cottonseed cake and prairie hay, free choice, was the most profitable system of management for the two periods. Similar work was reported by Brouse (1944) who found that the combined winter and summer gain was most profitable when the winter supplements were adjusted to produce from 0.75 to 1.0 pound daily gain per head.

Statistical analysis, as given in table 14, shows that there was no significant difference between the summer gains of the calves in lot 9, which were confined to the small trap, and the gains of the calves in the other lots. No significant differences occurred during this period in the gains of the calves which had been wintered on the high and low planes of nutrition. There was, however, a significant difference in summer gains of calves wintered on the range and in the trap. The calves which had been wintered on the range produced the greater gains during the summer.

Table 14. Analysis of Variance and Orthogonal Comparisons Used To Compare Treatments and Systems of Management in Grazing Yearling Steers, 1949

Source	Degrees of Freedom	Sum of Squares	Mean Square
Total	87	139862	
Treatment	(4)	42430	10607**
Large Traps and Range vs. Small Trap	1	2339	2339
Large Traps vs. Range	1	33854	33854**
Medium Level Trap vs. High Level Trap	1	2262	2262
Medium Level Range vs. High Level Range	1	3975	3975
Error	83	97432	1173

** Significant at .01 level of probability

Regression studies, given in table 15, indicate that a 100-pound advantage in weight at the end of the winter period in lots 3 and 4 was reduced to 28 pounds at the end of the summer. The steers in lots 5 and 6 showed an opposite trend. For each additional pound they gained during the winter, the summer gain was increased by 0.07 pound. Correlation studies of the different lots of steers indicate that the steers which made the least gains during the winter made the greatest summer gains with the exception of those steers in lots 5 and 6. The steers in these lots which made the greater winter gains made the larger summer gains.

Table 15. Regression and Correlation Studies of Winter and Summer Gains of Calves, 1948-1949

	Correlation Coefficient	Regression Coefficient
Medium Level Trap (Lots 1 and 2)	-.61	-.53 / 28.84
High Level Trap (Lots 3 and 4)	-.59	-.72 / 36.41
Medium Level Range (Lots 5 and 6)	+.07	+.08 / 29.10
High Level Range (Lots 7 and 8)	-.22	-.35 / 25.14
Medium Level Small Trap (Lot 9)	-.73	-.52 / 37.95

The relationship of winter gains to summer gains of the steers, made during 1948-1949, is shown in Figure 1.

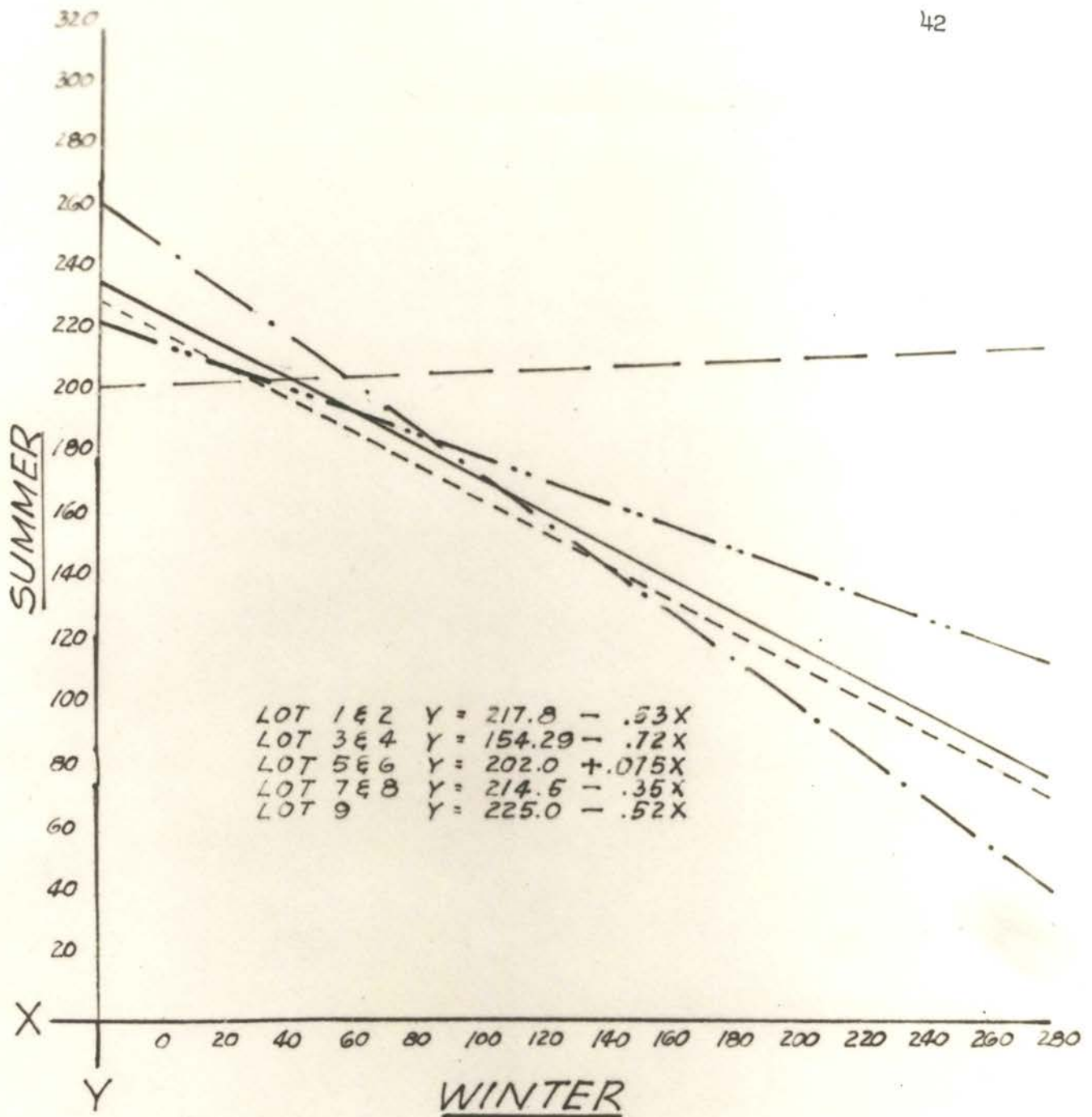
Wintering Yearling Steers, 1949-1950

Table 16, which summarizes the results of wintering yearling steers shows that the steers in lots 3 and 4, which were wintered in the large trap and fed prairie hay, cottonseed cake, and oats, made greater gains at a lower cost per unit of gain than the steers in lots 1 and 2 which were fed only prairie hay and cottonseed cake. Although the steers in lots 1 and 2 were appraised at the highest price, the steers in lots 3 and 4 returned the greater profit due to more economical gains and lower appraisal price at the beginning of the period.

The steers in lots 7 and 8 (wintered on the range and fed cottonseed cake and oats) gained 24 pounds more than the steers in lots 5 and 6 (wintered on the range and fed only cottonseed cake). The winter feed cost, however, was \$16.30 per head greater for the steers in lots 7 and 8. Consequently, the return per steer was less than for steers in lots 5 and 6.

The steers confined to the small trap with shelter during the winter and fed prairie hay and cottonseed cake (lot 9) gained 15 pounds more than the steers wintered on the same level of nutrition in the large trap without shelter (lots 1 and 2). The total profit for the wintering period was \$3.41 per head greater for the calves wintered in the large trap due to the lower feed cost and higher appraisal price at the end of the winter.

The data from this trial indicates that it was not profitable to feed a limited amount of oats to steers being wintered on native cured grasses and cottonseed cake (lots 7 and 8). The addition of approximately



KEY

LOT 1&2	-----
LOT 3&4	— . — . — .
LOT 5&6	-----
LOT 7&8	— . . — . .
LOT 9	=====

FIGURE I. THE RELATIONSHIP IN POUNDS OF WINTER GAINS TO SUMMER GAINS OF CALVES, 1948-1949.

Table 16. Wintering of Yearling Steers

1949-1950

	Lots 1&2		Lots 3&4		Lots 5&6		Lots 7&8		Lot 9	
	Prairie Hay C.S.C.	Prairie Hay C.S.C.	Prairie Hay C.S.C.	Prairie Hay C.S.C.	Range C.S.C.	Range C.S.C.	Range C.S.C.	Range C.S.C.	Prairie Hay C.S.C.	Prairie Hay C.S.C.
Number per lot	19	20	19	20	19	20	20	20	10	10
Average weights (lbs.)										
Initial 10-26-49	768	785	739	769	758	788	893	785	839	793
Final 4-28-50	788	893	785	839	793	20	108	46	70	35
Total gain	20	108	46	70	35	0.10	0.59	0.25	0.38	0.19
Average daily gain	0.10	0.59	0.25	0.38	0.19					
Average daily ration (lbs.)										
Cottonseed cake	1.25	1.25	2.31	2.33	1.25					
Oats	-	3.00	-	3.03	-					
Prairie hay	15.87	15.52	-	-	18.52					
Range	-	-	ad. lib.	ad. lib.	-					
Mineral	0.04	0.04	0.07	0.08	0.07					
Feed cost per cwt. gain (dollars)	130.75	38.66	48.65	55.26	82.68					
Financial results per steer (dollars)										
Initial cost per cwt.	21.50	21.00	21.50	21.00	21.00					
Initial cost per head (3% shrink)	160.17	159.81	154.15	156.66	154.35					
Feed cost per head	26.15	41.75	22.38	38.68	28.94					
Total cost (steers plus feed)	186.32	201.56	176.53	195.34	183.29					
Necessary selling price per cwt. to break even	23.64	22.57	22.49	23.28	23.11					
Appraised price per cwt.	25.00	24.00	25.50	25.00	24.00					
Value per steer (3% shrink)	191.00	207.84	194.05	203.50	184.56					
Net return per steer	4.68	6.28	17.52	8.16	1.27					

Feed Prices

Cottonseed cake	\$86.50 per ton
Oats	.925 per bushel
Prairie hay	11.00 per ton
Mineral mixture	1.91 per cwt.
Range	3.75 per head

3 pounds of oats to a wintering ration of cottonseed cake and prairie hay for steers wintered in the two-acre trap (lots 3 and 4) was more profitable than a ration of only cottonseed cake and prairie hay (lots 1 and 2).

Statistical analysis of the data for the winter period, found in table 17, indicates that there was no significant difference between the winter gains made by the steers in lot 9, which were wintered in the small trap, and the gains of other steers wintered on the range or in the large traps. Statistical analysis also failed to reveal a significant difference between the steers in the large traps and those on the range or between the high and medium planes of nutrition for steers wintered on the range. There was, however, a significant difference in gains made by the steers wintered on the two planes of nutrition in the large traps. The steers in lots 3 and 4 (high level) made greater gains than the steers in lots 1 and 2 (medium level).

Table 17. Analysis of Variance and Orthogonal Comparisons Used To Compare Systems of Management and Levels of Wintering for Yearling Steers, 1949-1950

Source	Degrees of Freedom	Sum of Squares	Mean Square
Total	87	206493	
Treatment	(4)	89493	22373
Large Traps and Range vs. Small Trap	1	6248	6248
Large Traps vs. Range	1	1005	1005
Medium Level Trap vs. High Level Trap	1	76291	76291*
Medium Level Range vs. High Level Range	1	5949	5949
Error	83	117000	14096

* Significant at .05 level of probability

Summer Treatment of Two-Year-Old Steers, 1950

During this period, when the steers were two years old, the cattle in lots 1, 3, 5, 7, and 9 were fed approximately 3 pounds of ground shelled corn on grass and marketed August 28, 1950. The steers in lots 2, 4, 6, and 8 were grazed during the summer on grass without supplemental feed. The two phases of this period will be discussed separately.

Two-Year-Old Steers Fed A Limited Amount of Grain on Grass

As shown in table 18, the steers in lot 3, which were wintered on a high plane of nutrition to gain 126 pounds per head, made the least summer gains but the largest annual gains. The total yearly gain was 37 pounds per head greater than the gains of the steers in lot 1, which were wintered to gain 25 pounds per head. Steers wintered on a high level of nutrition in a trial conducted by Black and Mathews (1930) were 85 pounds heavier at the end of the summer grazing season than steers wintered on a low level of nutrition.

The steers in lot 1 made the most economical summer gains and returned the greatest profit for the combined winter and summer periods. These steers made 92 per cent of their total gains during the summer.

The steers in lot 3, which gained 250 pounds during the summer made 66 per cent of their annual gain during this period. Although these steers made the least summer gain and were appraised at the lowest price at the end of the wintering period, they returned more profit for the two periods than the steers in lots 5 and 9.

Steers in lot 5, which were wintered on the range and fed cottonseed cake, were the most profitable steers for the wintering period. These

Table 18. Effect of Winter Gain Upon Summer Gain of Yearling Steers Fed A Limited Amount of Grain on Grass 1949-1950

	Lot 1	Lot 3	Lot 5	Lot 7	Lot 9
Number per lot	10	10	9	10	10
<u>Winter</u>					
Average weight per steer (lbs.)					
Initial 10-26-49	778	788	737	762	758
Final 4-28-50	803	914	785	830	793
Total gain	25	126	48	68	35
Average daily gain	0.14	0.68	0.26	0.37	0.19
Financial (dollars)					
Initial cost per cwt.	21.50	21.00	21.50	21.00	21.00
Appraised price per cwt.	25.00	24.00	25.50	25.00	24.00
Cost per cwt. gain	104.60	33.13	46.62	56.88	82.68
Return per head	6.28	10.69	17.96	7.38	1.27
<u>Summer Grazing</u>					
Average weight per steer (lbs.)					
Initial 4-28-50	803	914	785	830	793
Final 8-28-50	1117	1164	1097	1118	1090
Total gain	314	250	312	288	297
Average daily gain	2.57	2.05	2.56	2.36	2.43
Financial (dollars)					
Cost of steers when turned to grass	194.75	212.88	194.31	201.25	184.56
Cost of mineral, grass, and ground corn	26.79	26.79	27.01	26.99	26.99
Total cost (steers plus feed)	221.54	239.67	221.32	228.24	211.55
Cost per cwt. gain	8.53	10.71	8.65	9.37	9.08
Appraised price per cwt.	28.00	27.00	26.00	27.50	26.00
Value per steer (3% shrink)	303.52	304.83	276.64	298.37	274.82
Profit per steer	81.98	65.16	55.32	70.13	63.27
<u>Total Period</u>					
Total gain (lbs.)	339	376	360	356	332
Total feed cost (dollars)	52.94	68.54	49.39	65.67	55.93
Feed cost per cwt. gain (dollars)	15.66	18.23	13.72	18.45	16.85
Total profit per steer (dollars)	88.26	75.85	73.53	77.51	64.54

steers returned the least profit during the summer although they made 89 per cent of their total gain during the summer. The small return for the summer period can be attributed partly to the fact that these steers were appraised at the lowest price at the end of this period. Results of this period are in agreement with Sheets and Tuckwiller (1920) who found that steers wintered on a low plane of nutrition made better use of summer pasture than steers wintered on a high plane of nutrition.

Although steers in lot 9 made 89 per cent of their total gain on pasture, they were the least profitable steers for the two periods. The low return by these steers can be partially explained by their failure to make economical gains during the winter and the low appraisal price at the end of both the summer and winter periods.

Carcass data on these steers, found in table 19, shows that the steers in lot 3, which had been wintered two winters on a high plane of nutrition, had the highest dressing percentage. The dressing percentage of these steers was 56.83 per cent, which was 2.33 per cent higher than the steers in lot 5, which had been wintered two winters on the range and received only cottonseed cake. The average dressing percentage of the other lots of steers was 56.00 per cent, 55.97 per cent, and 55.37 per cent for lots 9, 1, and 7, respectively. The 49 head of steers produced 16 high commercial, 31 medium commercial, and 2 low commercial carcasses. Smith and Pickett (1949) concluded that the plane of nutrition over a long period of time influenced the dressing percentage and the grade of beef produced. In their feeding trial which extended over a two-year period, the steers in the low-wintered groups failed to produce carcasses that graded as high as those steers in the well-wintered groups.

Table 19. Carcass Data of Two-Year-Old Steers Marketed August 28, 1950

Lot 1			Lot 3			Lot 5		
No.	Dressing Percentage	Grade 1/	No.	Dressing Percentage	Grade 1/	No.	Dressing Percentage	Grade 1/
8	55.79	H. C.	3	57.10	H. C.	6	54.96	H. C.
14	54.97	M. C.	15	57.33	M. C.	16	53.42	M. C.
19	55.75	M. C.	26	55.72	M. C.	27	54.01	M. C.
21	55.48	M. C.	38	55.72	H. C.	43	56.19	M. C.
33	57.45	H. C.	44	57.33	M. C.	57	55.89	M. C.
50	56.32	M. C.	48	56.89	H. C.	62	53.28	M. C.
61	54.98	M. C.	53	56.90	M. C.	64	55.55	M. C.
63	56.95	M. C.	55	57.62	M. C.	87	54.57	M. C.
76	56.20	M. C.	65	57.48	H. C.	88	52.64	M. C.
85	55.82	M. C.	88	56.19	M. C.			
Average	55.97		Average	56.83		Average	54.50	

Lot 7		
No.	Dressing Percentage	Grade 1/
9	52.55	L. C.
23	51.53	M. C.
30	56.15	H. C.
32	54.85	M. C.
41	56.39	H. C.
45	55.86	H. C.
58	56.11	M. C.
59	57.62	H. C.
77	54.89	M. C.
81	57.99	H. C.
Average	55.39	

Lot 9		
No.	Dressing Percentage	Grade 1/
2	56.60	H. C.
11	54.57	M. C.
20	56.73	H. C.
36	56.98	M. C.
37	57.20	M. C.
39	56.20	H. C.
42	55.91	H. C.
49	53.19	L. C.
70	54.93	M. C.
74	57.75	M. C.
Average	56.00	

1/ H. C.--High Commercial
M. C.--Medium Commercial
L. C.--Low Commercial

As shown in table 20, there was no statistical difference between the gains of steers in lot 9 and steers wintered in the large traps or on the range. Orthogonal comparisons indicate no significant difference in gains made under the two systems of management (trap and range) or between levels of wintering on the range (lots 5 and 7). There was, however, a highly significant difference between the gains of steers which were wintered on a high and low level of nutrition in a trap (lots 1 and 3).

Table 20. Analysis of Variance and Orthogonal Comparisons Used To Compare Systems of Management and Levels of Wintering For Two-Year-Old Steers Fed Grain on Grass, 1950

Source	Degrees of Freedom	Sum of Squares	Mean Square
Total	48	79996	
Treatment	(4)	26357	6589**
Large Traps and Range vs. Small Trap	1	309	309
Large Traps vs. Range	1	2979	2979
Medium Level Trap vs. High Level Trap	1	20161	20161**
Medium Level Range vs. High Level Range	1	2908	2908
Error	44	53639	1219

** Significant at .01 level of probability

Regression studies, found in table 21, indicate that a 100-pound weight advantage in lot 3 at the end of the winter was reduced to 31 pounds at the end of the summer period. Other lots followed a similar trend with exception of lot 5 in which a 100-pound winter gain resulted in 145 pounds at the end of the summer. Correlations of winter and summer gains indicate that the steers which made the greatest winter gains made the smallest summer gains with the exception of lot 5 where steers which made the greatest winter gains also made the greatest summer gains.

Table 21. Regression and Correlation Studies of Winter and Summer Gains of Two-Year-Old Steers, 1949-1950

	Correlation Coefficient	Regression Coefficient
Medium Level Trap (Lot 1)	-.54	-.49 $\frac{1}{Z}$ 43.40
High Level Trap (Lot 3)	-.61	-.69 $\frac{1}{Z}$ 28.60
Medium Level Range (Lot 5)	+.33	+.45 $\frac{1}{Z}$ 29.06
High Level Range (Lot 7)	-.01	-.08 $\frac{1}{Z}$ 31.87
Medium Level Small Trap (Lot 9)	-.33	-.30 $\frac{1}{Z}$ 37.94

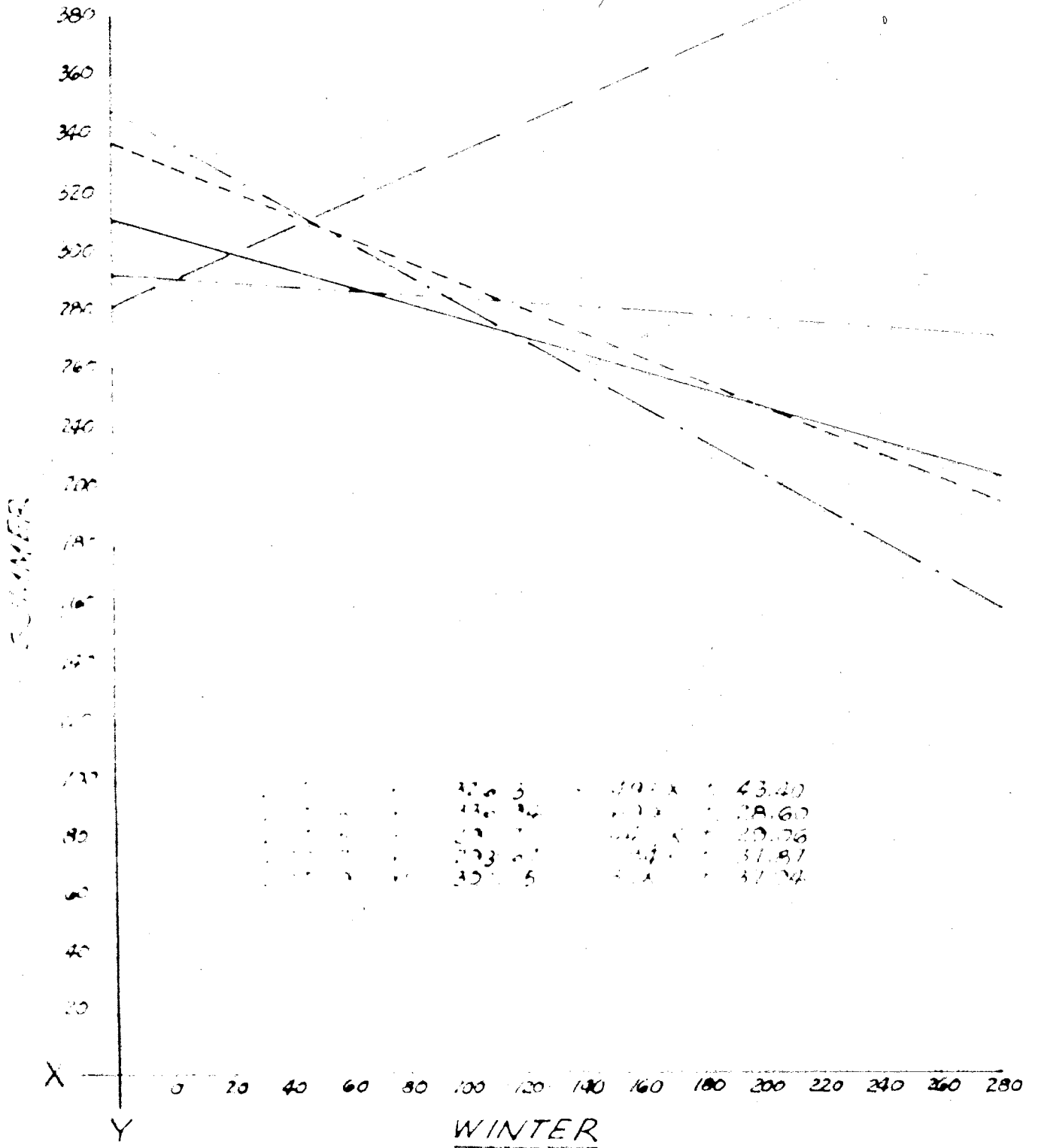
Figure 2 shows the relationship of winter gains of two-year-old steers to gains made during the summer when fed a limited amount of grain on grass.

Results of the entire two-year period, from wintering as calves in 1948-1949 to marketing in 1950, are given in table 22.

Under conditions of this experiment, wintering in the small trap on a medium plane of nutrition produced the least total gain and was the least profitable system of management when steers were fed a limited amount of grain on grass during the second summer. These steers were appraised at the lowest price and returned only \$38.61 per head for the two-year period.

Wintering on a high plane of nutrition in a two-acre trap (lot 3) produced the most total gain but these cattle failed to return as much profit as those steers in lots 1 (low plane of nutrition in a two-acre trap) and 5 (low plane of nutrition on the range) due to the high feed cost during the winter periods. These steers made only 56 per cent of their total gain on pasture.

The steers in lot 3 which were wintered in a trap and fed cottonseed cake and oats (high plane of nutrition) returned a profit of \$2.72 per head more than those steers in lot 7.



326	5	307	5	43.40
330	5	312	5	28.60
328	5	308	5	29.76
303	5	304	5	31.81
307	5	308	5	31.04

KEY
 LOT 1 -----
 LOT 3 -.-.-.-
 LOT 5 -.-.-.-
 LOT 7 -.-.-.-
 LOT 9 -.-.-.-

FIGURE 2. THE RELATIONSHIP IN POUNDS OF WINTER GAINS TO GAINS MADE DURING THE FOLLOWING SUMMER BY STEERS WHEN FED A LIMITED AMOUNT OF GRAIN ON GRASS, 1949-1950

Table 22. The Effect of Level of Wintering
Upon The Production of Two-Year-Old Steers

	Lot 1	Lot 3	Lot 5	Lot 7	Lot 9
	Pr. Hay C.S.C.	Pr. Hay C.S.C. Oats	Range C.S.C.	Range C.S.C. Oats	Pr. Hay C.S.C. S. Trap
Fed grain on grass, second summer					
Number of steers per lot	10	10	9	10	10
<u>Winter 1948-1949 (139 days)</u>					
Initial weight 11-18-48	497	497	501	497	497
Final weight 4-6-49	625	660	537	588	568
Total gain	128	163	36	91	71
Average daily gain	0.92	1.17	0.26	0.65	0.51
Total feed cost (dollars)	18.14	29.35	16.44	23.48	16.96
<u>Summer 1949 (203 days)</u>					
Initial weight 4-6-49	625	660	537	588	568
Final weight 10-26-49	778	788	737	762	758
Total gain	153	128	200	174	190
Average daily gain	0.75	0.63	0.99	0.86	0.94
Total feed cost (dollars)	14.22	14.22	14.22	14.22	14.22
<u>Winter 1949-1950 (184 days)</u>					
Initial weight 10-26-49	778	788	737	762	758
Final weight 4-28-50	803	914	785	830	793
Total gain	25	126	48	68	35
Average daily gain	0.14	0.68	0.26	0.37	0.19
Total feed cost (dollars)	26.15	41.75	22.38	38.68	28.94
<u>Summer 1950 (122 days)</u>					
Initial weight 4-28-50	803	914	785	830	793
Final weight 8-28-50	1117	1164	1097	1118	1090
Total gain	314	250	312	288	297
Average daily gain	2.57	2.05	2.56	2.36	2.43
Total feed cost (dollars)	26.79	26.79	27.01	26.99	26.99
<u>Summary</u>					
Initial weight (lbs)	497	497	501	497	497
Final weight (lbs)	1117	1164	1097	1118	1090
Total gain (lbs.)	620	667	596	621	593
Financial (dollars)					
Initial cost @ \$30 per cwt.	149.10	149.10	150.30	149.10	149.10
Total feed cost	85.30	112.11	80.05	108.37	87.11
Total cost (steers plus feed)	234.40	261.21	230.35	257.47	236.21
Selling price per cwt.	28.00	27.00	26.00	27.50	26.00
Value per steer (3% shrink)	303.52	304.83	276.64	298.37	274.82
Return per steer	69.12	43.62	46.29	40.90	38.61

Wintering on a medium plane of nutrition on the range (lot 5) produced gains that were exceeded by steers in lots 1, 3, and 7. These cattle made 85 per cent of their total gain during the summer periods and were exceeded in total profit only by the steers in lot 1.

The most profitable level of wintering and system of management was that followed in lot 1 in which steers were wintered on a medium plane of nutrition in a two-acre trap. These steers made 75 per cent of their total gain during the summer and returned a net profit of \$69.12 for the two-year period. They sold for the highest price of any of the lots at the end of the summer.

Statistical analysis of the data for the two-year period, as shown in table 23, indicates that there was no significant difference between the different levels of wintering and the systems of management at the end of two years.

Smith and Pickett (1949) and Black, Quesenberry, and Baker (1938) reported the same conclusions at the end of their trials.

Table 23. Analysis of Variance and Orthogonal Comparisons Used To Compare Systems of Management and Levels of Wintering for the Entire Two-Year Period

Source	Degrees of Freedom	Sum of Squares	Mean Square
Total	48	172499	
Treatment	(4)	34523	8630*
Large Traps and Range vs. Small Trap	1	9298	9298
Large Traps vs. Range	1	11614	11614
Medium Level Trap vs. High Level Trap	1	11014	11014
Medium Level Range vs. High Level Range	1	2566	2566
Error	44	137976	3135

* Significant at .05 level of probability

Figure 3 shows the average gain by periods of the steers in lots 1, 3, 5, 7, and 9.

Two-Year-Old Steers Grazed on Grass Without Supplement

As shown in table 24, steers in lots 2, 4, 6, and 8 were provided no grain during the summer grazing season.

The steers in lot 2, which were wintered in a trap and fed cottonseed cake and prairie hay, made the least winter gains (15 pounds) but were exceeded in summer gains by the steers in lot 6. These steers (lot 2) returned the most profit for the summer period. The summer period accounted for 95 per cent of the total gain of these steers. Steers in lots 6 and 8, which made 87 per cent and 78 per cent, respectively, of their total gain on grass were the most profitable groups of steers for the combined winter and summer periods.

Wintering in a trap on a high plane of nutrition (lot 4) was the least profitable system of management for the year. These steers made the largest winter gain (92 pounds per head) and the smallest summer gain. Their lower return at the end of the summer period can be attributed partially to the fact that they were appraised \$1.50 per hundredweight less at the end of the winter than the steers in lot 6 and \$1.00 per hundredweight less than those steers in lots 2 and 8.

Wintering on the range and feeding cottonseed cake (lot 6) was the most profitable system of management for the combined winter and summer periods. These steers made an average gain of 44 pounds per head during the winter. They made the largest summer and total gains for the year. The higher returns for these steers can be attributed to their higher appraisal price at the end of the winter and their economical summer gains. Similar results were reported by Sheets and Tuckwiller (1920)

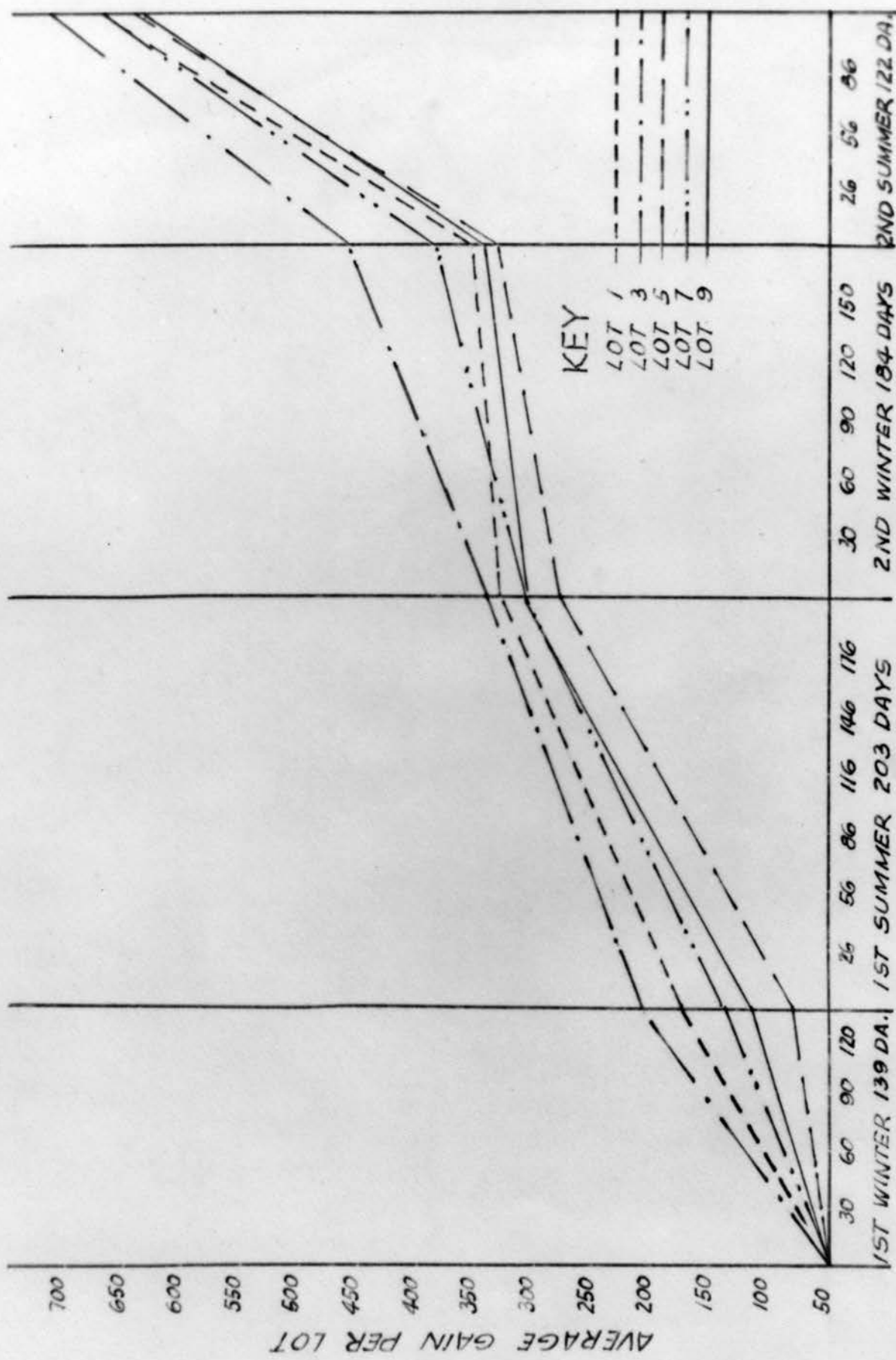


FIGURE 3. AVERAGE GAIN IN POUNDS BY PERIODS OF STEERS IN LOTS OF 1, 3, 5, 7, AND 9.

Table 24. Effect of Winter Gain Upon Subsequent Grazing of Beef Steers, 1949-1950

	Lot 2	Lot 4	Lot 6	Lot 8
Number per lot	9	10	10	10
<u>Winter</u>				
Average weight per steer (lbs.)				
Initial 10-26-49	756	782	740	776
Final 4-28-50	771	874	784	849
Total gain	15	92	44	73
Average daily gain	0.08	0.50	0.24	0.40
Financial (dollars)				
Initial cost per cwt.	21.50	21.00	21.50	21.00
Appraised price per cwt.	25.00	24.00	25.50	25.00
Cost per cwt. gain	174.33	45.38	50.86	52.99
Return per head	3.25	2.38	17.05	9.19
<u>Summer Grazing</u>				
Average weight per steer (lbs.)				
Initial 4-28-50	771	874	784	849
Final 10-30-50	1069	1124	1090	1122
Total gain	298	250	306	273
Average daily gain	1.61	1.35	1.65	1.48
Financial (dollars)				
Cost of steers when turned to grass	187.00	203.52	194.05	206.00
Cost of mineral and grass	15.22	15.22	15.22	15.22
Total cost (steers plus feed)	202.22	218.74	209.27	221.22
Cost per cwt. gain	5.10	6.08	4.97	5.57
Appraised price per cwt.	28.00	28.00	28.00	28.00
Value per steer (3% shrink)	290.36	305.20	295.96	304.64
Profit per steer	88.14	86.46	86.69	83.42
<u>Total Period</u>				
Total gain (lbs.)	313	342	350	346
Total feed cost (dollars)	41.37	56.97	37.60	53.90
Feed cost per cwt. gain (dollars)	13.22	16.66	10.74	15.58
Total profit per steer (dollars)	91.39	88.84	103.74	92.61

who concluded that pasture is best utilized by yearling steers wintered on a relatively low plane of nutrition.

Statistical analysis, as shown in table 25, shows no significant difference between the gains made during the summer of the steers that had been wintered in the trap or on the range. The different levels of wintering on the range produced no significant difference in the summer gains. There was, however, a highly significant difference in the gains of the steers that had been wintered on the two planes of nutrition in the traps as the steers in lot 2 made an average of 48 pounds more gain per head during the summer than the steers in lot 4.

Table 25. Analysis of Variance and Orthogonal Comparisons Used To Compare Summer Gains of Two-Year-Old Steers on Grass Without Supplement, 1950

Source	Degrees of Freedom	Sum of Squares	Mean Square
Total	38	71767	
Treatment	(3)	19268	6422**
Large Traps vs. Range	1	2691	2691
Medium Level Trap vs. High Level Trap	1	11296	11296**
Medium Level Range vs. High Level Range	1	5281	5281
Error	35	52499	1499

** Significant at .01 level of probability

Regression studies as found in table 26, indicate that a 100-pound advantage in gain during the winter for steers in lot 6 was reduced to -26 pounds by the end of the following summer. With the exception of steers in lot 6, the advantages in winter gains were gradually minimized but not entirely overcome at the end of the summer grazing season.

The negative correlations of the different lots of steers for the two periods as found in table 25 indicate that the steers which made slight gains during the winter made high gains during the summer.

Table 26. Regression and Correlation Studies of Winter Gains on Summer Gains of Two-Year-Old Steers, 1949-1950

	Correlation Coefficient	Regression Coefficient
Medium Level Trap (Lot 2)	-.33	- .27 $\frac{1}{Z}$ 46.32
High Level Trap (Lot 4)	-.75	- .38 $\frac{1}{Z}$ 17.05
Medium Level Range (Lot 6)	-.70	-1.26 $\frac{1}{Z}$ 28.14
High Level Range (Lot 8)	-.27	- .35 $\frac{1}{Z}$ 45.29

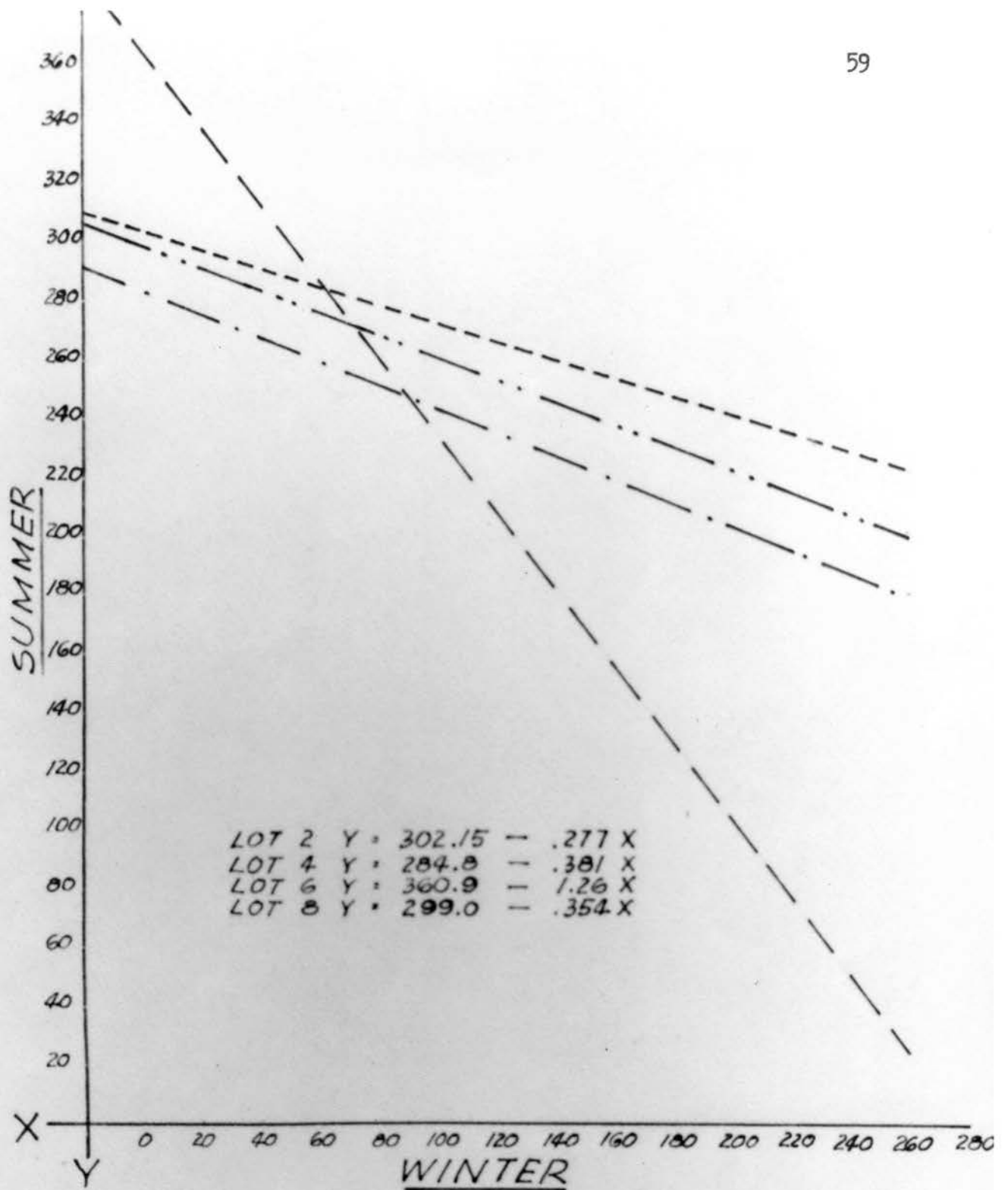
Figure 4 shows the relationship of winter gains of two-year-old steers to gains made during the summer on grass.

Table 27 gives the results of the production of two-year-old steers which were wintered at different levels during the two winters and grazed during the two summers without supplement.

Wintering two years on a high plane of nutrition in a trap (lot 4) was the least profitable system of management although this lot of steers made the greatest total gain per head of any lot during the two-year period. The total gain was 34 pounds greater per head than the gain made by the steers in lot 6 which made the greatest net return. This greater return for steers in lot 6 can be attributed to the lower feed cost over the entire period which was \$32.28 less than for steers in lot 4. The total gains made on pasture were 81 per cent and 86 per cent for the steers in lots 4 and 6, respectively.

Although the steers wintered on the range and fed cottonseed cake and oats (lot 8) made 57 pounds more total gain than the steers wintered in the trap on a medium level (lot 2), the net return per steer was \$7.42 greater for the medium level of wintering.

The high level of wintering on the range (lot 8) resulted in a \$3.38 greater return than wintering on a high level in the trap (lot 4).



KEY

LOT 2 -----
 LOT 4 -.-.-.-
 LOT 6 _____
 LOT 8-

FIGURE 4. THE RELATIONSHIP IN POUNDS OF WINTER GAINS TO GAINS MADE DURING THE FOLLOWING SUMMER BY STEERS WHEN GRAZED WITHOUT SUPPLEMENT, 1949-1950.

Table 27. The Effect of Level of Wintering
Upon the Production of Two-Year-Old Steers

	Lot 2	Lot 4	Lot 6	Lot 8
	Pr. Hay C. S. C.	Pr. Hay C. S. C. Oats	Range C. S. C.	Range C. S. C. Oats
Number of steers per lot	9	10	10	10
<u>Winter 1948-1949 (139 days)</u>				
Initial weight 11-18-48	501	497	497	497
Final weight 4-6-49	589	622	534	582
Total gain	88	125	37	85
Average daily gain	0.63	0.90	0.27	0.61
Total feed cost (dollars)	18.14	29.35	16.44	28.48
<u>Summer 1949 (203 days)</u>				
Initial weight 4-6-49	589	622	534	582
Final weight 10-26-49	756	782	740	776
Total gain	167	160	206	194
Average daily gain	0.82	0.79	1.01	0.96
Total feed cost (dollars)	14.19	14.22	14.22	14.22
<u>Winter 1949-1950 (184 days)</u>				
Initial weight 10-26-49	756	782	740	776
Final weight 4-28-50	771	874	784	849
Total gain	15	92	44	73
Average daily gain	0.08	0.50	0.24	0.40
Total feed cost (dollars)	26.15	41.75	22.38	38.68
<u>Summer 1950 (185 days)</u>				
Initial weight 4-28-50	771	874	784	849
Final weight 10-30-50	1069	1124	1090	1122
Total gain	298	250	306	273
Average daily gain	1.61	1.35	1.65	1.48
Total feed cost (dollars)	15.22	15.22	15.22	15.22
<u>Summary</u>				
Initial weight (lbs.)	501	497	497	497
Final weight (lbs.)	1069	1124	1090	1122
Total gain (lbs.)	568	627	593	625
<u>Financial (dollars)</u>				
Initial cost @ \$30 per cwt.	150.30	149.10	149.10	149.10
Total feed cost	73.70	100.54	68.26	96.60
Total cost (steers plus feed)	224.00	249.64	217.36	245.70
Selling price per cwt.	28.00	28.00	28.00	28.00
Value per steer (3% shrink)	290.36	305.20	295.96	304.64
Return per steer	66.36	55.56	78.60	58.94

The increased profit can be attributed to the more economical gains made by the range steers as there was only 2 pounds difference in the total gains and all steers were appraised at the same price.

Under conditions of this experiment, the steers in lot 6, which were wintered on a medium plane of nutrition on the range, proved to be the most profitable. These steers made 86 per cent of their total gains during the summer and returned \$78.60 per head for the two-year period. These results are similar to those reported by Black, Quesenberry, and Baker (1938). They concluded that if steer calves are to be developed into two-year-old feeder steers by use of summer range, they should be wintered to gain 25 to 50 pounds each during the first winter and kept in a thrifty condition on a plane of nutrition slightly above maintenance during the second winter.

Statistical Analysis of the entire two-year period, as found in table 28, shows that there was no significant difference in the total gains of the steers that were wintered in the trap and on the range. Feeding oats in addition to cottonseed cake on the range during the winter did not produce significantly greater gains. There was, however, a significant difference in the total gains of the steers wintered on the two levels of nutrition in the traps. The steers in lot 4, which were wintered on a high plane of nutrition, made an average of 59 pounds greater gain than the steers in lot 2.

Table 28. Analysis of Variance and Orthogonal Comparisons Used To Compare Systems of Management and Levels of Wintering For The Entire Two-Year Period

Source	Degrees of Freedom	Sum of Squares	Mean Square
Total	38	135123	
Treatment	(3)	22361	7453
Large Traps vs. Range	1	390	390
Medium Level Trap vs. High Level Trap	1	16026	16026*
Medium Level Range vs. High Level Range	1	5445	5445
Error	35	112762	3221

* Significant at .05 level of probability

Figure 5 shows the average gain by periods of steers in lots 2, 4, 6, and 8.

Wintering Two-Year-Old Steers, 1950-1951

Table 29 shows that the steers wintered on a high plane of nutrition in the trap (lot 4) made an average of 34 pounds per head greater gain than those steers wintered on a low plane of nutrition in a comparable trap. Although the well-wintered steers made this greater gain, there was only \$1.50 per head difference in the total profit for the winter period.

The steers which were wintered on the medium plane of nutrition on the range lost 52 pounds per head during the winter period and demanded the lowest appraisal price in the spring. Consequently, these steers returned the least profit for the winter.

Under conditions of this trial, wintering in the trap on a high level of nutrition was the most profitable system of management.

Analysis of variance and orthogonal comparisons used to compare systems of management and levels of wintering during this period are

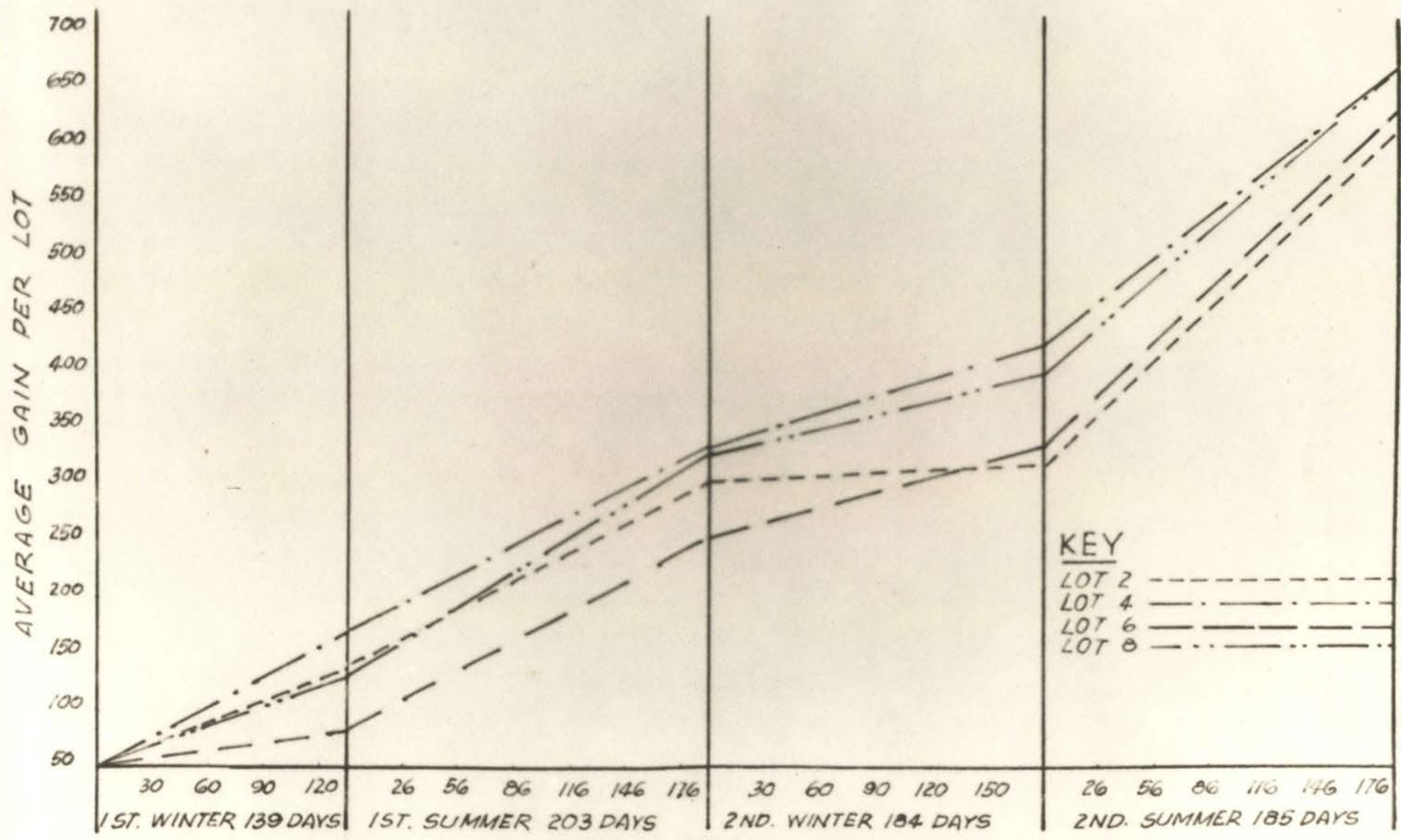


FIGURE 5. AVERAGE GAIN BY PERIODS OF STEERS IN LOTS 2, 4, 6, AND 8

Table 29. Wintering of Two-Year-Old Steers
1950-1951

	Lot 2	Lot 4	Lot 6	Lot 8
	Prairie Hay C.S.C.	Prairie Hay C.S.C. Oats	Range C.S.C.	Range C.S.C. Oats
Number per lot	10	9	10	10
Average weight (lbs.)				
Initial 10-30-50	1069	1124	1090	1122
Final 4-29-51	1095	1134	1038	1165
Total gain or loss	26	60	-52	43
Average daily gain	0.14	0.33	-0.29	0.24
Average daily ration (lbs.)				
Cottonseed cake	1.24	1.24	2.49	2.49
Oats	-	2.98	-	2.98
Prairie hay	19.29	16.32	-	-
Range	-	-	ad. lib.	ad. lib.
Mineral	0.10	0.08	0.17	0.17
Financial results per steer (dollars)				
Initial cost per cwt.	28.00	28.00	28.00	28.00
Initial cost per head (3% shrink)	290.36	305.28	295.96	304.64
Feed cost per head	24.71	37.87	22.49	38.10
Total cost (steers plus feed)	315.07	343.15	318.45	342.74
Necessary selling price per cwt.				
to break even	28.77	28.98	30.68	29.42
Appraised price per cwt.	34.00	34.00	32.50	33.00
Value per steer (3% shrink)	361.08	390.66	327.27	372.90
Net return per steer	46.01	47.51	8.82	30.16

Feed Prices

Cottonseed cake	\$77.50 per ton
Oats	.93 per bushel
Prairie hay	9.00 per ton
Mineral mixture	1.73 per cwt.
Range	5.00 per head

found in table 30. There was a highly significant difference between the gains of the steers wintered in the trap and on the range. The steers wintered in the traps made 53 pounds greater gains than the steers wintered on the range. There was no significant difference between the levels of wintering in the traps but the loss of weight by steers in lot 6 and the gain in weight for steers in lot 8 resulted in a difference which was highly significant.

Table 30. Analysis of Variance and Orthogonal Comparisons Used To Compare Systems of Management and Levels of Wintering for Two-Year-Old Steers, 1950-1951

Source	Degrees of Freedom	Sum of Squares	Mean Square
Total	38	139809	
Treatment	(3)	74870	24956**
Traps vs. Range	1	23369	23369**
Medium Level Trap vs. High Level Trap	1	5422	5422
Medium Level Range vs. High Level Range	1	46079	46079**
Error	35	64939	1855

** Significant at .01 level of probability

SUMMARY

The data in this report are the results of an experiment designed to obtain information as to the most desirable level of wintering from the standpoint of economy of the winter ration as well as the effect on subsequent summer gains. Also, the feeding of grain on grass during the second grazing season was studied and compared with a system where steers were grazed without supplemental feed.

The steers in lots 1, 2, 3, and 4 were wintered in two-acre traps at the experimental range area. The steers in lots 1 and 2 were fed prairie hay, free choice, plus approximately 1.25 pounds of cottonseed cake per head daily (medium level of nutrition). The steers in lots 3 and 4 were fed prairie hay, free choice, plus about 1.25 pounds of cottonseed cake and 3 pounds of whole oats per head daily (high level of nutrition).

The steers in lots 5, 6, 7, and 8 were wintered in 200-acre pastures at the experimental range area. The dried native grass was supplemented with approximately 2.25 pounds of cottonseed cake per head daily for the steers in lots 5 and 6 (medium level of nutrition) and about 2.25 pounds of cottonseed cake and 3 pounds of whole oats per head daily for the steers in lots 7 and 8 (high level of nutrition).

The steers in lot 9 were wintered in a small trap approximately 50 feet by 50 feet. These steers were fed prairie hay, free choice, and approximately 1.25 pounds of cottonseed cake per head daily (medium plane of nutrition). The purpose of this lot was to study the effect of close confinement on the gains made by the steers when they were turned to pasture.

All steers were allowed only native grass pasture during the summer months with exception of the summer of 1950. During this period when the steers were two years old, the cattle in lots 1, 3, 5, 7, and 9 were fed approximately 3 pounds of ground shelled corn per head per day while on grass.

During both wintering and grazing periods, all cattle were allowed access to a mineral mixture of 2 parts ground rock salt and 1 part steamed bone meal.

Wintering Steer Calves, 1948-1949

None of the lots of calves showed a profit for this period which was due to a drop in the prices of stocker cattle.

The largest gains were made by the calves in lots 3 and 4 which were wintered on a high level of nutrition in the traps.

The most profitable method of wintering was to feed approximately 1.25 pounds of cottonseed cake and provide prairie hay, free choice, to steers in a two-acre trap (lots 1 and 2).

Wintering Steer Calves, 1950-1951

Wintering on a high level of nutrition in the trap (lots 3 and 4) produced the most gain but returned the least profit of any lot of calves during this period.

Under conditions of this study, the steers in lots 1 and 2 which were wintered on a medium level of nutrition in the trap were the most profitable although they returned only \$3.07 per head more than the calves which were wintered on a high plane of nutrition on the range.

Grazing of Yearling Steers, 1949

The steers in lots 3 and 4, which had been wintered on a high plane of nutrition in the traps, made the largest winter and total gains for the year but the least summer gain.

The calves in lots 5 and 6 which were wintered on a medium level of nutrition on the range made the least winter gains but the most summer gains and returned the greatest profit for this period.

The steers which had been wintered on a high plane of nutrition in the trap (lots 3 and 4) or on the range (lots 7 and 8) did not return as much profit for the combined winter and summer period as those steers which had been wintered on a medium level of nutrition (lots 1 and 2, 5 and 6).

Wintering on a medium plane of nutrition in the two-acre trap was the most profitable system of management for the combined winter and summer period.

It appears that confinement of steers to a small trap (lot 9) does not affect their grazing or gaining ability.

Calves which had been wintered on a medium level of nutrition on the range (lots 5 and 6) made significantly greater gains during the summer than those which had been wintered on a high level of nutrition on the range.

The correlation coefficients and regression coefficients, respectively, for gains made during the winter and summer periods were $-.61$ and $-.53$, $-.59$ and $-.72$, $+.07$ and $+.08$, $-.22$ and $-.35$, and $-.73$ and $-.52$ for the steers in lots 1 and 2, 3 and 4, 5 and 6, 7 and 8, and 9, respectively.

Wintering Yearling Steers, 1949-1950

Wintering steers on a high level of nutrition in the trap (lots 3 and 4) produced the most gain while wintering on a medium plane of nutrition in the trap (lots 1 and 2) produced the least gains during this period.

The steers that were wintered on the range and fed cottonseed cake (medium level of nutrition) made the greatest return for this period.

Wintering on a high level on the range (lots 7 and 8) returned a greater profit than wintering on a medium level in the trap (lots 1 and 2).

Summer Treatment of Two-Year-Old Steers, 1950

Grazing of Steers with Supplement

Steers in lots 1, 3, 5, 7, and 9 were fed approximately 3 pounds of ground shelled corn during this period.

The steers in lot 1, which had been wintered in the trap on a medium level of nutrition, returned the greatest profit for the summer period and for the combined winter and summer period.

The steers in lot 3, which had been wintered on a high plane of nutrition, had the highest dressing percentage.

All carcasses from these steers graded high, medium, or low commercial.

The steers that had been wintered on a medium level of nutrition in the trap (lot 1) made the greatest summer gains and significantly greater gains than the steers that had been wintered on a high level of nutrition in the trap.

The correlation coefficients and regression coefficients, respectively, for gains made during the winter and summer periods were $-.54$

and $-.49$, $-.61$ and $-.69$, $+.33$ and $+.54$, $-.01$ and $-.08$, and $-.33$ and $-.30$ for the steers in lots 1, 3, 5, 7, and 9, respectively.

Grazing of Steers without Supplement

Steers in lots 2, 4, 6, and 8 did not receive supplement during the summer grazing season.

The steers in lot 2, which had been wintered on a medium level of nutrition in the trap, made the most profit during the summer.

The least profit for the summer period was made by the steers in lot 8, which had been wintered on a high plane of nutrition on the range.

The most profitable system of management for the combined winter and summer period was wintering steers on a medium plane of nutrition on the range (lot 6).

The greatest gain made during the summer period and for the combined winter and summer period was made by those steers in lot 6. These gains were significantly greater than the summer gains of steers in lot 8 which had been wintered on a high level of nutrition on the range.

There was no significant difference in the summer gains of the steers that had been wintered in the trap and on the range.

The correlation coefficients and regression coefficients, respectively, for gains made during the winter and summer periods were $-.33$ and $-.27$, $-.75$ and $-.38$, $-.70$ and -1.26 , and $-.27$ and $-.35$ for the steers in lots 2, 4, 6, and 8, respectively.

Wintering Two-Year-Old Steers, 1950-1951

Wintering in the trap on a medium level of nutrition (lot 2) and in the trap on a high level of nutrition (lot 4) were the most profitable systems of management for two-year-old steers.

The greatest gains during this period were made by those steers in lot 4 which had been wintered on a high level of nutrition in the trap.

Systems of Management for the Production of Two-Year-Old Steers

The most profitable system of management was to winter steers two years on a medium plane of nutrition on the range (lot 6). These steers made 86 per cent of their total gain during the two summer periods and returned \$78.60 per head for the two years.

Wintering steers in a small 50 feet by 50 feet trap on a medium plane of nutrition followed by feeding grain on grass during the second summer was the least profitable system of management.

Under conditions of this experiment, it was not profitable to feed grain on grass during the second summer before the steers were marketed with exception of steers in lot 1 which had been wintered two winters on a medium level of nutrition in the trap. These steers returned \$2.76 per head more profit for the two-year period than the steers in lot 2 which were wintered on the same level but received no supplement during the second summer.

Wintering two winters on a high level of nutrition in the trap followed by feeding a supplement on grass during the second summer (lot 3) produced the greatest gains over the two-year period.

The least gains for the two-year period were made by the steers in lot 2, which were wintered on a medium plane of nutrition in the large trap.

At the end of the two-year period, there was no significant difference in the gains made by the steers which received grain on grass during the second grazing season.

For those steers which received no supplement during the second summer, there was no significant difference between the gains of the steers in the traps and on the range or between the two levels of wintering on the range. There was, however, a significant difference between the high and low levels of wintering in the trap as the steers in lot 4 made 59 pounds more gain than the steers in lot 2.

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