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# Integrated Livestock and Forage Production through Multi-species Grazing: A Progress Report

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## Introduction

Grazing two or more species of livestock together on the same land area is a common management technique in the western and southwestern range areas of the United States. Matthews et al. (1986) found that range conditions were improved and red meat production per acre increased by co-grazing cattle and sheep on high elevation Utah summer rangeland. Apparently increased efficiency of total utilization occurs with multi-species grazing because cattle and sheep diets overlap only 35 %, with sheep preferentially grazing high ground and cattle the lower areas (Baker and Jones, 1985).

Sheep, because of mouth and lip anatomy, are more selective grazers than are cattle. Sheep prefer to graze weeds, forbs, and immature grasses. Cattle tend to consume larger more mature grasses and legumes. Meyer 1985) reported that, since a 1984 Federal Court ban on the use of herbicides on federally owned lands in Oregon, sheep have successfully been used to control weeds in clear-cut forest areas. '

Limited research data is available on multi-species grazing in the Midwestern United States. Sanderson et al. (1988) concluded that pasture use efficiency in southern Iowa was increased by sequentially grazing steers and dry, mature ewes. Umberger et al. (1984) found that adding one ewe per cow resulted in an increase in net profit of 29% when compared to cattle grazed alone. Wedin (1985) stated that interest in multi-species grazing in the Midwestern United States far exceeds the available research data.

Highly erodible land in southwest Indiana is being removed from .crop production in compliance with the 1985 Federal Food Security Act and Indiana's "T by 2000" program. These programs necessitate that economically viable and sustainable agriculture systems be explored. The objectives of the current research are to determine if multi-species grazing will increase total productivity per unit of land area and what effect multi-species grazing will have on forage utilization, pasture botanical composition and forage nutritional quality.

## Procedures

The 1991 grazing season was the first of a three-year project to investigate a strategy of multi-species grazing on pasture forage utilization and animal productivity per fixed land area. This is a progress report on preliminary data. These data have not been statistically analyzed, thus, should be interpreted with caution. The total three-year data base will be statistically analyzed at completion of the project and conclusions can be reached with a higher degree of certainty.

## Source of Data

This study is being conducted at the Southern Indiana Purdue Agricultural Center (SIPAC) located in Dubois County, Indiana. The terrain at SIPAC is rolling and steep and the research center has active research programs in forage production, beef cattle production, forestry and aquaculture. Much of this region is in pasture, with a strong cow/calf industry.

Three experimental treatments were used; cows with calves grazing alone, ewes and their lambs grazing alone and cows and ewes with their offspring grazing the same pasture simultaneously. Cows were stocked at one cow/calf pair per 1.33 acres. Ewes were substituted at a rate of five ewes per cow on the sheep only treatment. Re multi-species treatment consisted of adding one ewe and her lambs for each cow present. Each treatment was replicated two times for a total of six pastures. Each pasture has eight acres. The cattle only pastures had six cow/calf pairs, the sheep only had 30 ewes and lambs, and the multi-species pasture contains six cow/calf pairs and six ewe/lamb units.

Forage base of the pastures are tall fescue with red and ladino clover. These are forages commonly utilized in this region of the state.

There was a perimeter fence; a six-strand, high tensile, electrified fence. Existing fencing of four and five strand barbed wire for cattle was modified with two strands of electrified wire to contain sheep. Pastures are divided between and within by two strands of electrified wire. Overall, this fencing strategy is low cost and effectively controls the animals.

Ewes are crossbred Polypay type ewes, that were acquired in November of 1990. When purchased, they were 16 to 18 months of age, had lambed at 12 months of age and were in thin condition. They had been exposed to Polypay rams just prior to their acquisition and transport. Ewes are randomly assigned to treatment by number of lambs suckled.

Cows are crossbreds of Hereford, Angus and Simmental breeding. Cows were randomly assigned to treatment by breed make-up, age and sex of their calf.

Ewes were treated for internal parasites, weighed and put on pasture without supplemental feed. A mineral mix was available for free choice consumption. Lambs have ad libitum access to a 16% crude protein creep ration that contains lasalocid. Cows were weighed, treated for parasites, conditioned scored and placed on their respective pastures. Calves were weighed and were not creep fed.

The eight-acre pastures were divided into two equal parts and were grazed and rested as forage status dictated. Hay was taken off one side of the pastures during the first flush of spring growth.

Lambs were weaned on August 6 and calves weaned on October 10. Ewes and cows remained on pasture until November 6.

Ewes were fed a flushing diet of one pound of shelled corn per ewe daily for 45 days starting on September 12. Fertile Suffolk rams were placed with ewes on October 3 and were rotated among pastures at 10 to 14?day intervals.

## Data Collection

Cows and ewes were weighed at the initiation (April 25, 1991) of the grazing season and were weighed at monthly intervals. Calves and lambs were also weighed at the start and at monthly intervals.

Forage samples were taken on April 25, July 5 and September 26. This corresponded to a spring, summer and early fall sample. Forage samples were taken on the half of the eight-acre pasture that was not hayed in the early spring. This portion of the paddocks received heavier grazing pressure. Forage was collected using a three-square foot frame and hand clippers. Forage was cut at a level just above the ground (one-half inch). Four samples were taken per replicated pasture for a total of 24 samples for each sampling period. Samples were refrigerated before botanical separation.

Each forage sample was hand separated by botanical species. Each grass, legume and weed species was dried, weighed and then recombined for quality analysis.

Response variables to determine effect of type of grazing treatment were: growth performance of lambs and calves relative to pasture treatment, forage botanical composition and dry matter production, forage quality analysis and in vitro digestibility.

## Results and Discussion

Again, caution should be used in interpreting these data as this is only a progress report on the first year's data.

During the course of the grazing season, two ewes and two lambs died. This was 3 to 4% of the total on study and is well below an average death loss. Ewes were not supplemented with grain, except for prior to and during the breeding season.

One calf died from pneumonia on the cattle-only treatment just prior to weaning. His weight is included in the data.

Percent lambs suckling ewes was quite low for this region of the United States. Ewes on the sheep only treatment had a lambing percent of 98% and the ewes on the multi-species treatment had a 100% lamb crop. This low lambing rate was attributed to the thin condition of the ewes at breeding and the transport of the ewes immediately post breeding. There were some open ewes on the pasture to keep the stocking rate at the desired level. Thus, the productivity data of the sheep relative to cattle would be lower than expected if a higher number of lambs were suckling the ewes.

The 1991 grazing season was affected by a drought. Precipitation during the time animals were grazing was only 69% of the average for this time period.

Weight gains of lambs and calves. Total weight weaned of lambs and calves from their respective treatments is presented in Table 1. Total weight weaned was 2755, 2096 and 3271 lbs. for the cattle, sheep, and multi-species treatments, respectively. Total weight gain (weaning weight less starting weight) was 1665 lbs. for calves on cattle only treatment, 1283 lbs. for lambs on the sheep only regime, and 1985 lbs. for lambs and calves on the mixed species treatment. Weight gain per acre of lambs and calves also seemed to favor the multi-species treatment. Pastures with both species of livestock present had 40 lbs. more gain per acre than the cattle only treatment and 88 lbs. higher gain per acre than the sheep only treatment.

Table 2 highlights calf performance only between the cattle-only treatment and the multi-species treatment. Based on these preliminary results, it appears that calf growth and gain did not decrease when sheep were added to the grazing regime.

Lamb performance (Table 3) only compared between sheep and multispecies treatments seemed to follow the same trend exhibited by the calves. Weight weaned and total weight gain by the lambs cannot be compared directly between the treatments because of differing lamb numbers. Although, the average daily gain (ADG) of lambs on the multi-species treatment (.51 lb. vs. .48 lb.) was not any lower than on the sheep-only treatments.

Based on these preliminary data it appears that total weight weaned, total weight gained and gain per acre can be increased by co-grazing sheep and cattle relative to either species grazed alone. Furthermore, increasing the stocking rate by adding another species of livestock does not appear to lower the gains and

performance of either species when compared to the gains of the calves and lambs on the cattle-only and sheep-only grazing treatments.

Botanical and Chemical Composition of Forage. One of the main objectives of this study was to monitor botanical changes in plant species mix within the same grazing season and over the entire three-year project period. Results from the first year are presented in Table 4.

Several trends are suggested by this data. Samples from the first forage harvest from the respective pasture treatments indicate that there was a relatively uniform distribution of plant species, with the exception of higher levels of buckhorn plantain detected in samples from the cattle-only pastures. Samples from the second harvest suggest a trend for lower percentages of legumes and weeds detected and a higher percentage of tall fescue for those pastures containing sheep (sheep only and multi-species as compared to those with only cattle grazing. Sheep may be preferentially consuming the weeds and the higher protein legumes. Previous research from Purdue University indicated that Suffolk ewe lambs selectively grazed higher quality forages than the average of the forages available.

Because of extremely dry conditions and poor pasture regrowth, hay was offered to all animals from August 1 to September 16. Sheep consumed 907 Ibs., cattle consumed 7,120 1bs. and the animals in the multi-species pastures consumed 7,472 lbs. of hay during this period.

Forage samples from the third harvest (9/26/92) appear to even-out in percentages of grasses and legumes across treatments. Although, pastures containing sheep had lower levels of weeds (plantain, crabgrass, knotweed) than pastures containing cattle only.

Pounds of forage dry matter per acre (Table 5) indicate similar amounts of forage for the sheep and cattle pastures, but, lower levels of forage available for the multi-species groups during the first and third sampling periods.

Chemical composition and in vitro digestibility of the forage samples collected are presented in Table 6. Forage quality seemed to be fairly uniform over treatments during all harvest periods. However, pastures containing sheep only contained an average of 13.9% crude protein compared to 14.8% CP for cattle only pastures and 14.6% CP for multi-species pastures.

## Summary

Preliminary results comparing a multi-species grazing strategy to a cow/calf grazing strategy and a ewe/lamb grazing program indicate that grazing cattle and sheep together on the same land area increases productivity with minor additional inputs. Grazing cattle and sheep simultaneously increased animal gain

per acre by 40 lbs. when compared to cattle-only and by 88 lbs. when compared to sheep grazed alone. There seemed to be no detrimental effect on gain and performance of either livestock species in multi-species grazing strategy when compared to the performance of the respective animal species grazed alone.

Dual electrified wires added to existing cattle fencing did a satisfactory job in containing sheep. Predators (coyotes) were seen and heard in the area, but there were no animal losses to predation.

More data needs to be collected to determine clear patterns and trends regarding forage botanical and chemical composition. The project is scheduled for two more years.

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Table 1. Lamb and Calf Performance by Pasture Treatment

| Item | Cattle | Sheep | Mixed Species |
|---|---|---|---|
| Weight weaned, lbs. | 2755 | 2096 | 3271 |
| Weight gain, lbs. | 1665 | 1283 | 1985 |
| Gain/acre, lbs. | 208 | 160 | 248 |

Table 2. Performance of Calves by Pasture Treatment

| Item | Cattle | Mixed Species |
|---|---|---|
| Weight weaned, lbs. | 2755 | 2783 |
| Weight gain, lbs. | 1665 | 1683 |
| Average daily gain, lbs. | 1.67 | 1.69 |
| Gain/acre, lbs. | 208 | 210 |

Table 3. Effect of Pasture Treatment on Lamb Performance

| Item | Sheep | Mixed Species |
|---|---|---|
| Weight weaned, lbs. | 2096 | 487 |
| Weight gain, lbs. | 1283 | 302 |
| Average Daily gain, lbs. | .48 | .51 |
| Gain/acre, lbs. | 160 | 37.7 |

Table 4. Botanical Composition of Forage Samples by Pasture Treatment and

| Sampling Period[a]. | | | |
|---|---|---|---|
| **Harvest 1 (4/25/91)** | Cattle | Sheep | Mixed Species |
| Tall fescue | 66.15 | 67.22 | 72.48 |
| Bluegrass | 20.44 | 16.43 | 16.47 |
| Orchardgrass | 2.06 | 2.54 | 1.25 |
| Ladino clover | 5.91 | 5.70 | 6.12 |
| Red clover | 1.43 | 8.10 | 3.20 |
| Buckhorn plantain | 4.09 | ----- | .50 |
| Chickweed | ----- | .003 | ----- |
| Dandelion | ----- | .015 | ----- |
| **Harvest 2 (7/5/91)** | | | |
| Tall fescue | 80.84 | 89.55 | 90.85 |
| Bluegrass | 6.90 | 4.81 | 4.09 |
| Orchardgrass | 1.03 | .25 | .54 |
| Ladino clover | 8.40 | 4.51 | 4.15 |
| Red clover | .95 | .86 | .24 |
| Buckhorn plantain | 1.77 | ----- | .15 |
| Horsenettle | .12 | .02 | ----- |
| **Harvest 3 (9/26/91)** | | | |
| Tall fescue | 88.29 | 89.99 | 86.68 |
| Bluegrass | 7.30 | 8.42 | 10.94 |
| Orchardgrass | 1.27 | .92 | 1.09 |
| White clover | .73 | .48 | .81 |
| Buckhorn plantain | 1.78 | .19 | .49 |
| Crabgrass | .34 | ---- | ---- |
| Knotweed | .54 | ---- | ---- |
| [a]percentage on a dry weight basis | | | |

Table 5. Forage Dry Matter Per Acre (lbs) by Pasture Treatment and Sampling Period.

| | Cattle | Sheep | Multi-Species |
|---|---|---|---|
| Harvest 1 (4/25/91) | 1815 | 1841 | 1387 |
| Harvest 2 (7/15/91) | 808 | 799 | 812 |
| Harvest 3 (9/26/91) | 422 | 467 | 290 |

| Table 6. Chemical Composition and Digestibility of Forage by Pasture Treatment and Sampling Period. | | | |
|---|---|---|---|
| **Harvest 1 (4/25/91)** | Cattle | Sheep | Multi-Species |
| NDF, % | 54.86 | 55.26 | 55.63 |
| ADF, % | 29.83 | 30.51 | 30.83 |
| Crude protein, % | 13.56 | 13.96 | 13.33 |
| Digestibility, % | 51.90 | 53.70 | 51.70 |
| **Harvest 2 (7/5/91)** | | | |
| NDF, % | 53.24 | 55.39 | 55.31 |
| ADF, % | 26.90 | 27.01 | 27.39 |
| Crude protein, % | 15.54 | 14.20 | 15.59 |
| Digestibility, % | 53.39 | 54.06 | 53.82 |
| **Harvest 3 (9/26/91)** | | | |
| NDF, % | 56.59 | 60.65 | 59.32 |
| ADF, % | 31.19 | 32.21 | 31.28 |
| Crude protein, % | 14.77 | 13.87 | 14.59 |
| Digestibility, % | 48.65 | 46.32 | 47.85 |

## Literature Cited


Baker, F.H. and R. Jones. 1985. Proceedings of a conference: Multispecies grazing. Winrock International, Morrilton, Arkansas.

Matthews et al. 1986. The Professional Animal Scientist. Volume 2:2:18.

Meyer, H.H. 1985. Proceedings of a conference: Multispecies grazing. Winrock International, Morrilton, Arkansas.

Sanderson et al. 1988. Beef-Sheep Research Report. pp. 31. Iowa State Univ., Ames.

Umber er et al. 1984. Virginia Coop. . Ser. Pub. 410:pp. 851.

Wedin, W.F. 1985. Proceedings of a conference: Multispecies grazing. Winrock International, Morrilton, Arkansas.