Estimating the Sustainability and Productivity of a Meat Goat Operation on NY Pastures

Farmer/Grower Grant Final Report

FNE99-276

1. Objectives

The overall objective of the study was to evaluate the sustainability and productivity of the meat goat management system that had evolved over time on our farm. The hope was to obtain some real figures that would be helpful to other pasture-based meat goat operations.

Goats are effective eradicators of woody plants. It is often assumed that their presence on a pasture will be transient, i.e., they will move on once the browse is eradicated. However, many meat goat producers cannot readily convert their goat-improved pastures to another farm enterprise or continually move their goatherds to new farm sites. Our forage management system developed in an attempt to 1) utilize improved pastures without letting our goats accumulating the dangerous worm loads associated with such pastures, and 2) sustain browse in our remaining brush pastures for as many years as possible.

The pasture-based system on our farm relied on winter drylots with barn access from mid Dec through April, rotational grazing of conventional pastures from May through July, month-long grazing of two brush pastures Aug through Sept, and strip grazing of hay field regrowth from Oct until mid Dec. Two horses followed the goats through the conventional pastures and continued to rotate through these same pastures in August and September.

To evaluate how ecologically and economically sustainable the model was, we needed to determine:

a) How the pasture ecology changed from year to year and season to season in both conventional and brush pastures. (Did the ratio of desirable plants decrease? Was it possible to maintain brush plants?)

b) How the quality and quantity of pasture varied seasonally and annually. (How many breeding does and offspring could be maintained per acre depending on the season, year, and the doe's stage in pregnancy/lactation.)

c) How fecal worm counts and incidences of severe anemia varied as goats passed from winter drylots to conventional pastures to brush pastures to grazing hay field regrowth. (How effective was chemical deworming during these different management stages?)

d) The productivity of a group of does maintained under this pasture-based system. (What were the growth rates, dressing percentages, and mortality rates of their kids? How did rates of weight gain and loss vary between does with single kids and multiple births? Between yearling does and mature does? How did income per doe vary?)

e) Major labor and financial costs of running a small meat goat farm.

2. Farm Description

The farm remains a meat goat operation and none of the areas that were fallow at the beginning of this research grant have been incorporated into the enterprise. At the initiation of this grant, I reported having 54 acres of which 8 acres were in fenced pastures and 15 acres in hayfields. We were better able to

measure the acreage during the study. In reality, the farm has about 10 acres in fenced pastures and 14 acres in hay fields (East hay field – 5 acres, West hay field 9 acres). We still run ~30 breeding does and their kids. In 2003, we maintained 35 does. However, in 2004 we plan to again freshen only 30 does as our indoor barn space (500 sq. ft.) is too crowded when more than 25 - 30 goats freshen during our early April kidding season.

During the second year of our project we built an inexpensive outdoors feed rack for our round bales that decreased our winter hay wastage and built a three-sided addition to our hay barn that increased our winter hay storage capability.

3. Cooperator Descriptions

Drs. Dan Brown and **Deborah Cherney**, Cornell University Animal Science Department, provided advice on pasture management, and forage sampling and evaluation. Both of them also participated physically in the forage surveys conducted twice yearly on the grazed lands. Deborah Cherney presented data from the first year of the study during a goat pasture management workshop at the 1999 Caprine Outing. Dan Brown in consultation with parasitologist, Dr. Dwight Bowman, advised on presentation of the fecal worm count information.

Certified foresters, **Dr. Peter Smallidge** and **Don Schaufler**, walked the wetland and brush sections of the pastures each year and advised on browse physiology. They participated in the annual sampling of the wetland area.

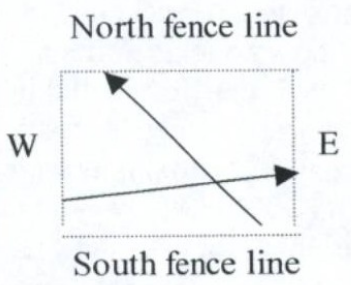
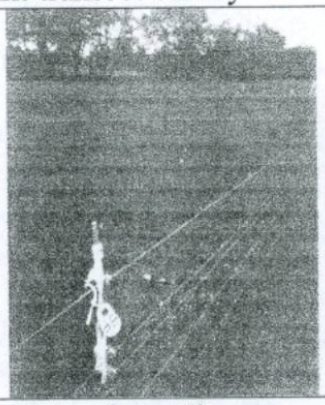
Three different people held the Cornell Cooperative Extension grazing specialist position for our region of NY over the duration of this study. **Greg Albrecht** helped out with the initial planning of the project and first soil samples. **Kathy Finnerty** toured the pastures and provided her input at the end of the first year. **Dan Demaine** walked and advised on the pastures the second year and organized the farm field day at the study's end. He took the final soil samples.

4. Project Methods

a. Pasture Ecology

We kept track of plant species changes in the 3 grazed areas (conventional pastures, brush pastures, hay field regrowth) by doing a **"step point transect survey"** twice yearly of each field. Two random transects were assigned per field. In the case of rectangular fields, one transect or line ran across the field from the North to South fence lines, the other from the East to West fence line. Triangular pastures were "crisscrossed" as best as possible. We then put permanent markers at the point where each transect intersected the fence line so that the same transect could be sighted along and evaluated for each survey. The fields consisted of 5 conventional pastures ranging from .94 to 1.51 acres; two brush pastures ranging from 1.48 to 2.54 acres, and one hayfield of approximately 5 acres. A farm map is available in Appendix 1. Surveys for the conventional pastures and hay fields were done 5/11/99, 11/12/99, 5/16/00 and 11/14/00. The brush pastures were surveyed 5/25/99, 11/12/99, 5/16/00 and 11/14/00. The procedure consisted of one person carrying a thin metal rod and walking the designated line. Every 2 to 4 paces depending on the size of the field, the person would place the rod at the tip of their shoe and report which plant species the rod first encountered. The accompanying person would record this plant species. In some cases only bare ground, plant stubble, or manure was encountered. These occurrences were also recorded. The results were then compared across two seasons and years.

Table 1.Conducting a step-point transect survey

		
Estimating a transect	Marking fence line	Sighting along the markers
		
"Stepping"along the transect	"Pointing" the rod to determining the plant species first encountered	Writing down the plant (or rock or dirt or?) encountered

One hedgerow and one brushy wetland that had been severely girdled by goats in earlier years had small subsections of them chain sawed at the crown in January 1999 to see if such pruning would stimulate sprouting of suckers within the predated plant species (willow, red-stem dogwood and honey suckle. Photos of the various treatments were taken in late spring and the plots visually evaluated by two certified foresters. In addition, the large brushy wetland area (located in Pasture 7) had a transect sighted along its entire length. Eight equally spaced points were pinpointed along this line and marked with fiberglass posts. On 8/8/99 and 8/3/00 immediately prior to the goats being brought into the pasture, the wetland was surveyed using **"point intercept measurements"**. An 8 ft pole was held upright at each point and used to determine the health of the vegetation as measured by height and density. The pole was marked at foot and inch intervals. These marks were used to 1) determine the height of the tallest brushy plant present at the point, and 2) estimate the percentage of coverage of each plant species present at the point within its habitat level. For example, if a berry bush was present at that point and inhabited the lowest 3 feet of the pole, how densely did it cover these respective three feet ?

b. Forage Productivity

Productivity of the grazing areas was measured by taking approximately 3 plant samples (1 sq. ft. each) per acre as goats entered each field. These samples were taken by randomly flinging a wooded "L" across the field. The "L" was made of plywood and each "arm" was 1 ft in length. The "L" worked well on tall herbs such as golden rod and dogwood as it was easy to slip over them for sampling. These plant samples were used to calculate wet and dry matter weights.

Approximately two 4 ft x 4 ft mobile exclusion cages per acre were erected in each field as the goats entered in 1999. A sq. ft. of pasture in the middle of each cage was periodically trimmed to mimic goat-grazing behavior. For example, if the goats stayed in the pasture two weeks, the area might be trimmed at day 5, day 10 and day 14 to a similar length as that of the grazed area outside the exclusion cages. These samples were analyzed for nutrient composition through the Dairy Herd Improvement Lab in Ithaca, NY. However, exclusion cages were not used in 2000 because each conventional field was further subdivided in two and grazed for only 1 week at a time. It was theorized that there would be too little regrowth in a 1 week period to warrant the time and labor of moving the cages from field to field. (The first year had been relatively dry and little regrowth had been noted on trimmed swaths after the first "manual trimming to mimic grazing". Of course, the second year was much wetter and we sometimes regretted not having used the exclusion cages!). Instead, the initial plant samples taken as goats entered a field were used not only to estimate wet and dry matter but also for the nutritional analysis in 2000.

c. Worm Control

Fecal samples from a representative 10% of the herd were taken about 1 week before goats were moved to a new forage management area, for example, from conventional pastures to brush pastures, from brush pastures to hayfields, from hay fields to dry lots. They were also taken prior to kidding and weaning or anytime chemical worming was contemplated. In most cases, fecal samples were also taken 7 to 10 days after worming. Although attempts were made to sample the same goats throughout a year, the assigned goats often conspired against us. If a doe yielded no feces, a doe of similar age and body condition was substituted for her. Fecal

samples were analyzed for worm and coccidia eggs through the Cornell Diagnostic lab, except for twice when tatiana Stanton and Jennifer Ketzis ran the samples themselves.

d. Doe Productivity

Does and kids were weighed and average daily weight gain (or loss) calculated 1) each time they were moved to a new forage management area and 2) at least once monthly within these management areas (generally corresponding to a move to a new pasture subdivision). Kids were also weighed at birth, weaning and upon sale or slaughter. Individual doe records also recorded litter size, kids reared, etc. Records were kept on the prices and quantity of winter hay fed and on supplemental grain fed. Other financial expenses were also recorded as well as price received for the sale of meat or goats.

Table 2.Weighing procedure

		
We built a crate to fit on a balance beam scale then placed them in one of our jugs.	The goats were clipped in the crate for weighing.	The scale was read
		
And weight recorded.	The goats were marked when done.	Small kids were weighed on a hanging scale.

5. Project Results

a. Pasture Ecology

Step Point Transect Survey –

The results of the survey are shown in the five tables below and the accompanying bar graphs. It is important to keep in mind that the step point method measures the first plant encountered by the rod or essentially the tallest plant. Thus, it does not necessarily measure the density of the different plant species in a field. Our objective was to assert how much biodiversity existed in the pastures and changes in this biodiversity. We knew that if we conducted the surveys in late May or June, the grasses in the conventional pasture and the goldenrod in the brush pastures would tower over and "mask" many of the other plant species. We also knew we would confuse the survey if we timed it when some pastures had already been grazed and others had not. Therefore, our spring surveys were completed by mid May. The disadvantage of this is that plant species like Timothy and alfalfa were just starting to emerge and difficult to identify while others like vetch were not present yet. We conducted the fall surveys on November 12, 1999 and Nov 14, 2000, theorizing that this was as late in the fall as we could wait without risking major frost burn off of the forages. However, this was also late enough that the Timothy that was obvious in June and July was again absent or difficult to identify. Fall '00 was colder than Fall '99 and the pastures experienced some severe frosts prior to surveying unlike in Nov '99.

The surveys revealed substantial biodiversity even in the conventional pastures (Pastures 1 –5). They were very similar in composition to the East Hay Field (identified as Pasture 6). This was expected as prior to 1995 they had all composed one large uniformly managed hay field. The primary plant in Pastures 1 – 6 as measured as the tallest plant encountered was orchard grass regardless of season or year. However, bedstraw, dandelions and goldenrod were also well represented as "tallest plants" in most of these pastures at each sampling period. Forage legumes (primarily red clover and birdsfoot trefoil) were also well represented. The pasture composition changed from spring to fall, but the trends were rarely uniform from year to year. Poverty grass was an early grass identified in all the conventional pastures in May but never in November. However, the percentage of bedstraw as the "tallest plant" increased substantially during the relatively dry growing season from the Spring 99 to Fall 99 and decrease sharply from Spring '00 to Fall '00 during a wet growing season/cold fall.

The wet growing season/cold fall of 2000 also likely explains the substantial "litter" recorded in Fall '00. This litter was composed primarily of decomposing grass stubble. The goats grazed the conventional pastures only through July each year and left much of the coarse stems particularly in Pastures 4 and 5. Two horses grazed the regrowth of the conventional pastures but had difficulty keeping on top of them. The severe frosts in Fall '00 as compared to Fall '99 appeared to have resulted in an early kill of some of the grasses in Pastures 1 – 6. Increases in dirt and manure sighting in Pastures 4 and 5 in Fall '00 can probably be explained by the horses staying 3 more weeks in this section of the farm in 2000 as compared to 1999 and in allowing them to overnight in these fields- a practice not allowed in 1999. Pasture 2 also showed an increase in dirt sightings in the fall of 2000 compared to 1999. In 1999, the buck kid herd was kept on Pasture 1 throughout the fall. In 2000, the buck kid herd spent 4 weeks on Pasture 2 and 6 weeks on Pasture 1. These changes in Pasture use may account for the changes in dirt sightings in Pasture 1 and 2 observed between the two years.

With the exception of Pasture 5 where buttercup was identified as the tallest plant 1% of the time in Spring '00 but not Spring '99, undesirable forages were fewer in 2000 than in 1999. We originally thought we had a toxic weed, Senecio, in the pastures. We followed the growth of the plant we identified as Senecio during the 2nd year of the survey and, at least for that year, the plant turned out to be daisy instead.

In truth, the step-point transect surveys did not reveal any blatant changes in the pasture ecology of our conventional pastures that could be easily attributed to goat grazing. Growing conditions from year to year and season to season probably explained much of the variation observed. Impact of the goats on the pasture ecology of these conventional pastures appears to be relatively minor. We would probably need to undertake these surveys for several years to truly isolate trends from their presence.

Table 3. Results from Step-Point Transect Surveys of Pastures 1 and 2

Pasture 1 – conventional pasture

Plants	Spring '99	Spring '00	Fall '99	Fall '00
Orchard	55.1%	43.2%	41.2%	39.4%
Timothy	0.0%	1.2%	0.0%	0.0%
Poverty	6.7%	6.8%	0.0%	0.0%
Trefoil	4.6%	1.1%	0.0%	1.9%
Red Clover	2.2%	3.3%	0.0%	6.5%
Ox Tongue	0.0%	0.0%	0.0%	2.8%
Yarrow	0.0%	0.0%	0.0%	1.9%
Plantain	0.0%	0.0%	2.5%	5.6%
Dandelions	4.8%	4.5%	0.0%	6.9%
Bedstraw	8.9%	19.3%	16.7%	9.7%
Golden Rod	4.3%	6.8%	7.4%	4.6%
Other good forbs	4.3%	5.8%	7.7%	0.0%
Undesirable forbs	2.2%	1.2%	5.0%	0.0%
Litter	2.4%	2.3%	8.5%	20.8%
Moss	2.4%	0.0%	1.4%	0.0%
Manure	0.0%	1.2%	2.5%	0.0%
Dirt	2.2%	3.4%	7.1%	0.0%
Total	100.0%	100.0%	100.0%	100.0%

[1]Undesirable forbs in spring were thought to be Senecio but were later identified as daisies.
[2]Undesirable forbs in fall were ragweed
[3]Litter in fall was decomposing orchard grass

Pasture2 – conventional pasture

Plants	Spring '99	Spring '00	Fall '99	Fall '00
Orchard	24.3%	37.7%	16.9%	40.2%
Timothy	2.6%	3.9%	8.8%	0.0%
Poverty	2.2%	3.6%	0.0%	0.0%
Other grasses	3.3%	2.6%	2.3%	0.0%
Trefoil	7.3%	5.0%	4.2%	2.1%
Red Clover	10.6%	1.3%	4.6%	8.5%
Other clovers	4.9%	1.2%	1.0%	2.1%
Violet	1.1%	3.5%	0.0%	0.0%
Strawberry	2.6%	0.0%	0.0%	0.0%
Yarrow	0.0%	1.2%	0.0%	0.0%
Plantain	0.0%	0.0%	0.0%	6.3%
Dandelions	5.8%	11.8%	12.2%	1.6%
Bedstraw	14.6%	11.2%	24.4%	9.5%
Golden Rod	7.5%	3.9%	7.8%	0.0%
Other good forbs	4.6%	5.3%	5.5%	10.1%
Undesirable forbs	1.3%	0.0%	3.9%	0.0%
Litter	5.1%	6.6%	7.4%	11.1%
Manure	0.0%	0.0%	1.0%	0.0%
Dirt	2.2%	1.2%	0.0%	8.5%
Total	100.0%	100.0%	100.0%	100.0%

[1]Undesirable forbs in spring were Canadian thistles
[2]Undesirable forbs in fall were ragweed
[3] Other grasses were predominantly ryegrass
[4] Litter in fall was mostly decomposing orchard grass

Table 4. Results from Step-Point Transect Surveys of Pastures 3 and 4

Pasture 3 – conventional pasture					Pasture4 – conventional pasture				
Plants	Spring '99	Spring '00	Fall '99	Fall '00	Plants	Spring '99	Spring '00	Fall '99	Fall '00
Orchard	31.7%	40.3%	24.1%	50.9%	Orchard	34.6%	29.0%	36.2%	38.1%
Timothy	0.0%	5.5%	10.5%	0.0%	Timothy	0.0%	3.5%	9.1%	0.0%
Poverty	3.8%	5.1%	0.0%	0.0%	Poverty	2.2%	9.3%	0.0%	0.0%
Other grasses	2.4%	3.9%	10.1%	0.0%	Other grasses	2.2%	1.8%	4.2%	0.0%
Trefoil	7.0%	1.6%	2.7%	5.7%	Trefoil	10.0%	3.6%	3.2%	1.5%
Red Clover	14.9%	10.7%	4.1%	3.9%	Red Clover	12.1%	1.4%	1.1%	3.0%
Other clovers	3.8%	2.8%	0.9%	13.5%	Other clovers	0.0%	4.9%	1.1%	5.1%
Plantain	1.0%	0.0%	1.6%	1.7%	Vetch	0.0%	1.4%	0.0%	0.0%
Dandelions	7.5%	10.3%	9.3%	2.6%	Ox Tongue	0.0%	2.7%	0.0%	0.0%
Bedstraw	12.5%	13.4%	13.9%	4.8%	Strawberry	0.0%	0.0%	1.0%	0.0%
Golden Rod	5.6%	5.1%	3.4%	1.3%	Plantain	0.0%	0.0%	3.1%	0.0%
Other good forbs	7.0%	1.6%	5.1%	0.0%	Dandelions	9.8%	6.3%	3.2%	3.3%
Undesirable forbs	0.0%	0.0%	1.8%	0.0%	Bedstraw	8.4%	24.8%	16.6%	6.6%
Litter	0.0%	0.0%	9.1%	14.3%	Golden Rod	7.7%	7.1%	4.2%	0.0%
Moss	1.0%	0.0%	0.0%	0.0%	Other good forbs	8.7%	3.5%	1.1%	1.8%
Manure	0.0%	0.0%	0.8%	0.0%	Undesirable forbs	1.0%	0.0%	4.2%	0.0%
Dirt	1.8%	0.0%	2.4%	1.3%	Litter	2.2%	0.9%	9.4%	36.0%
Total	100.0%	100.0%	100.0%	100.0%	Moss	0.0%	0.0%	0.0%	0.0%
					Manure	0.0%	0.0%	2.1%	1.5%
					Dirt	1.0%	0.0%	0.0%	3.0%
					total	100.0%	100.0%	100.0%	100.0%

[1] Other clovers were usually white clover except in fall '00 when red clovers had such small leaves from the cold that watermarks were difficult to see.

[2] Undesirable forbs in fall were ragweed

[3] Other grasses were predominantly ryegrass

[4] Litter in fall was mostly decomposing orchard grass

Chart 1. Vegetation Changes for Pastures 1 & 2 across seasons and years

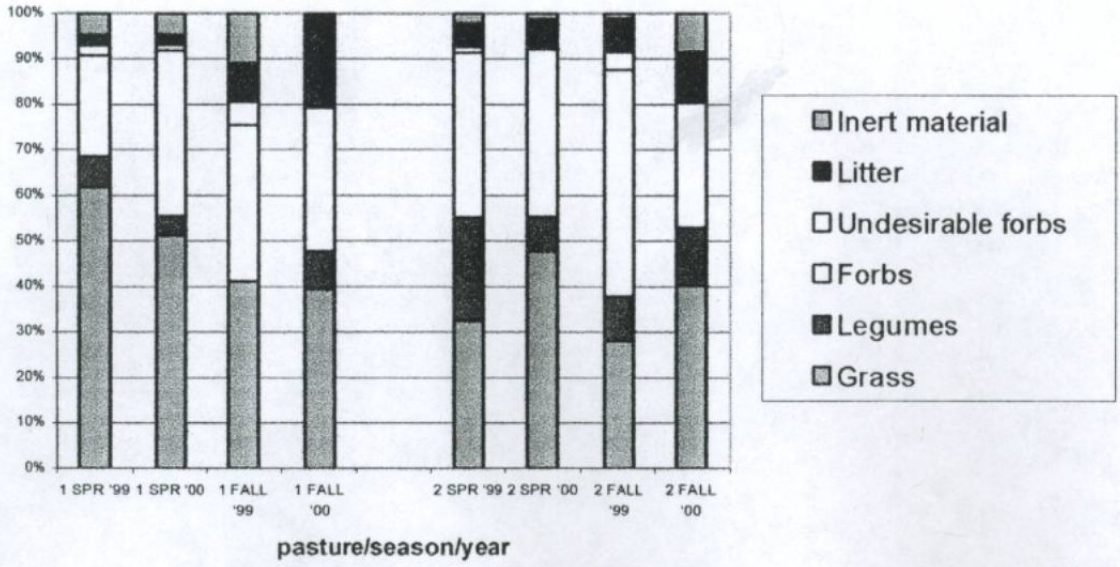


Chart 2. Vegetation Changes for Pastures 3 and 4 across seasons and years

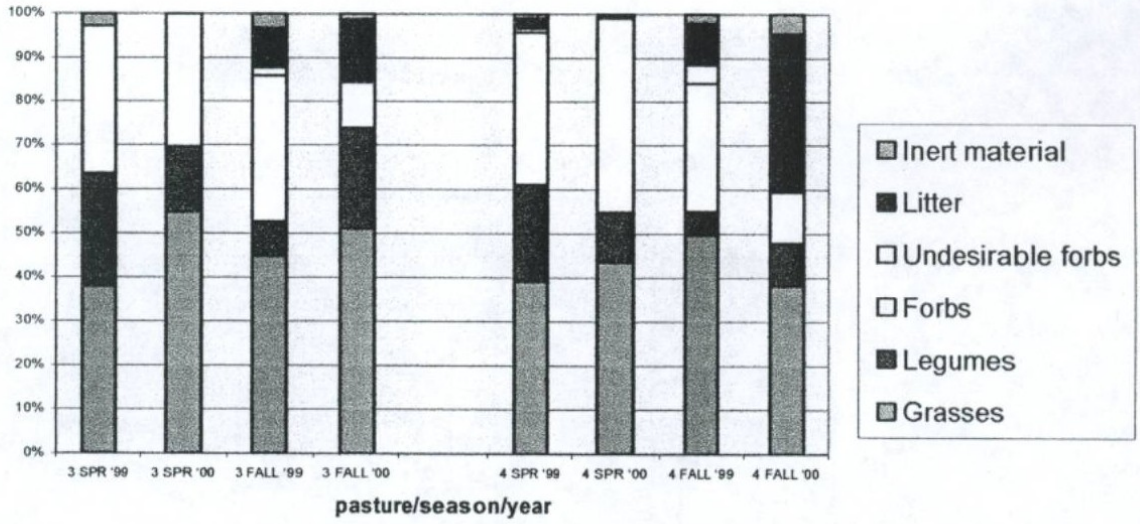


Table 5. Results from Step-Point Transect Surveys of Pastures 5 and 6

Pasture 5 – conventional pasture					**Pasture6 – East hay field**				
Plants	Spring '99	Spring '00	Fall '99	Fall '00	Plants	Spring '99	Spring '00	Fall '99	Fall '00
Orchard	50.9%	44.4%	50.9%	55.4%	Orchard	49.5%	44.7%	28.5%	48.4%
Timothy	1.1%	0.0%	0.0%	0.0%	Timothy	0.0%	0.0%	1.8%	0.0%
Poverty	3.6%	14.3%	0.0%	0.0%	Poverty	2.8%	4.7%	0.0%	0.0%
Other grasses	2.1%	2.0%	1.8%	1.3%	Other grasses	2.4%	0.0%	7.6%	0.0%
Trefoil	2.5%	0.0%	1.8%	0.0%	Trefoil	0.5%	2.1%	3.9%	2.0%
Red Clover	9.3%	1.0%	0.0%	2.9%	Red Clover	3.3%	3.9%	1.1%	10.0%
Other clovers	0.0%	1.8%	0.9%	2.6%	Other clovers	0.0%	0.4%	2.0%	0.0%
Alfalfa	2.5%	0.0%	0.0%	0.0%	Vetch	1.4%	0.4%	0.0%	0.0%
Vetch	0.0%	1.0%	0.0%	0.0%	Ox Tongue	0.0%	7.7%	0.0%	2.4%
Strawberry	3.6%	0.0%	1.8%	0.0%	Strawberry	2.3%	2.1%	2.1%	1.4%
Plantain	0.0%	0.0%	1.8%	1.3%	Yarrow	0.0%	0.0%	0.0%	0.6%
Dandelions	0.0%	6.9%	9.5%	1.3%	Plantain	0.5%	1.3%	0.0%	0.6%
Bedstraw	0.0%	15.8%	11.1%	4.2%	Dandelions	7.6%	8.9%	3.2%	1.2%
Golden Rod	5.3%	7.7%	3.7%	1.3%	Bedstraw	13.1%	17.8%	15.8%	5.5%
Berry	0.0%	1.0%	0.0%	0.0%	Golden Rod	1.8%	3.8%	2.0%	1.2%
Other good forbs	7.8%	3.1%	0.0%	1.3%	Honeysuckle	0.5%	0.0%	0.0%	0.0%
Undesirable forbs	0.0%	1.0%	0.0%	0.0%	Other good forbs	7.1%	0.9%	15.6%	1.4%
Litter	11.4%	0.0%	15.0%	23%	Undesirable forbs	0.9%	0.9%	0.9%	0.0%
Manure	0.0%	0.0%	1.8%	5.1%	Litter	4.6%	0.0%	12.6%	23.1%
Dirt	0.0%	0.0%	0.0%	1.3%	Moss	0.0%	0.4%	0.0%	0.0%
Total	100.0%	100.0%	100.0%	100.0%	Manure	1.4%	0.0%	0.0%	0.8%
					Dirt	0.0%	0.0%	2.9%	1.8%
					Rocks	0.5%	0.0%	0.0%	0.0%

[1]Other clovers were usually white clover except in fall '00 when red clovers had such small leaves from the cold that watermarks were difficult to see.

[2]Undesirable forbs in spring was buttercup.

[3] Dirt area grew due to horses congesting.

[4] Litter in fall was a combination of decomposing orchard grass and tree leaves from the adjoining hedgerow.

Total	100.0%	100.0%	100.0%	100.0%

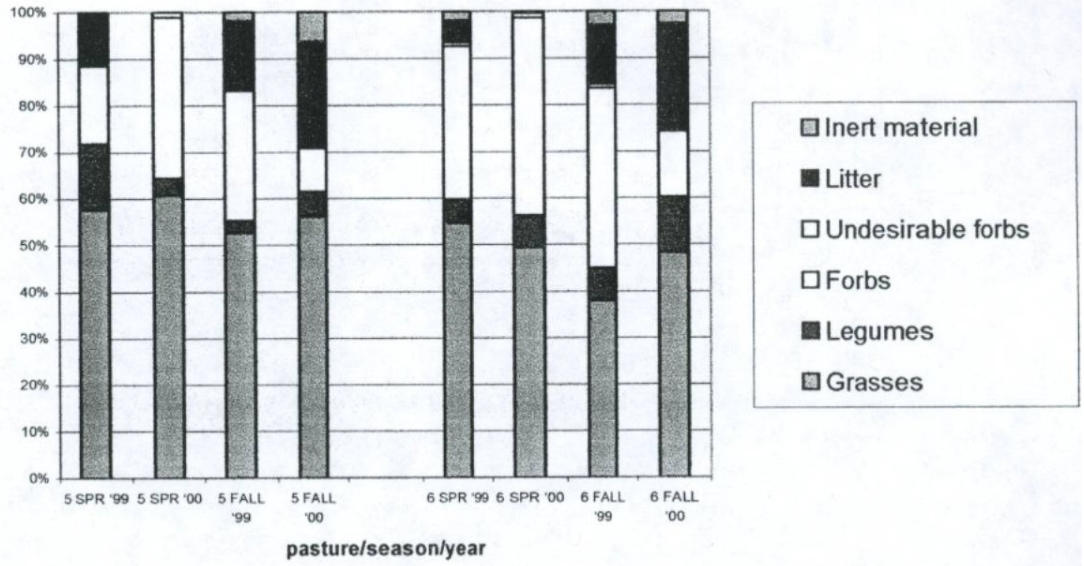
[1]Other clovers were usually white clover except in fall '00 when red clovers had such small leaves from the cold that watermarks were difficult to see.

[2] Undesirable forbs in spring were 50% leafy spurge and 50% Senecio (incorrectly identified-really daisies).

[3] Undesirable forbs in fall were ragweed.

[4] Litter in fall was mostly decomposing grasses.

Chart 3. Vegetative Changes for Pastures 5 and 6 across seasons and years



The sustainability of our brush pastures was dealt a blow in Spring '99 when a logging company in exchange for access through to a neighbors' woodlot agreed to bush hog our fallow field (Field 9) and instead bush hogged our brush pastures (fences and all). They broke through many of our berry brambles and provided until-then-unavailable access to the core of these thickets for the goats. Unfortunately, the goats were then able to predate these thickets to a degree unpracticed before.

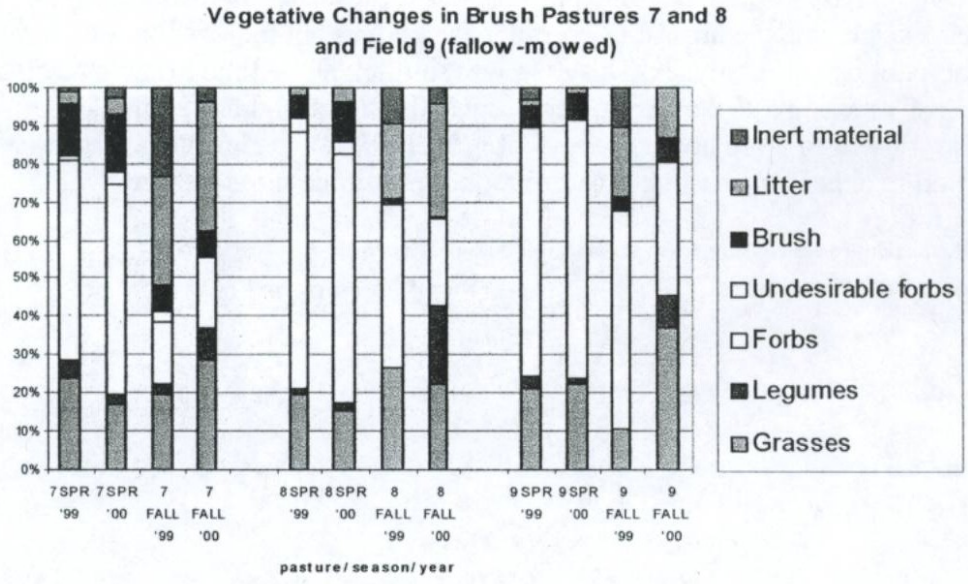
Both brush pastures had spring compositions primarily of golden rod as measured as the "tallest plant". A variety of grasses, and unidentified "good' forbs (some of these were other varieties of golden rod) were also well represented. Berry brambles made up about 10% of the sightings in Pasture 7 in the spring but were less represented in Pasture 8 and in the fall. Wild strawberries provided about 10% of the sightings in both pastures in Spring '99 but less in the wet spring of 2000. Both pastures were severely grazed for 3 to 4+ weeks each in August or September. This is probably responsible for the sharp decrease in golden rod and increase in dirt recorded in the fall compared to spring. Leaf and twig litter were also commonly reported as the "encountered plant' in the fall. The presence of orchard grass in both pastures increased from 1999 to 2000. Red clover jumped to 20% of the sightings in Pasture 8 in Fall '00. Berry brambles were the most common woody browse reported. However, dogwood, honeysuckle, multiflora rose, black willow, maple and poplar were sighted. Woody browse made up ~15% of the

sighting in Pasture 7 each spring but was less represented in Pasture 8. However, Pasture 8 has a small wetland area at its entrance which was not included in the transect survey or in the later pasture analyses. This area was so thick at the time of the study that we could not easily measure its perimeter (the dogwood, willow and honeysuckle that predominated in it are now severely eaten back-2003). Undesirable forbs were rarely sighted in either Pasture 7 or 8 and remained about the same between years.

Table 6. Results from Step-Point Transect Surveys of Pastures 7 and 8

Pasture 7 – brush pasture					Pasture 8 – brush pasture				
Plants	Spring '99	Spring '00	Fall '99	Fall '00	Plants	Spring '99	Spring '00	Fall '99	Fall '00
Golden Rod	26.9%	25.0%	2.8%	4.9%	Golden Rod	36.2%	33.5%	18.1%	3.9%
Timothy	9.6%	0.0%	1.4%	0.0%	Timothy	5.7%	1.3%	0.0%	0.0%
Orchard Grass	0.0%	4.4%	5.7%	18.1%	Orchard Grass	0.0%	3.2%	11.6%	12.1%
Poverty Grass	1.9%	1.9%	0.0%	0.0%	Poverty Grass	0.0%	1.3%	0.0%	0.0%
Other grass	10.0%	11.4%	12.8%	10.7%	Other grass	14.5%	10.1%	15.1%	10.3%
Fine Grass	2.4%	0.0%	0.0%	0.0%	Fine Grass	0.0%	0.0%	0.0%	0.0%
Vetch	0.0%	0.0%	0.0%	0.0%	Vetch	0.0%	0.0%	0.0%	0.0%
Red Clover	2.9%	1.8%	1.4%	5.9%	Red Clover	0.0%	1.9%	0.0%	20.2%
Trefoil	1.8%	0.6%	0.0%	1.4%	Trefoil	1.6%	0.0%	0.0%	0.0%
Other clovers	0.0%	0.0%	1.4%	1.0%	Other clovers	0.0%	0.0%	0.0%	0.0%
Strawberry	9.4%	4.3%	8.5%	5.7%	Strawberry	12.5%	3.8%	1.5%	0.8%
Ox Tongue	0.0%	3.5%	0.0%	0.0%	Ox Tongue	0.0%	7.5%	0.0%	0.0%
Yarrow	0.0%	0.6%	0.0%	2.0%	Yarrow	0.0%	1.3%	0.0%	0.0%
Dandelion	0.0%	3.1%	0.0%	4.3%	Dandelion	0.0%	1.3%	2.9%	0.0%
Plantain	0.0%	1.8%	5.7%	1.4%	Plantain	0.0%	3.8%	0.0%	6.0%
Other good forbs	17.1%	13.8%	0.0%	0.0%	Other good forbs	20.8%	15.4%	20.2%	12.0%
Mustard	0.0%	4.7%	0.0%	0.0%	Poison Ivy	0.6%	0.0%	0.0%	0.0%
Undesirable forbs	1.0%	3.1%	2.8%	0.0%	Mustard	0.0%	1.3%	0.0%	0.0%
Berry	10.6%	11.0%	4.2%	7.0%	Undesirable forbs	3.5%	3.2%	0.0%	0.0%
Dogwood	1.3%	0.6%	0.0%	0.0%	Berry	1.3%	5.1%	0.0%	0.0%
Multiflora rose	0.0%	0.6%	0.0%	0.0%	Dogwood	1.3%	1.9%	0.0%	0.8%
Honeysuckle	0.0%	0.0%	0.0%	0.0%	Multiflora rose	0.0%	0.6%	0.0%	0.0%
Poplar	0.5%	0.6%	0.0%	0.0%	Willow	0.0%	0.0%	1.5%	0.0%
Maple	0.5%	0.0%	0.0%	0.0%	Leaf and twig litter	2.2%	3.8%	19.7%	13.3%
Leaf and twig litter	2.8%	4.3%	29.5%	27.9%	Dirt	0.0%	0.0%	6.5%	1.7%
Dirt	1.3%	1.8%	12.6%	2.4%	Moss	0.0%	0.0%	2.9%	2.5%
Moss	0.0%	0.6%	11.1%	1.4%	Rocks	0.0%	0.0%	0.0%	0.0%
Rocks	0.0%	0.6%	0.0%	0.0%	Grass Stubble	0.0%	0.0%	0.0%	16.3%
Grass Stubble	0.0%	0.0%	0.0%	5.9%	Total	100.0%	100.0%	100.0%	100.0%
Total	100.0%	100.0%	100.0%	100.0%					

[1] Undesirable forbs were braken fern and the miss-identified Senecio.



A fallow field adjoined these brush pastures. Prior to the inadvertent bush hogging of Pastures 7 & 8 we had planned to bush hog Field 9 each year and compare its changes to those of these goat browsed pastures. We did bush hog Field 9 each year but obviously could not make the comparison. It too was made up primarily of golden rod in the spring followed by a variety of grasses and good forbs. It was mowed each June and golden rod content dropped in the fall compared to spring. Unlike Pasture 7, the percentage of berry bramble sightings did not decrease from spring to fall probably because no goats were grazing the brambles in Aug/Sept. Leaf and twig litter increased in the fall as expected. We anticipated that the content of trefoil and red clover would increase over time based on what had happened to a path that had been mowed over time on the perimeter of this field. Trefoil sightings were rare but red clover did account for 6.5 % of the sightings in Fall '00 as compare to 0% at all other sampling periods. However, the sighting of orchard grass increased from 0% in Spring '99 to 20% in Spring '00 and from 7% in Fall '99 to 30% in Fall '00. This two-year comparison suggests that mowing of these pastures would reduce the golden rod content and increase orchard grass making them more similar to our conventional pastures.

Table 7. Results from Step-Point Transect Surveys of Fallow Field (Field 9)

Plants	Spring '99	Spring '00	Fall '99	Fall '00	Plants	Spring '99	Spring '00	Fall '99	Fall '00
Golden Rod	47.0%	27.1%	14.3%	19.6%	Plantain	0.0%	3.4%	0.0%	2.2%
Timothy	10.6%	0.0%	3.6%	0.0%	Other forbs	18.2%	8.5%	32.1%	8.7%
Orchard Grass	0.0%	20.3%	7.1%	30.4%	Mustard	0.0%	5.1%	0.0%	0.0%
Other grass	10.6%	1.7%	0.0%	6.5%	Berry	4.5%	6.8%	3.6%	6.5%
Red Clover	0.0%	0.0%	0.0%	6.5%	Multiflora rose	1.5%	0.0%	0.0%	0.0%
Trefoil	3.0%	1.7%	0.0%	2.2%	Leaf and twig litter	1.5%	1.7%	17.9%	8.7%
Strawberry	0.0%	3.4%	3.6%	2.2%	Dirt	3.0%	0.0%	3.6%	0.0%
Ox Tongue	0.0%	5.1%	0.0%	0.0%	Moss	0.0%	0.0%	3.6%	0.0%
Yarrow	0.0%	1.7%	0.0%	2.2%	Rocks	0.0%	0.0%	3.6%	0.0%
Dandelion	0.0%	13.6%	7.1%	0.0%	Grass Stubble	0.0%	0.0%	0.0%	4.3%

Pastures 7 and 8 had a history of past predation by goats. The randomly assigned transects encountered some woody browse. However, most of the woody browse remaining in Pasture 7 is concentrated in the brushy wetland area surveyed below.

Point Intercept Survey –

The results of the point intercept survey of the brushy wetland area of Pasture 7 are shown in the two tables below. The tallest brushy plants at the sample points were predominantly red-stemmed dogwood. Honeysuckle and elderberry were also represented. The height of the brushy plants decreased from 1999 to 2000 at 6 of the 8 sample points as shown in Table 8. Losses ranged from 3 to 12 inches with the exception of one point where the plant had died. The height remained the same at one sample point and increased 2 inches at the remaining point.

Table 8. Comparison of height of browse along sample points in 1999 and 2000

	Pt 1	Pt 2	Pt 3	Pt 4	Pt 5	Pt 6	Pt 7	Pt 8
Year	dogwood	dogwood	dogwood	dogwood	dogwood	dogwood	honey-suckle	elder-berry
1999	41"	36"	41"	36"	24"	41"	48"	41"
2000	38	32"	28"	24"	24"	0"	50"	36"

Table 9. Comparison of density of browse as measured by coverage of vertical pole at 8 sample points in 1999 and 2000

	Pt 1	Pt 1	Pt 2	Pt 2	Pt 3	Pt 3	Pt 4	Pt 4	Pt 5	Pt 5	Pt 6	Pt 6	Pt 7	Pt 7	Pt 8	Pt 8
	1999	2000	1999	2000	1999	2000	1999	2000	1999	2000	1999	2000	1999	2000	1999	2000
Dogwood	5	3	3	3	2	3	3	2	2	4	2	0	0	0	0	0
Grasses	2	1	3	2	5	2	2	1	5	4	2	1	3	2	2	1
Sensitive Fern	0	3	0	0	0	0	0	0	2	2	5	5	3	3	5	3
Raspberry	2	0	0	1	0	0	2	0	0	0	0	0	0	0	0	0
Poison Ivy	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
Goldenrod	2	2	2	2	1	1	2	1	3	1	3	1	2	1	2	0
Potentiala	3	0	0	2	0	0	0	1	0	1	0	0	0	1	0	0
Dried Vetch	2	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0
Willow	0	0	2	1 (dead)	4	4	2	3	4	4	0	0	5	5	0	0
Heal All (Mint)	0	0	2	1	2	0	2	0	2	0	0	0	0	0	0	0
Honey-suckle	0	0	0	0	3	3	0	0	0	0	2	0	3	3	3	3
Jewel Weed	0	0	0	2	2	1	0	2	0	0	0	0	2	1	2	1
Elm	0	0	0	0	0	0	4	2	0	0	1 (dead)	1 (dead)	0	0	0	0
Straw-berry	0	0	0	0	0	1	2	0	0	0	0	0	0	0	0	0
Buttercup	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0
Grape	0	0	0	0	0	2	0	0	2	1	0	0	0	0	0	0
Elderberry	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2
Total	**16**	**9**	**12**	**14**	**19**	**17**	**22**	**13**	**20**	**17**	**14**	**7**	**19**	**16**	**16**	**10**

Key =

0 = absent
1 = trace coverage
2 = 1 - 25% coverage
3 = 26 - 50% coverage
4 = 51 - 75% coverage
5 = 76 - 100% coverage

Density of the vegetation at 7 of the 8 sample points decreased from 1999 to 2000 as shown in Table 9. Although 2000 was a wetter year than 1999, the certified foresters judged that the wetland had not received too much water in 2000. Their opinion was that damage from predation by the goats explained the loss in height and density of the wetland browse. This section of Pasture 7 is immediately attacked when the goats enter Pasture 7. The goats remain on this brush pasture for 30 days and completely defoliate the entire pasture. They make plenty of return trips during that time to this favorite section where they prune off tender growing points and girdle smaller stems. Antidotal evidence suggests that in the years since 2000 the browse in this wetland has further deteriorated as judged visually although it still exists. Plans in 2004 include fencing it off and providing a fenced path through it. It will be rested for a year and then gradually exposed to limited, short duration goat browsing as it recovers.

Chain sawed test plots –

The certified foresters visually evaluated the chain-sawed areas (composed primarily of dogwood) in August 99. It was their consensus that there were not appreciable differences in the amount of suckering or regrowth between the girdled dogwood that had been pruned back with a chainsaw compared to the control plants. The pruned sections did look more aesthetically pleasing. Black willow and multiflora rose samples within the chain sawed areas possibly showed more suckering but there were too few plants to make a serious judgment. The chainsaw tended to jam on the thin twigs and stems of browse plants and took more time and labor to treat a small area than anticipated. Thus, the vague results probably do not warrant the effort.

Forage Productivity

Nutritional Analyses –

The nutritional composition of the conventional pastures changed fairly predictably across the seasons. We did see a lot of variation from sample to sample within a field determining on whether the "L" landed on a big chunk of bedstraw or a nice mix of orchard grass and red clover. We took samples from 2 to 3 spots per acre and had each "spot' analyzed separately in our study. I think if I were to do this study again, I would take many more nutritional samples per acre and send bulk samples in for analyses. However, the variation exhibited by the samples does show how much potential there is for selective grazing in these pastures by goats. However, the pastures were grazed quite short and uniformly particularly in 1999. The horses tended to avoid trefoil and bedstraw. Neither aversion was exhibited in the goats. We took plant samples based on what plant parts the goats appeared to be grazing. They showed a strong aversion to the coarse fibrous stems of mature orchard grass particularly in the wet summer of 2000. They tended to avoid the woody base of the main stem of mature golden rod in the brush pastures. These plant components were therefore selectively removed from our plant samples. Even so, the nutritional analyses show that the value of the goats' forage diet changed substantially from season to season.

The nutritional composition of the pastures was fairly good until early July in the dry spring of 1999 (Table 10). The goats were the first animals grazed in all the pasture sections. Two horses followed behind the goats and grazed each pasture again 2 weeks after the goats had left. Therefore, Pasture 5 was grazed for the first time when the goats entered in July 19th. By this time, its average crude protein percentage (CP) was only 7.3% and the neutral detergent fiber percentage (NDF) even without including coarse stems was 57%. The goats repeatedly broke out of this pasture to graze regrowth from the other pastures or the recently mowed hay fields despite the large amount of forage standing.

The nutritional range for samples from this pasture was pretty narrow indicating little potential for selective grazing. In contrast, Brush Pasture 7, despite similar means for CP and NDF, exhibited a wide range of values across its samples. During the first few weeks of grazing Pasture 7, the goats may have been able to select a diet well above the mean values. Pasture 7 had been inadvertently mowed in June '99. On the advice of the foresters we chopped down several cottonwood trees in this pasture during the last week the goats grazed it. Samples for these leaves contained 12.7% CP. They probably helped to improve the goats' diet during the last week's grazing. Aspens are colony plants. A grove is interconnected by its root base and is actually one entity. Thus chopping the trees down stimulates the prolific sprouting of roots from the colony into many saplings. Unlike the mature trees, these saplings would inhabit a grazing canopy that goats can reach and might help maintain the brush content of the pasture.

In general, mature browse plants do not appear to deteriorate in CP% and increase in fiber content to the extent noted for conventional grasses. Plant analyses we had done on the leaves and growing points of mature dogwood, honeysuckle, multiflora rose, and berry brambles in September '01 as part of this study yielded CP% of 9.1, 11.2, 11.3 and 10.6 and NDF% of 18, 25.6, 28.4 and 34.1, respectively.

Brush Pasture 8 was very nutritious in 1999. Similar to Pasture 7, it had been inadvertently mowed. It may be that the recent mowing delayed the maturity of the golden rod and other forbs that predominated in this pasture. I have no idea why Pasture 7 was not similarly affected. Pasture 8 had had 3 months for regrowth as opposed to 2

months and possibly the forbs were able to produce more leafy material in that extra month.

The goats spent October through December 15th on hay field regrowth. These fields were characterized by a CP % of 11 to 13, NDF% of 43 to 57 and TDN of 61 to 63. There may have been a slight trend for NDF% to increase and TDN% to decrease as the fall progressed.

Table 10. Changes in Pasture Nutritional Analyses Across the Growing Season in 1999

Pasture #	Date	DM, %	CP, %	NDF, %	% NSC	%TDN	Ca, %	P, %
1 Average		**22.8**	**11.9**	**58.8**	**18.5**	**60**	**0.60**	**1.02**
Range	5/15/99	9 to 67	9.6 to 14.2	53.9 – 63.7	15.9 –21.1	59 – 61	.58 - .61	.29 – 1.02
2 Average		**21.1**	**15.3**	**52.85**	**21.05**	**62**	**0.77**	**0.31**
Range	6/1/99	18 - 27	14.4 – 16.2	52.6 – 53.1	19.9 –22.2	62	.71 -.82	.3 - .31
3 Average		**32.2**	**12.7**	**46.1**	**30.4**	**63**	**1.19**	**0.22**
Range	6/14/99	29 - 38	11 – 14.4	41.9 – 50.3	27.9 – 32.9	62 – 64	1.04 – 1.33	.2 -.24
4 Average		**35.1**	**8.5**	**61.1**	**19.6**	**60.1**	**0.59**	**0.22**
Range	7/3/99	30 - 39	7.8 – 13.3	57.5 – 61.4	18.4 – 20.1	60 – 61	.57 - .76	.21 - .26
5 Average		**39.4**	**7.3**	**57.3**	**24.6**	**61**	**0.51**	**0.2**
Range	7/19/99	37 - 44	6.5 – 7.9	56.1 – 58.8	23.9 – 25.2	61	.39 - .6	.17 - .33
7 Average		**39.5**	**8.2**	**56.3**	NA	**62**	**0.9**	**0.17**
Range	8/11/99	28 - 53	3.9 –15.8	29.6 – 62.6	NA	60 –67	.29 – 1.87	.12 - .36
8 Average		**38**	**16.6**	**39.5**	**33.1**	**66.1**	**1.35**	**0.29**
Range	9/12/99	38	14.2 -18	35.7 – 47.9	26.7 - 36	64 –67	.99 – 1.65	.17 - .36
6A Average			**12.0**	**43.4**	**28.1**	**63.1**	**0.97**	**0.22**
Range	10/2/99	**32**	9 –13.7	38 –45.9	23.1 – 30.4	61 – 64	.73 – 1.23	.15 - .31
6B Average			**13.2**	**48.9**	**27.1**	**63.2**	**1.19**	**0.27**
Range	10/16/99	**35**	11.8-14.2	42.3 - 54	23.4 – 34.2	62 – 65	.83 – 1.78	.25 - .27
6C Average			**12.0**	**50.0**	**27.1**	**63.0**	**1.00**	**0.28**
Range	11/6/99	**37**	11.9 – 12.4	49.5 – 51.5	25.3 – 27.8	63	.85 – 1.05	.27 - .28
6D Average			**10.7**	**52.4**	**26.1**	**62.5**	**1.04**	**0.25**
Range	11/15/99	**37**	8.5 – 12.1	45.6 – 63.3	17.4 – 31.5	60 – 64	.58 – 1.33	.24 - .26
West hay field								
Average		**37.6**	**11.4**	**56.5**	**21.4**	**61.2**	**0.84**	**0.23**
Range	12/2/99	37 - 38	10.5 – 11.9	53.2 – 61.7	17.1 – 24.1	60 – 62	.73 - .91	.23

Similar seasonal changes in nutritional content were noted in 2000. The pastures started out quite nutritious but NDF % increased rapidly in this wet, warm spring. The horses had been put out on two pastures prior to goats in an attempt to keep these pastures from getting too mature before the goats had a chance to graze them. The horses grazed Pasture #1 from May 20th – May 26th and Pasture 5 from May 27th –June 18th. This strategy might have worked in a dry year but was not aggressive enough in 2000. Pasture 4 was first grazed June 11th and already had a NDF% of 66. The goats repeatedly attempted to break out of both subsections of it to seek other grazing. In hindsight, the horses also should have also grazed this pasture in May or June.

Six days of horse grazing in May were insufficient to slow the maturity of Pasture 1. Despite the large amount of forage in it, the goats had to vacate each subsection of it one day early. The grass in it was so tall, brittle and mature that the stems lodged when stepped on by the goats and much of it was wasted due to trampling and soilage. The NDF% of samples from this pasture averaged only 49% but did not include the brittle stems. Pasture conditions did not continue to deteriorate when the goats went into Pastures 5 and 3A. This was undoubtedly because both pastures had been heavily grazed earlier in the season. For example, the nutritional analysis of a small section of Pasture

3A that had escaped the first grazing indicates CP%=5.5 and NDF%=66% compared to CP%=11.9 and NDF% = 60% for the regrown pasture area.

Pastures 7 and 8 again exhibited a substantial range of nutritional values amongst samples indicating the potential for selective grazing. Unfortunately, the long duration that the goats are left on these pastures probably counteracts this. Many new cottonwood saplings were noted in Pasture 7. However, they were completely defoliated by the time the goats left the pasture so it is not clear how long they can continue to exist. (Note - in 2003, these saplings still existed but their population has clearly not expanded). Nutritional analyses and weight performance of the goats reinforce that these predominantly golden rod "brush" pastures were a feasible option for supporting goats in August and September.

As in 1999, the plane of nutrition on the hay field regrowth was again good in the fall. A severe frost occurred prior to mid November and is probably responsible for the increase in dry matter % as much of the grass dried up.

There were differences noticed between the years (Table 11). Dry matter contents of all the conventional pastures tended to be higher in the wet year of 2000 compared to 1999. The plane of nutrition for Pasture 8 was much lower in 2000 than in 1999. Without the accidental mowing of 1999, the forbs were very mature by the time the goats entered the pasture for the first time in August '00. However, the nutritional composition was still better than mature grasses.

Table 11. Changes in Pasture Nutritional Analyses Across the Growing Season in 2000

Pasture #	Date	DM, %	CP, %	NDF, %	% NSC	%TDN	Ca, %	P, %
2 Average		**13. 6**	**21.3**	**55**	**12.9**	**61.8**	**0.64**	**0.40**
Range	5/13/00	12 - 15	17.2 - 24.3	51.2 - 57.8	7.1 - 20.8	61 - 63	.4 - .96	.37 - .42
3 Average		**31.4**	**10.9**	**61.3**	**13.6**	**59.6**	**0.34**	**0.26**
Range	5/21/00	14 - 48	4.7 - 14.3	54.7 - 73.1	11.4 - 14.8	57 - 61	.27 - .38	.12 - .34
4 Average	**6/11/00**	**23.7**	**10**	**65.6**	**13.6**	**59**	**0.32**	**0.26**
Range	6/11/00	22 - 26	9.5 - 10.6	64.8 - 66.4	13.4 - 13.8	59 - 59	.31 - .33	.25 - .28
1 Average		**34.6**	**7.3**	**49.0**	**18.9**	**59.8**	**0.40**	**0.20**
Range	7/1/00	32 - 37	6 - 9.2	43 - 58	16.8 - 22	59 - 61	.34 - .48	.17 - .24
3 Average	7/13/00	**34.8**	**11.9**	**60.4**	**16.9**	**60**	**0.41**	**0.32**
5 Average		**35.4**	**10.0**	**59.8**	**19.4**	**60.6**	**0.48**	**0.26**
Range	7/18/00	35 - 36	9.4 - 10.4	58.4 - 61.7	18 - 20.5	60 - 61	.42 - .56	.25 - .26
7 Average		**36. 5**	**10. 4**	**55.1**	**NA**	**61.6**	**0.89**	**0.21**
Range	8/4/00	32 – 39	6.5 - 12.7	44.5 - 60.7		61 - 64	.61 - 1.3	.17 - .26
8 Average		**38.4**	**10.8**	**50.3**	**28.1**	**63.1**	**1.11**	**0.17**
Range	9/10/00	30 – 49	5.7 - 16	39.2 - 62	21.5 - 34	60 - 66	.65 - 1.57	.12 - .26
6A Average		**22.3**	**23.3**	**43.7**	**22.2**	**64.**	**0.69**	**0.36**
Range	10/7/00	20 - 25	20.6 - 26.5	40.3 - 46.3	16.5 - 27.2	64 - 66	.47 - .94	.29 - .44
6B Average		**52.2**	**14. 6**	**46.5**	**28.1**	**64**	**1.00**	**0.29**
6B Range	11/16/00	50 - 55	14.1 - 15	45 - 47.7	26.4 - 30.1	64	.92 - 1.1	.28 - .30

Pasture yields and carrying capacity -

The acreage of our pastures was difficult to estimate. We used a wheel to measure the distance of our fence lines but none of our pastures had perfect right angles and our east hayfield had a curved perimeter. Thus, dry matter yields per field were difficult to accurately estimate. Additionally, our plant samples within each individual pasture yielded a wide range of yields and dry matter percentages. Yields also varied widely from year to year. As expected, the conventional pastures yielded more dry matter in the wet spring of 2000 than they did in 1999 (Tables 12 and 13). The brush

pastures yielded less in 1999 than in 2000 due to the accidental mowing. The regrowth on the hay fields in Oct '00 yielded less dry matter in Oct '99. The hay field was more mature when harvested for hay in 2000 due to the wet spring. This may have adversely affected the regrowth of the orchard grass and Timothy.

Predictably, yields were highest in mid June through July when the grass was most mature and its nutritional quality was poorest. Therefore, wet and dry matter yield per acre were not always the best indicators of the carrying capacity of a field. An example of this is Pasture 1 in 2000 where the goats had to be removed early because they had trampled and wasted so much of the forage. We measured carrying capacity as the number of days a pasture could support a doe unit (a doe and her kid crop). Pasture 1 only had 319 Doe Unit Days per acre (DUDays/acre) in 2000 despite having about 3 tons of dry matter per acre. Over time we have found that most of our conventional pastures can support about 30 does per half acre for a 6 to 7 day period from May through July or about 360 to 420 DUDays/acre. The does are in early lactation and are supplemented with 2 to 2 ½ lbs of grain and are either maintaining their weight (as in 1999) or losing some (as in 2000) while the young kids are growing rapidly.

Brush Pasture #7 supported only 260 DUDays/acre in 1999 but 413 DUDays/acre in 2000. Since then we have found that this 2.5-acre pasture generally supports 30 doe units for about 30 days or about 354 DUDays per acre. Weaning generally takes place while the goats are in Pasture 8. Male kids are removed permanently from the breeding herd. Doe kids or their dams are put back into the conventional pastures for a 1 to 2 week period until the does dry up. Also, the entrance to Pasture 8 includes a small area of wetland/browse that was so dense during this study that we could not access it for any kind of surveying. The goats tended to stay in this area for several days before they moved on to the actual pasture. In the summer of 2003, this same browse area was so sparse that it sustained them for only one day before the herd moved on. The timing of weaning and the lack of information about this browse area make estimating the actual carrying capacity of Pasture 8 impossible.

The hay field regrowth in 1999 and 2000 supported fewer DUDays per acre than either the first growth on the conventional pastures or the brush pastures. Keep in mind that these later doe units represent a dry doe and her weaned doe kid. Over time we have found that this hay field in October and November will generally support about 20 mature does and their weaned doe kids per .5 acres for 5 to 7 days or about 240 DUDays/acre. The west hay field (Pasture 9) has suffered considerable frost damage by the time the goats enter it in December. It supported 140 DUDays/acre in 1999 and 80 DUDays/acre in 2000. Snow tends to drift on it leaving some slopes of it exposed except after a very deep snow fall, thus, we have usually been able to graze it until Dec 15th.

We had hoped that pasture sampling could be used to predict the amount of days the does could stay on a given pasture. For example, if the samples indicated that a field had a ton of dry matter per acre and a 120 lb lactating doe was eating about 5% of her body weight in dry matter then you could count on a pasture supporting ~333 DUDays per acre (2000 lb DM / 6 lb). In truth, you would expect to have to add in a percentage or two for some general wastage of the forage. However, the year differences between 1999 and 2000 were substantial (Tables 13 and 14). The goats were supplemented with hay the first 2 weeks they were on pasture each year. This explains the lower percentages for "DM used as a % of body wt" for Pasture 1 in 1999 and pasture 2A in 2000. The kids probably start doing significant grazing by the time they weigh 30 lbs. Therefore, it may not be outrageous to suggest that a doe unit representing a lactating doe and her

nursing/grazing kids could consume in combination 7% to 8% of the body weight of the mature doe even in a situation like ours where the does were receiving about 2% of their body weight in grain. Figures for "DM used as a % of body wt" ranged from 6.1 to 8.6% prior to weaning in 1999 but were far more variable in 2000. Pasture 1 is the pasture that the goats completely trampled so it is easy to explain how an over-inflated figure of 19.6% resulted there. Grain intake was reduced from 2 lbs to ½ lb per doe when the goats went into Pasture 7. This helps account for the increase in DM as a % of body weight observed in this field. "DM used as a % of body wt' ranged from 5.7 to 10.9% for the remaining fields that the does were in while nursing kids. Does lost more weight while nursing and kids did not appear to gain as well on pasture in 2000 compared to 1999. After weaning, it probably makes sense to express DM used as a percentage of the total weight of all dry does and weaned kids in the herd rather than just as a percentage of the mature doe weight. It appears that dry matter used for this period averages about 4 to 5% of total herd body weight.

Table 12. 1999 Pasture Yields per Acre and per Doe Unit (doe and her kids)

Pasture #	Date	Days grazed	DU days	Acres	DU days /Acre	Wet Yield /Acre	Dry Yield /Acre	Lbs. DM /Field	Lbs. DM /Day	Lbs.CP /Day	Lbs. TDN /Day
1	5/15/99	16	400	1.13	354	6425	1465	1656	103.5	12.3	62.1
2	6/1/99	13	325	1.02	319	11105	2340	2387	183.6	28.1	113.8
3	6/14/99	19	475	1.51	315	9672	3110	4696	247.2	31.4	155.7
4	7/3/99	16	368	0.95	387	8803	3088	2934	183.3	15.6	110.2
5	**7/19/99**	**23**	**529**	**0.94**	**563**	**10088**	**3951**	**3714**	**161.5**	**11.8**	**98.5**
7	8/11/99	30	660	2.54	260	5504	2177	5529	184.3	15.1	103.8
8	9/12/99	20	380	1.48	257	3241	1228	1817	90.8	15.1	60
6A	10/2/99	15 (7,8)	225	1.2	188	4919	1573	1887	125.8	15.1	79.4
6B	10/17/99	20 (10,10)	300	1.3	231	6808	2388	3104	155.2	20.5	98.2
6C	11/6/99	11 (5,6)	154	1	154	5130	1899	1899	172.6	20.8	108.8
6D	11/17/99	20 (10,10)	280	1.5	187	5130	1899	2848	142.4	15.3	89
9	12/7/99	10 (5,5)	140	1	140	3308	1247	1247	125.7	14.2	76

Table 13. 2000 Pasture Yields per Acre and per Doe Unit (doe and her kids)

Pasture #	Date	Days grazed	doe unit Days	Acres	doe unit Days/Acre	Wet Yield /Acre	Dry Yield /acre	Lbs. DM /Field	Lbs. DM /Day	Lbs. CP /Day	Lbs. TDN /Day
2A	4/29/00	14	420	0.51	824	29422	3894	1986	141.8	30.2	87.7
2B	5/13/00	7	210	0.51	412	29422	3894	1986	283.7	60.4	175.4
3	5/20/00	22 (8,7,7)	660	1.51	437	13522	2580	3895	177.1	19.3	105.5
4A	**6/11/00**	**10**	300	**0.475**	632	**30880**	**7298**	**3467**	**346.7**	**34.8**	**204.5**
4B	**6/21/00**	**10**	300	**0.475**	632	**30880**	**7298**	**3467**	**346.7**	**34.8**	**204.5**
1	**7/1/03**	**12 (6,6)**	360	**1.13**	319	**19468**	**6588**	**7445**	**620.4**	**45.1**	**371**
3A	7/13/00	5	150	0.49	306	9206	3203	1570	313.9	37.4	188
5	7/18/00	11 (6,5)	330	0.94	351	8104	2858	2686	244.2	24.3	147.9
7	8/4/00	35	1050	2.54	413	14366	5198	13202	377.2	39.1	232.2
8	9/8/00	26	520	1.48	351	4968	1899	2810	108.1	11.7	68.2
6A&B	10/7/00	40 (moved 5 to 7 d)	680	3.5	194	5821	1295	4531	113.3	26.4	73.4
6C&D	11/16/00	22 (moved 5 to 7 d)	352	1.5	235	7145	3711	5567	253	36.9	161.9
9	12/8/00	10 (7,6)	160	2	80	NA	NA				

Table 14. Pounds (lbs) of dry matter (DM), crude protein (CP), total digestible nutrients (TDN) used per day per doe unit in 1999. Also, dry matter used (consumed and wasted) as either 1) a percentage of total body weight of all dams or 2) a percentage of total weight of herd.

Pasture #	# of doe units	Lbs. DM per day /doe unit	Lbs. CP per day /doe unit	Lbs.TDN per day /doe unit	DM used as a % of body wt[a]	DM used as a % of body wt[b]	Description
1	25	4.1	0.49	2.48	3.6	2.7	25 does(23 lactating, 2 preg),averaging 113.9 lb, gaining .05 lb daily, raising 40 kids averaging 21.7 lb, gaining .44 lb
2	25	7.3	1.12	4.55	**6.4**	4.5	25 does(23 lactating, 2 preg),averaging 114.7 lb, gaining .05 lb daily, raising 40 kids averaging 29.3 lb, gaining .4 lb
3	25	9.9	1.26	6.23	**8.6**	6.1	25 does(23 lactating, 2 preg),averaging 115.4 lb, gaining .05 lb daily, raising 40 kids averaging 34.5 lb, gaining .4 lb
4	23	8	0.68	4.79	**6.9**	4.3	23 does(22 lactating, 1 preg),averaging 115 lb, losing .05 lb daily, raising 40 kids averaging 40 lb, gaining .33 lb daily
5	23	7	0.51	4.28	**6.1**	3.8	23 does(22 lactating, 1 preg),averaging 114.2 lb, losing .05 lb daily, raising 40 kids averaging 45.2 lb, gaining .33 lb daily
7	22	8.4	0.69	4.72	**7.4**	4.3	22 does(all lactating),averaging 113 lb, gaining .09 lb daily, raising 35 kids averaging 50.5 lb, gaining .27 lb
8	19	4.8	0.79	3.16	4.2	2.2	19 does(all lactating), averaging 113.1 lb, gaining .04 lb daily, 1 wether, raising 34 kids averaging 58 lb, gaining .24 lb, **WEANING** occurred Sept 25th by removing dams of doe kids to Pasture 2 for 7 to 14 days and permanently removing buck kids to Pasture 1.
6A	15	8.4	1.01	5.29	7.3	**4.1**	15 dry does, averaging115.3 lb gaining.34 lb daily, 1 wether, and 21 weaned doe kids averaging63.1 lb gaining .18 lb
6B	15	10.3	1.36	6.54	8.6	**4.9**	15 dry does, averaging120.3 lb gaining.34 lb daily, 1 wether, and 21 weaned doe kids averaging 65.8 lb gaining .18 lb
6C	14	12.3	1.48	7.77	10	**5.3**	14 dry does averaging 123.5 lb, gaining .06 lb daily, 1 wether, and 21 weaned doe kids averaging 69.4 lb, gaining .24 lb
6D	14	10.2	1.09	6.35	8.2	**4.4**	14 dry does averaging 124.2 lb, gaining .06 lb daily, 1 wether, and 21 weaned doe kids averaging 72 lb, gaining .24 lb
9	14	8.9	1.01	5.45	7.1	**3.8**	14 dry does averaging 125.4 lb, gaining .06 lb daily, 1 wether, and 21 weaned doe kids averaging 76.8lb, gaining .24 lb

[a] Dry matter used expressed as a percentage of the total weight of all dams.

[b] Dry matter used expressed as a percentage of the total weight of herd. This included weight of kids, dams and any dry animals also in herd at the time.

Table 15. . Pounds (lbs) of dry matter (DM), crude protein (CP), total digestible nutrients (TDN) used per day per doe unit in 1999. Also, dry matter used (consumed and wasted) as either 1) a percentage of total body weight of all dams or 2) a percentage of total weight of herd.

Pasture #	# of doe units	Lbs. DM per day /doe unit	Lbs. CP per day /doe unit	Lbs.TDN per day /doe unit	DM used as a % of body wt [a]	DM used as a % of body wt [b]	Description
2A	30	4.7	1.01	2.92	4.1	3.2	30 does (27 lactating, 3 pregnant) averaging 115.5 lbs, losing .23 lb daily, nursing 45 kids averaging 20.3 lb, gaining .42 lb daily plus 3 newborns, i.e. 48 kids.
2B	30	9.5	2.01	5.85	**8.4**	6.2	30 does (29 lactating, 1 pregnant) averaging 112.5 lbs, losing .23 lb daily, nursing 45 kids averaging 26.2 lbs, gaining .42 lb daily plus 7 newborns, i. e. 52 kids.
3	30	5.9	0.64	3.52	**5.3**	3.7	30 does (29 lactating, 1 pregnant) averaging 111 lbs, losing .16 lb daily, nursing 52 kids averaging 26.9 lb, gaining .38 lb daily.
4A	30	11.6	1.16	6.82	**10.7**	6.8	30 does(all lactating) averaging 107.5 lbs, losing.16 lbs daily, nursing 52 kids averaging 35.3 lb, gaining .38 lb daily.
4B	30	11.6	1.16	6.82	**10.9**	6.6	30 does (all lactating) averaging 106 lbs, losing.06 lb daily, nursing 52 kids averaging 38.6 lb, gaining .19 lb daily, 1 dry yearling.
1	30	20.7	1.5	12.37	**19.6**	11.6	30 does (all lactating) averaging 105.4 lbs, losing.06 lb daily, nursing 52 kids averaging 40.5 lb, gaining .19 lb daily, 1 dry yearling..
3A	30	10.5	1.25	6.28	**10**	5.8	30 does (all lactating) averaging 104.6 lbs, losing.06 lb daily, nursing 52 kids averaging 42.8 lb, gaining .19 lb daily, 1 dry yearling.
5	30	8.14	0.81	4.93	**7.8**	4.5	30 does (all lactating) averaging 104.3 lbs, losing.06 lb daily, nursing 52 kids averaging 43.7 lb, gaining .19 lb daily, 1 dry yearling.
7	30	12.6	1.3	7.74	**12.2**	6.7	30 does (most lactating) averaging 103.2 lbs, gaining .09 lb daily, nursing 48 kids averaging 47.4 lb, gaining .22 lb daily, 1 dry yearling, 2 pet wethers.
8	20	5.4	0.59	3.41	5.1	2.7	20 does (most lactating) averaging 106.5 lbs, gaining .09 lb daily, nursing 29 doe kids averaging 57.9 lbs, gaining .11 lb daily, 1 dry yearling, 2 pet wethers. Buck kids **WEANED** off as does entered pasture.
6A&B	17	6.7	1.55	4.32	5.9	**2.9**	17 does (being dried off) averaging 112.8 lb, gaining .05lb daily, nursing 29 doe kids averaging 61.1 lb, gaining .11 lb daily, 1 dry yearling, 1 pet wether. Doe kids **WEANED** Oct 17th by removing their dams for 11 days.
6C&D	16	15.8	2.31	10.12	14.1	**7.2**	16 dry does averaging 112 lbs, gaining .26 lb daily, and 25 weaned doe kids averaging 62.9 lbs, gaining .12 lb daily, 2 pet wethers.
9	16						16 does averaging 120.7 lbs, gaining .26 lb daily, and 25 weaned doe kids averaging 65.5 lbs, gaining .12 lb daily, 2 pet wethers.

[a] Dry matter used expressed as a percentage of the total weight of all dams.

[b] Dry matter used expressed as a percentage of the total weight of herd. This included weight of kids, dams and any dry animals also in herd at the time.

b. Worm Control

Introduction

The pasture analyses discussed in the previous section indicate that our conventional pastures would benefit from intensive rotational grazing. Why then, do we not intensively rotate these pastures? The answer is worms. Prior to 1999, the goat herd followed 2 weeks after 2 horses in a continuous rotation of Pastures 1 through 5 moving to the next pasture once per week from June 1st through Oct 15th. Goats were moved to brush pastures 7 & 8 from Oct 16th - Dec 15th. They returned to Pastures 1 – 5 for the winter where round bales were provided in Pasture 3 to sustain them for winter. A barn was available but goats often bedded down right in the round bales.

Pastures looked good and labor was minimal but worm counts were extremely high even as late as December 15th. Some does showed bottle jaws in late summer and one fatality occurred early winter one year from extremely high worm infestation. Brush pastures suffered from the goats' eagerness to girdle the bark on the brush and trees during the fall season.

We decided to avoid having the goats repeat grazing on any one area in order to better control worms. This ruled out intensive rotational grazing. Instead we decided to move the goats through our conventional pastures only from May through July. We changed our management to have the horses follow the goats rather than rotate in front of them. This allowed the horses to ingest goat worm eggs. Also, the goats would not be exposed to the short pasture heights that followed the horses, and thus, would avoid close grazing to goat droppings and worm larva.

We planned to put the goats on our brush pastures in August through September. We theorized that this would give the brush plenty of chance to replenish the nutrients lost when it budded out after winter while still providing plenty of forage for the goats. Lastly we would use temporary fencing to move our goats onto a new section of our east hay field weekly from October to December. Our west hay field would also be available if needed.

Summary of 1999

Table 16 shows that worm counts were over 1000 eggs per gram on some of the does in early spring even before the goats got out on pasture. If Fenbendazole was effective anymore in our herd it did not appear to have a very long lasting effect. Grass did emerge in our winter holding area in April and goats were observed grazing there and this may have provided a source of re-infestation. Average worm counts were already over 1000 when goats entered the conventional pastures. Worming set the worms back but fecal counts at 10 to 14 days after worming usually indicated noticeable worm loads again. Bottle jaws were observed on three different lactating does on Aug 1st, Aug 31st, and Sept 3rd while on either the conventional pastures or first brush pasture. Goats stayed in any one conventional pasture for up to 23 days and it was felt that Haemonchus might be completing a life cycle during that time and re-infesting them. The accidental mowing of the main portion of Brush Pasture 7 meant that goats were grazing far closer to the ground that we had planned. We questioned whether either Fenbendazole or Albendazole (both in the same chemical family) were having much affect on our herd anymore. Worm counts did not stay low until the goats were put on East Hay Field. This field had been harvested for hay and was thus "worm free". Goats were moved to new sections of it every 7 to 10 days so there was little chance of re-infestation.

Plans for 2000

After evaluating results from 1999, we decided to subdivide pastures 1 – 5 so goats did not stay in any section of them longer than 7 to 10 days. We also decided to try ivermectin as our primary wormer. We had avoided ivermectin for the last two years based on the results of some earlier fecal tests that suggested the herd might be resistant to it. Despite our earlier resolution to have the horses always follow the goats, we felt that we absolutely had to let them go ahead of the goats on some pastures in May and June to keep the pastures from getting too mature.

Summary of 2000

In mid March we wormed does due to kid first and moved them to holding area. The worm loads on these goats remained low after worming. However, later kidding does were not wormed and were left in the holding pen despite the fresh grass that was emerging there. Worm loads on the goats sampled in this group averaged 1750 eggs/gram by May 3rd indicating that they were either re-infested by grazing or that immature dormant larvae had over-wintered in them and hatched out. On May 3rd we started the goats on pasture and wormed the entire herd at the same time including does that had kidded the previous week. Ivermectin appeared to work better than our wormers from the previous year despite the fact that some does were wormed only once while all does had been wormed twice the previous year.

No bottle jaws observed were observed in either the conventional or brush pastures despite the wet Spring conditions. Albendazole was used to worm the goats as they moved from the brush pastures to the hay fields and it seemed only mildly effective. Similar to 1999, worm loads stopped being a problem as the goats were dried up and strip grazed though the clean East hay field. We generally assume that strongyle worms go dormant for the winter. However, we did pick up substantial eggs in the fecal analyses for both the Winters of '99 and '01.

A couple of things were observed from sampling the goats:

1) eye membrane color was a better estimate of worm egg count than was body condition.
2) The does were fed a coccidia control in their salt and coccidia loads were generally low except for kids in July and August shortly before weaning.
3) Strongyles were by far the worm most frequently observed. Hatchabilities were done during the summer of 2000 and Haemonchus was identified as the major strongyle present.

Table 16. Worm Counts (Strongyle eggs per gram feces) across years and season

Date	Worming Status	Management Status/ Wormer Used	Older does	Younger does	Doe kids
3/15/99	5 days Preworm	moving to kidding area	1062.5	200	
3/20/99	Wormed	Fenbendazole 10 mg/kg as drench, each doe received again within 24 hr of kidding	Wormed		
5/19/99	All does had been wormed w/in 6 wks	4 days after started on conventional pasture	2625	3050	
5/31/99	Wormed	Albendazole 7.5 mg/kg as taken out of Pasture 1 and moved to Pasture 2	Wormed		
6/1/99	1 day Postworm	Conventional pastures	1274.75	1867.5	
6/14/99	14 days Postworm	Conventional pastures	665.75	1400	
8/1/99	62 days Postworm	First bottle jaw noted in lactating does	Bottle jaw		
8/11/99	same day Preworm	Moving from conventional pastures to brush pastures	80	3144	1854
8/11/99	Wormed	Albendazole 7.5 mg/kg as drench	Wormed		Wormed
8/21/99	10 days Postworm	Brush pastures	149.5	865	
8/31/99	20 days Postworm	Second bottle jaw noted in lactating does	Bottle jaw		
9/3/99	23 days Postworm	Third bottle jaw noted in lactating does	Bottle jaw		
9/9/99	Wormed	Albendazole 7.5mg/kg as moved out of first brush pasture. Put in hedgerow for 3 days	Wormed		
9/27/99	14 days Postworm	2nd brush pasture and weaning of all kids	416	62.5	3175
10/02/99	Wormed	Albendazole 7.5 mg/kg as moving from brush pastures to hay fields	Wormed		Wormed
10/11/99	9 days Postworm	Hay fields	715	990	1218
12/17/99	same day Preworm	moving from hay fields to to winter drylot	177.5	107	693.37
12/17/99	Wormed	Injectable Ivermectin .3/kg as a drench	Wormed		Wormed
2/23/00	68 days Postworm	Winter drylot	575.7	869.25	
3/19/00	Same day Preworm	Winter drylot, some being moved to kidding area	453.37	340.5	
3/19/00	Wormed some	Ivermectin to the most pregnant does (these were moving to kidding area)	Wormed some		
4/2/00	14 days Postworm	Does that were in kidding area	0	89.37	
5/3/00	Same day Preworm	3 days after starting to be introduced to conventional pastures	57.5[a]	3	
5/3/00	Wormed	Ivermectin to all does	Wormed		
6/1/00	28 days Postworm	Conventional pastures	25	28	
7/10/00	67 days Postworm 18 daysPreworm	Conventional pastures	2960	2987.5	17
7/28/00	Wormed	Albendazole 10 mg/kg as moving from conventional pastures to brush pastures. Put in hedgerow 4 days	Wormed		Wormed
8/18/00	21 days Postworm	Grazing in first brush pastures, buck kids being weaned	3100	1410	
10/07/00	Wormed	Ivermectin as moved from brush pastures to hay fields	Wormed		Wormed
10/25/00	18 days Postworm	Hayfields	888	225	1581.5
12/21/00	Same day Preworm	moving from hay fields to winter drylot	213	591	145.5
12/21/00	Wormed	Ivermectin	Wormed		Wormed
1/8/01	18 days Postworm	Winter drylot	1149.5	110	7.5
3/21/01	90 days Postworm	As getting ready to worm again and move to kidding area	2310	968	1280

[a] Sample average does not include does that kidded late and thus were not wormed on 3/19/00 and were held in holding pen where grass was emerging until April 3, 2000. These does averaged 1750 eggs/g.

c. Doe Productivity

Performance parameters

All twenty five of the does bred in the Fall of 98 kidded in 1999. Two of these does kidded after May. One litter of twins was lost in the April/May kiddings. These were from an unassisted birth to a yearling and were dead when found. The doe successfully fostered one of triplets born to an older doe. One of the four kids born to the two does kidding after May died within 24 hours of birth. Birth weights for this litter were only 4.5 and 4 lbs. Thus, these kids were probably premature and should have been given special treatment for their first night. Thus, mortality rate within 24 hrs of birth was 3/46 or ~6%. There was no mortality in any of the remaining 43 kids.

The herd was composed of 11 first freshening yearlings (44%) with 17 live kids (7 live twin litters, 1 dead twin litter, 3 single litters) or 1.46 kids each. Fourteen does (56%) were 2 to 5 years old and they produced 26 live kids (1 triplet litter, 9 live twin litters, 1 twin litter with 1 death, 2 single litters) or 1.86 kids each.

Thirty of 31 does bred in Fall '99/Winter '00 kidded in 2000. The youngest yearling had been kept from the buck until January and no activity was observed when she was finally put in with him. Most of the does kidded in late March or April. Three does kidded in May and one doe in June. The breeding herd consisted of 17 first freshening yearlings (57 %) with 25 live kids (9 live twin litters, 1 litter of twins with 1 kid dying in the birthing process, 8 single litters) or 1.47 live kids each. Thirteen does (43% of the herd) were 2 to 5 years of age. These mature does produced 29 live kids (3 triplet litters, 10 twin litters) or 2.23 kids each. However one weak twin died within 1 week of birth. Thus, mortality rate within the first week of birth was 2/55 or ~4%. As in 1999, no more kids were lost during the year. We had to euthanize one 3 yr old doe with a long history of vague illness. An autopsy revealed substantial scar tissue along her small intestine and Dr. Mary Smith suggested that her intestine had been perforated as a young kid possibly by another goat landing on her. No other does died during the project.

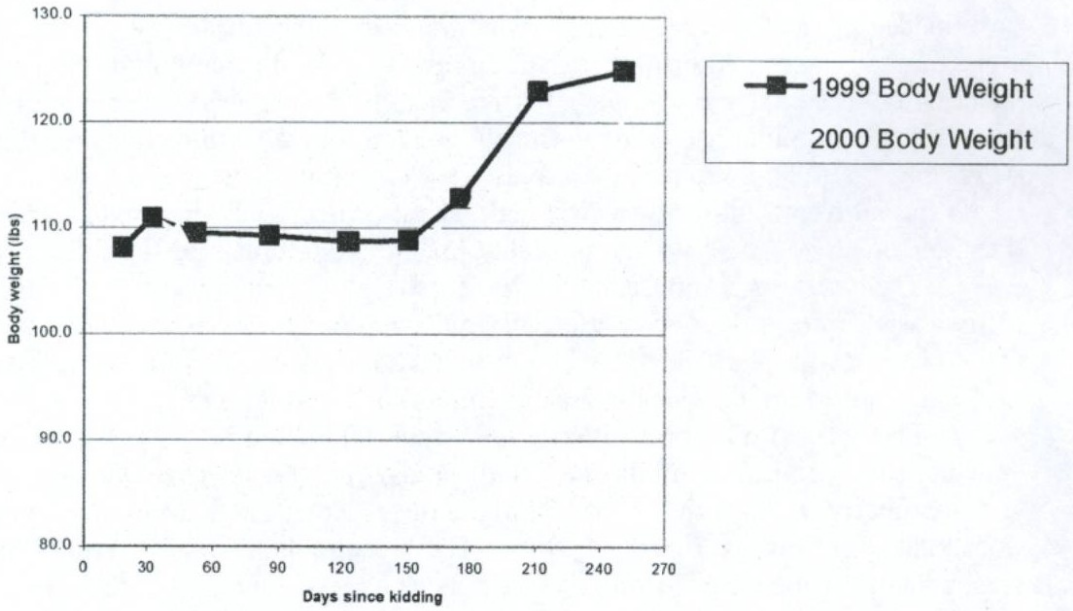
Nine male kids were slaughtered and sold directly to end consumers in 2000. They weighed 73 to 103 lbs at 7.5 to 8.5 months of age. Wet carcass weights with hides off, heads on averaged 44.8 lb (ranged from 38 to 60 lbs) and dressing percentages averaged 54.9% (ranged from 52.3% to 57.3%).

Weight curves and average daily gains

The goats were weighed monthly. Unfortunately, a fast munching goat consumed the Sept '00 weights. The weight curves and daily gains shown in this section were taken by comparing weights for all does at the same stage in reproduction. We removed a couple of outliers (does kidding after May) each year. We compared doe weight changes by age of the doe at kidding and number of kids nursing. Yearling first fresheners were designated as "Young does". Second+ fresheners ranging in age from 2 to 5 years were designated as "Mature".

Growth curves and daily gains for kids were taken by lining up their dates of birth. Thus, weights were compared by age rather than by averaging the weights over a particular sample date. Again, a few late born kids were removed. We looked at the effect of sex on growth rate and also did a comparison based on the maturity of the dam and the size of the litter she was raising.

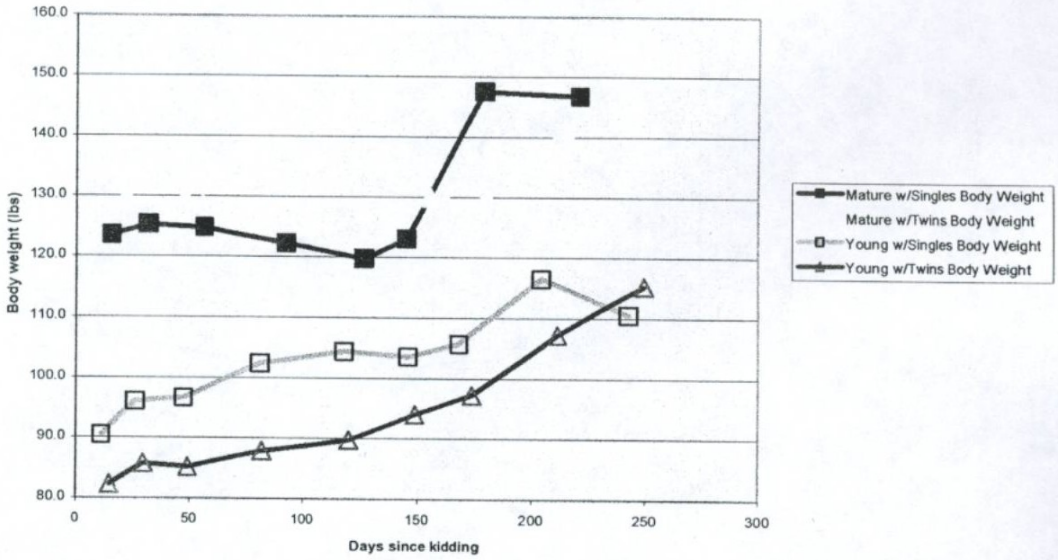
Chart 4. Weight Curves for Lactating Does by Year



The average weight of does was slightly less in 1999 than in 2000 despite a smaller proportion of the herd being first fresheners (Chart 4). However, doe weights stayed relatively stable in 1999 until weaning at about 5 months after kidding. Does gained weight rapidly after weaning and were rebred ~7 months after kidding. In contrast, does lost weight while nursing kids in 2000. They did not start gaining this weight back until the buck kids were weaned shortly after 4 months following kidding. There was no sharp increase in weight gain after the doe kids were weaned at about 6 months of age (this may indicate that the doe kids had already weaned themselves naturally). Doe weights further improved about 8 months after kidding (1 month pregnant) when the does were half way through the hay fields.

Litter size and age affected weights as we would normally predict in 1999. There are only two mature does with single kids represented in Chart 5. One of these does was euthanized shortly after 150 days since kidding . The remaining doe was far heavier and this accounts for the sharp increase in weight noted for this class after weaning.

Chart 5. Weight Curve of Does from mid-April '99 to mid-Dec '99

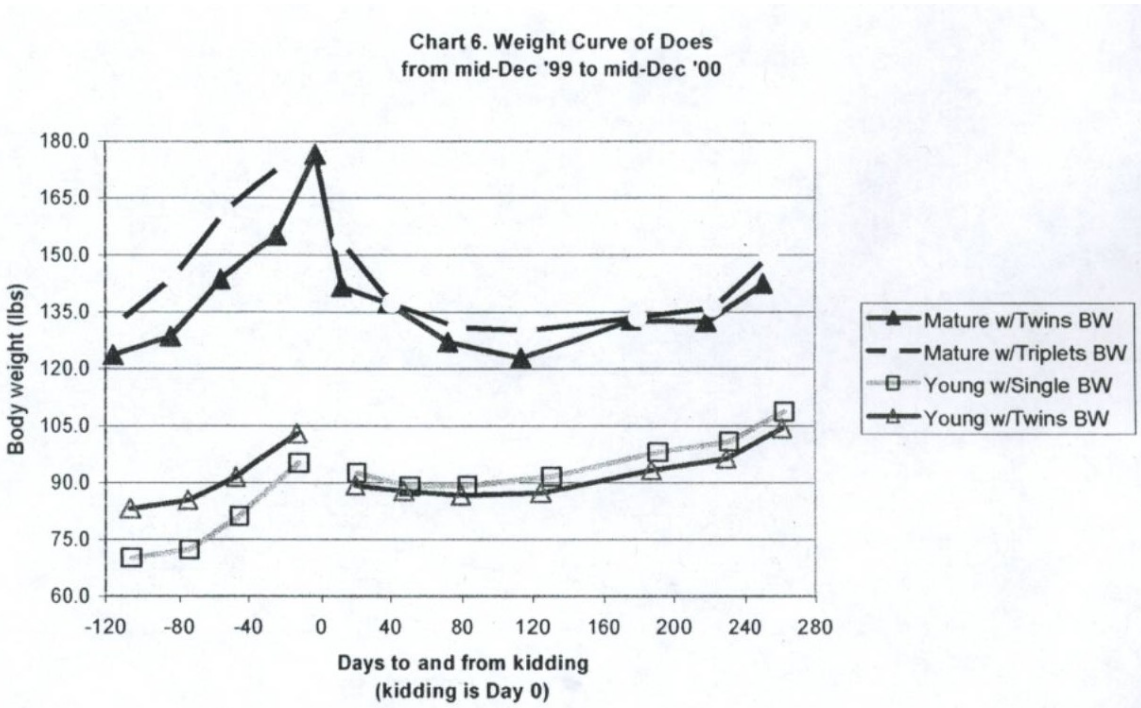


In 1999, doe weights from heaviest to lightest after kidding were: mature does carrying twins →mature does with singles→ yearling does with singles → yearling does with twins. Yearling does (even those nursing twins) gained weight during lactation while older does lost some weight (Table 17). All does put on compensatory weight after weaning.

Table 17 . Average daily weight gains (**DG**) of Does within a range of days after kidding in 1999.

Type	N	DG2	DG3	DG4	DG5	DG6	DG7	DG8	DG9
All Does	23	**0.20** (18 to 33[a])	**-0.08** (33 to 52)	**0.06** (52 to 86)	**-0.01** (86 to 123)	**0.09** (123 to 150)	**0.09** (150 to 175)	**0.29** (175 to 211)	**0.08** (211 to 251)
Mature Does With Singles	2	**0.10** (17 to 32)	**0.01** (32 to 57)	**-0.08** (57 to 93)	**-0.11** (93 to 127)	**-0.63** (127 to 145)	**0.70** (145 to 180)	**-0.02** (180 to 221)	
Mature Does With Twins	10	**0.12** (23 to 37)	**-0.18** (37 to 56)	**0.01** (56 to 89)	**-0.07** (89 to 126)	**0.19** (126 to 156)	**-0.05** (156 to 179)	**0.36** (179 to 214)	**0.00** (214 to 255)
YoungDoes With Singles	4	**0.37** (12 to 27)	**0.01** (27 to 48)	**0.18** (48 to 82)	**0.06** (82 to 119)	**-0.01** (119 to 146)	**0.09** (146 to 169)	**0.31** (169 to 204)	**0.10** (204 to 243)
YoungDoes With Twins	7	**0.24** (16 to 30)	**-0.02** (30 to 49)	**0.08** (49 to 82)	**0.03** (82 to 121)	**0.16** (121 to 149)	**0.09** (149 to 175)	**0.28** (175 to 211)	**0.14** (211 to 250)

[a] expresses range of days that this daily weight gain takes place during, i.e., 18 days after kidding until 33 days after kidding.



During pregnancy in the winter of 2000, doe weights from heaviest to lightest were: mature does carrying triplets → mature does carrying twins → yearling does with twins → yearling does with singles (Chart 6). We had hoped that the weight gain from 40 days pregnant to 130 days pregnant could be used to predict liter size so that does could be separated about 2 to 3 weeks prior to kidding and yearlings carrying twins and mature does carrying triplets given extra grain to better protect them from ketosis in late pregnancy. During these 90 days, older does with triplets, older does with twins, young does with twins and young does with singles gained 42 lbs, 32 lbs, 20 lbs and 25 lbs, respectively in 2000. Thus, weight gain from 40 to 130 days pregnant was not a good indicator of litter size in yearling does in our herd in 2000. There was a 10 lb average different weight gain between mature does carrying triplets versus twins. However, there were individual does carrying twins that gained more than individual does carrying triplets so this parameter is clearly not 100% accurate and may not be very useful.

Similar to 1999, yearling does with twins lost more weight at kidding and were lighter weight throughout lactation than yearling does nursing singles. However, they were only about 5 lbs lighter throughout lactation in 2000 whereas in 1999 they were ~ 10 lbs lighter. As in 1999, weight curves were more persistent for yearling does than mature does. Yearlings lost less weight than mature does in early lactation and started to gain their weight back about 3 months after kidding. The 3 does nursing triplets were able to maintain their weight as well or better than the other mature does nursing only twins. All does stopped losing weight when the buck kids were weaned at ~120 days of age and, as noted earlier, gained even more weight in their 8th month after kidding. The does were flushed during breeding and were taken off grain completely for this weigh period. However, Pastures 6C&D were very nutritious. Pasture analyses indicated that the does and weaned doe kids had about 7.2% of their body weight available as dry matter during this period. This may account for their compensatory weight gains (Table 18).

Table 18. Average daily weight Gains (**DG**) of does within a range of days before or after kidding for 2000.

Type	N	DG1	DG2	DG3a	DG3b	DG4a	DG5	DG6	DG7	DG8	DG9	DG10
All Does	30	**0.14** [a] (-110 to -79)	**0.38** (-79 to -51)	**0.37** (-51 to -17)		**-0.33** (-17 to 16)	**-0.22** (16 to 45)	**-0.14** (45 to 77)	**-0.04** (77 to 122)	**0.08** (122 to 184)	**0.06** (184 to 225)	**0.27** (225 to 25
Mature Does With Twins	10	**0.16** (-116 to -85)	**0.53** (-85 to -57)	**0.30** (-57 to -25)	**0.65** (-34 to -4)	**-0.37** (-25 to 11)	**-0.34** (11 to 38)	**-0.31** (38 to 72)	**-0.13** (72 to 113)	**0.06** (113 to 176)	**0.01** (176 to 217)	**0.31** (217 to 25
Mature Does With Triplets	3	**0.42** (-114 to -84)	**0.58** (-84 to -54)	**0.37** (-54 to -20)		**-0.66** (-20 to 11)	**-0.54** (11 to 41)	**-0.17** (41 to 77)	**-0.16** (77 to 117)	**0.06** (117 to 180)	**0.06** (180 to 221)	**0.41** (221 to 25
YoungDoes With Singles	8	**0.07** (-106 to -75)	**0.29** (-75 to -45)	**0.42** (-45 to -12)		**-0.11** (-12 to 20)	-0.12 (20 to 51)	**-0.03** (51 to 83)	**0.04** (83 to 130)	**0.13** (130 to 192)	**0.08** (192 to 231)	**0.18** (231 to 26
YoungDoes With Twins	9	**0.07** (-107 to -76)	**0.22** (-76 to -48)	**0.33** (-48 to -14)		**-0.40** (-14 to 19)	**-0.05** (19 to 47)	**-0.04** (47 to 79)	**0.01** (79 to 124)	**0.09** (124 to 188)	**0.08** (188 to 229)	**0.24** (229 to 26

[a] expresses range of days that this daily weight gain takes place during, i.e., 110 days before kidding until 79 days before kidding.

Average birth weights were heavier for male kids than female kids and for kids from mature does (2 to 5 yrs old) than from yearling does (~12 mo old) (Table 19). The birth weights for kids whose dams were in the same age group tended to decrease as the litter size increase. Please remember that we are referring to averages here. You could certainly have a doe kid who was bigger than a similar buck kid or twins that were lighter than triplets etc.

Average birth weights were better for all groups in 2000 compared to 1999. This can probably be explained by nutrition. The alfalfa hay fed for the last two weeks prior to kidding in 2000 was more nutritious than in 1999. The does were each fed 1½ lbs of grain for the last 4 weeks of pregnancy in 2000 as compared to 1 lb of grain in 1999. This may also explain why weight differences between yearling does with singles versus twins were less after kidding in 2000 than in 1999 and why the average weight of all does after kidding was more in 2000 compared to 1999.

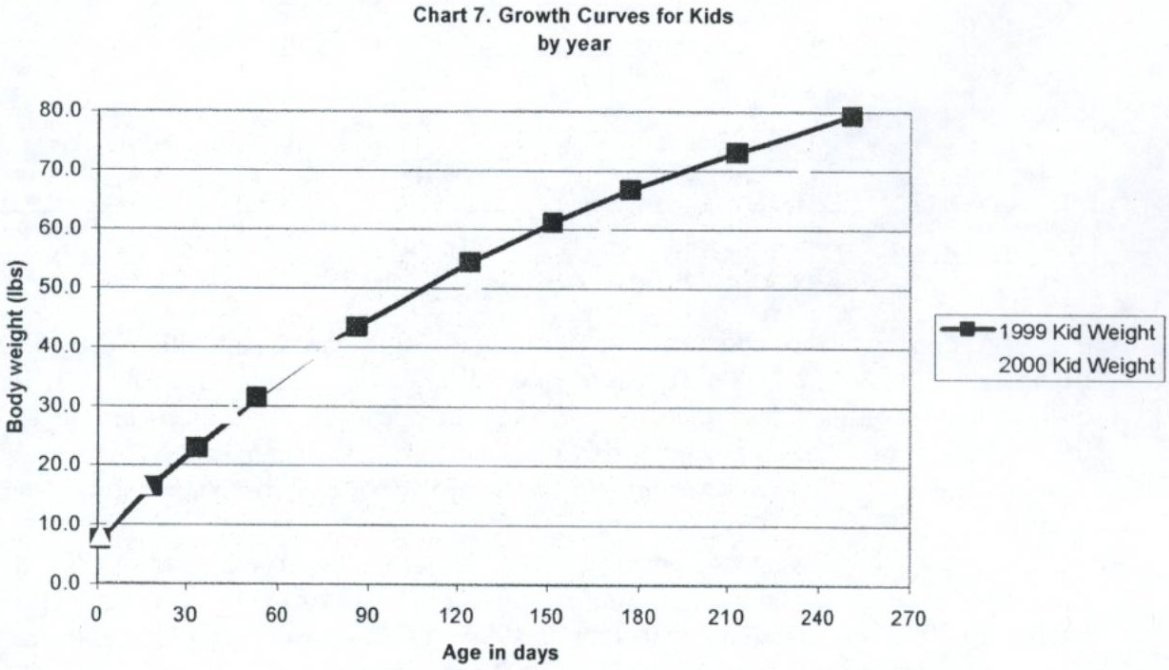
Table 19. Average birth weight of kids by year, sex and litter type.

1999			2000		
Type	N[a]	**Birth Weight**	Type	N[a]	**Birth Weight**
Male kids	20	**7.9**	Male kids	25	**8.3**
Female kids	20	**7.0**	Female kids	29	**7.7**
Singles from mature does	2	**9.5**	Singles from mature does	0	
Twins from mature does	20	**8.4**	Twins from mature does	22	**8.6**
Triplets from mature does	3	**7.3**	Triplets from mature does	9	**8.1**
Singles from young does	6	**7.4**	Singles from young does	7	**8.5**
Twins from young does	14	**6.0**	Twins from young does	18	**7.1**

[a] Number of observations for females and males includes only kids that were still alive 1 week after birth. Number of observations for kids by litter size at birth includes as well kids that died at birth or shortly after.

Average daily weight gains for goat kids in our herd under our management tend to start at ~ .5 lbs daily and decrease to ~.15 lbs daily as kids mature (Tables 19 and 20). The growth curve for kids in 1999 was remarkably smooth and showed no detrimental effect from weaning. Even though initial birth weights were better for kids in 2000 than in 1999, the kids did not grow quite as well that year. They gained about the same or better until 80 to 90 days after kidding and then started to fall behind and never really caught up again even at 8 to 9 months of age. A larger proportion of the herd in 2000 was made up of yearlings nursing twins and mature does nursing triplets which may be why growth was poorer. However, it also appears that there was no benefit from weaning

males at 4 months and weaning females at 6 months rather than just weaning all the kids together at 5 months as was done in 1999 (Chart 7).



Male kids grew better than female kids until about the 8th month in 1999 (Chart 8). We sold many kids between the 8th and 9th month. Possibly we sold the smaller doe kids and the bigger buck kids and this may explain why female kids caught up with the males by 270 days of age. The daily weight gains for male and female kids that we kept in the herd were the same for both sexes (~.13 lb/day) during this same time period. Male kids grew better than female kids throughout 2000. Their weigh gains stayed stable after weaning whereas those for doe kids dropped. Doe kids averaged 69 lbs at 255 days of age in 2000 compared to 81 lbs at 253 days of age in 1999 (Chart 9). There appears to have been no benefit in delaying their weaning and it appears that their plane of nutrition after weaning was worse in 2000 than in 1999. Similar to the adult does their weight gains improved at about 8 months of age when they were in Pastures 6C&D.

Chart 8. Kid Growth Curves for 1999
by sex of kid

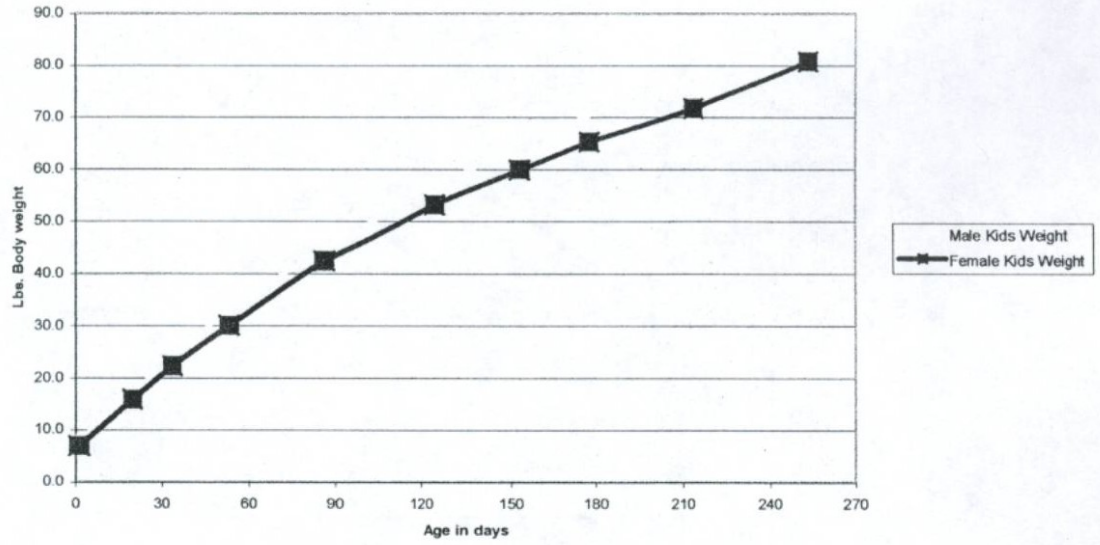
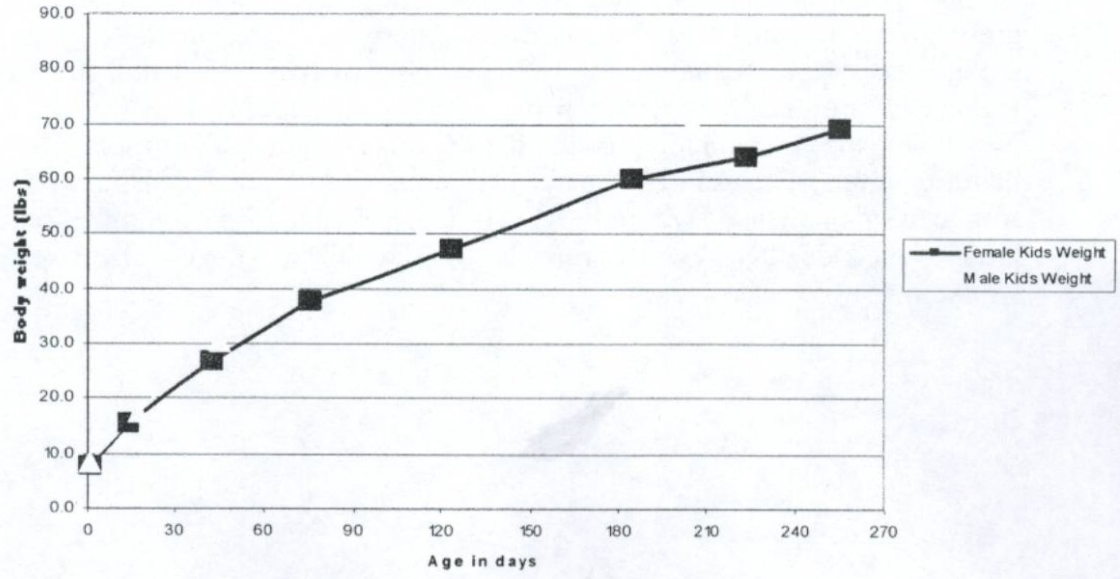
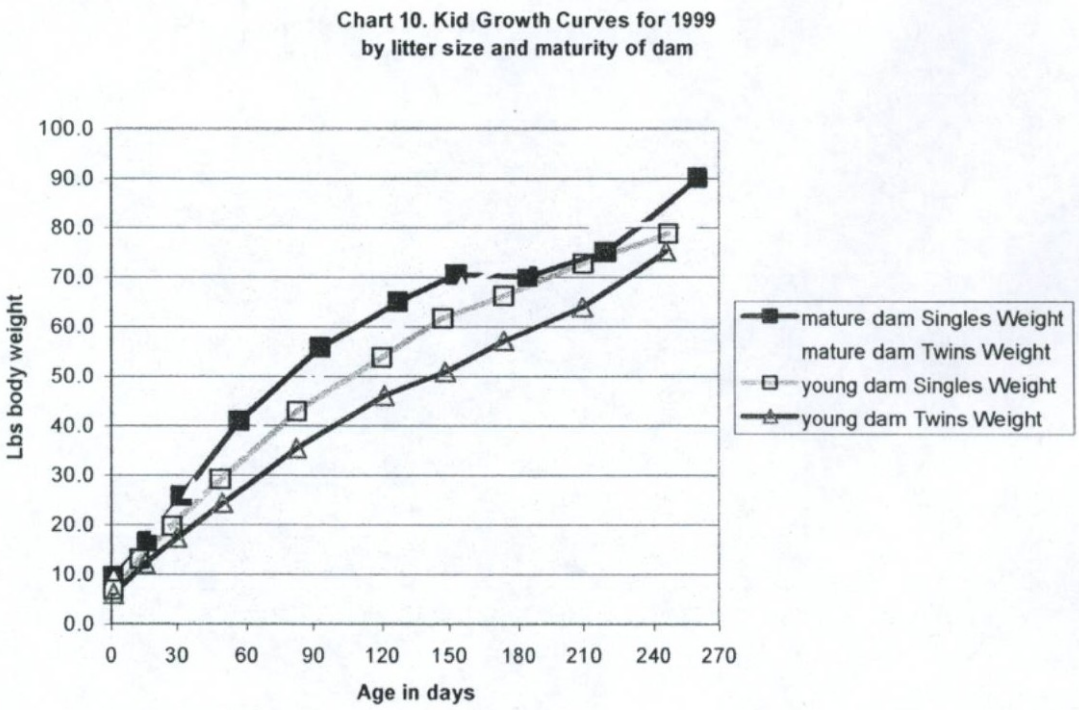


Chart 9. Growth Curve of Kids in 2000
by sex of kid

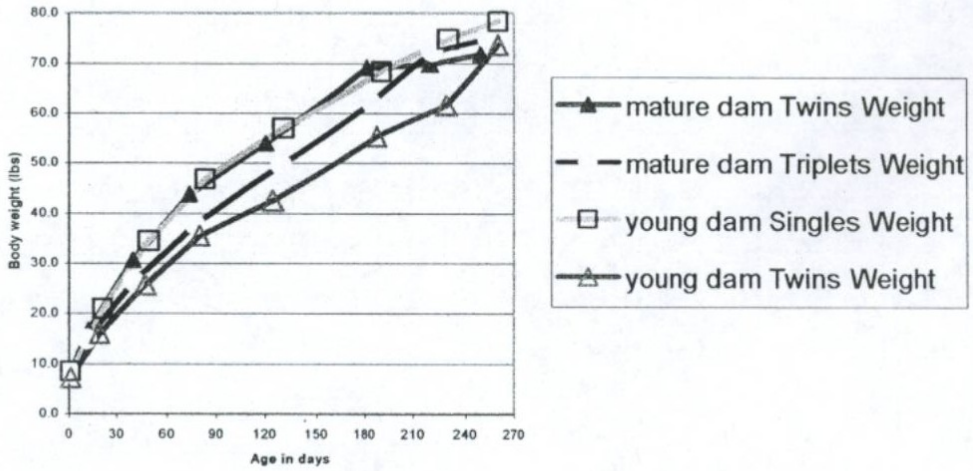


Litter size and maturity of doe affected kid growth similarly both years (Charts 10 and 11, Tables 20 &21). In 1999, twins to yearlings grew slower than singles to yearlings particularly during the last weigh period prior to weaning. Singles to yearlings were slightly smaller than twins to mature does but had very similar grow curves. Singles to mature does grew fastest but seemed to take weaning hard unlike any of the other kid groups.



In 2000, single kids from yearlings grew equally fast as twin kids from mature does and were not adversely affected in late lactation or after weaning. In contrast, twin kids from mature does stopped growing at about 180 days of age or about the same time doe kids got weaned. Triplet kids from mature does grew slower than either of the above groups while nursing but started to catch up after weaning. Twin kids to yearlings were the lightest prior to weaning but did a lot of compensatory growth at 8 months of age. Milk yield from mature does with triplets and yearling does with twins was probably insufficient for optimum kid growth after the first 2 months of lactation. The early maturity of the pastures in 2000 may have contributed to this and also provided a poor source of supplemental feed for these kids. Creep feeding of kids and the feeding of more grain to doe kids after weaning probably would allow for more compensatory gains but would increase our feed costs.

Chart 11. Growth Curve of Kids in 2000
by litter size and maturity of dams



Suckling kids need to gain about .5 lbs per day (without accounting for birth weight) in order to be considered top quality Easter kids. On our farm we do not aim for the suckling kid market but instead keep most of our slaughter kids on pasture until late fall/early winter and sell them as weaned market kids. However, twins to mature does and singles to yearling does easily met the criteria for top notch suckling kids under our management system. The situation was more variable for triplets from mature does and even more so for twins from yearling does. These two groups would need to either 1) be creep fed or 2) have their dams fed more grain, if we were to convert to a suckling kid market. However, there was a lot of variability exhibited in the ability of yearlings to raise twin litters or mature does to raise triplet litters. Genetic selection for weight at weaning after accounting for litter size and age of dam would probably have a great deal of potential and be another way to achieve this goal. In reality, performance from kidding to weaning is the main criteria we use in our herd for selecting does and doe kids to remain in the herd. We now have several does that do an excellent job supporting these large litters in our herd. Neither creep feeding (due to feed costs and a few magical does that can get into any creep feeder) nor partitioning the doe herd into two separate herds for preferential graining has proven very feasible given the small size of our herd. We have rearranged things so that doe kids continue to receive supplementary grain even after they are reunited with their dams after weaning.

Table 20. Daily Weight Gains (DG) for kids in 1999.

Type	N	DG1	DG2	DG3	DG4	DG5	DG6	DG7	DG8	DG9
Averages	40	**0.46** (1 to 19)	**0.45** (20 to 33)	**0.44** (34 to 53)	**0.38** (54 to 86)	**0.31** (87 to 124)	**0.25** (125 to 152)	**0.25** (153 to 177)	**0.19** (178 to 213)	**0.13** (214 to 251)
Male kids	20	**0.46** (1 to 19)	**0.45** (20 to 33)	**0.47** (34 to 52)	**0.38** (53 to 85)	**0.35** (86 to 122)	**0.27** (123 to 150)	**0.32** (151 to 175)	**0.21** (176 to 212)	**0.13** (213 to 245)
Female kids	20	**0.45** (1 to 19)	**0.45** (20 to 34)	**0.41** (35 to 53)	**0.38** (54 to 86)	**0.28** (87 to 125)	**0.24** (126 to 153)	**0.22** (154 to 178)	**0.18** (179 to 213)	**0.12** (214 to 253)
Singles from mature does	2	**0.35** (1 to 17)	**0.59** (18 to 32)	**0.59** (33 to 57)	**0.40** (58 to 93)	**0.26** (93 to 127)	**0.21** (128 to 153)	**0.26** (154 to 184)	**0.14** (185 to 219)	**0.37** (220 to 260)
Twins from mature does	20	**0.51** (1 to 23)	**0.50** (24 to 37)	**0.47** (37 to 56)	**0.41** (57 to 88)	**0.33** (89 to 127)	**0.27** (128 to 155)	**0.25** (156 to 180)	**0.19** (181 to 216)	**0.10** (217 to 256)
Singles from young does	4	**0.51** (1 to 13)	**0.45** (14 to 28)	**0.46** (29 to 49)	**0.41** (50 to 83)	**0.30** (84 to 120)	**0.28** (121 to 147)	**0.18** (148 to 173)	**0.18** (174 to 210)	**0.12** (211 to 246)
Twins from young does	14	**0.38** (1 to 16)	**0.36** (17 to 30)	**0.38** (31 to 49)	**0.34** (50 to 82)	**0.29** (83 to 121)	**0.21** (122 to 148)	**0.29** (149 to 173)	**0.19** (174 to 209)	**0.13** (210 to 245)

Table 21. Daily Weight Gains (DG) for kids in 2000.

Type	N	DG1	DG2	DG3	DG4	DG5	DG6	DG7
Kid Averages	52	**0.59** (1 to 16)	**0.42** (17 to 44)	**0.35** (45 to 78)	**0.20** (79 to 125)	**0.22** (126 to 185)	**0.15** (186 to 225)	**0.19** (226 to 255)
Female kids	23	**0.59** (1 to 14)	**0.40** (15 to 42)	**0.33** (43 to 76)	**0.20** (77 to 123)	**0.21** (124 to 184)	**0.10** (185 to 223)	**0.12** (224 to 255)
Male kids	29	**0.60** (1 to 17)	**0.44** (18 to 45)	**0.36** (46 to 79)	**0.21** (80 to 127)	**0.23** (128 to 187)	**0.21** (188 to 227)	**0.28** (228 to 255)
Singles from mature does	1	**0.39** (1 to 23)	**0.49** (24 to 55)	**0.23** (56 to 100)	**0.26** (101 to 163)	**0.27** (164 to 204)	**0.14** (205 to 234)	
Twins from mature does	18	**0.72** (1 to 12)	**0.49** (13 to 40)	**0.40** (41 to 73)	**0.21** (74 to 120)	**0.25** (121 to 181)	**0.12** (182 to 220)	**0.10** (221 to 249)
Triplets from mature does	9	**0.59** (1 to 11)	**0.39** (12 to 41)	**0.32** (42 to 77)	**0.25** (78 to 130)	**0.23** (131 to 184)	**0.19** (185 to 221)	**0.14** (222 to 253)
Singles from young does	7	**0.60** (1 to 21)	**0.47** (22 to 49)	**0.37** (50 to 83)	**0.21** (84 to 131)	**0.18** (132 to 191)	**0.17** (192 to 230)	**0.16** (231 to 260)
Twins from young does	17	**0.47** (1 to 19)	**0.35** (20 to 47)	**0.29** (48 to 80)	**0.15** (81 to 124)	**0.20** (125 to 188)	**0.15** (189 to 229)	**0.33** (230 to 260)

6. Economic Impact -

Our farm records for 1999 indicated the following upkeep costs per doe unit -

Item	Cost
Supplemental Feed (does not include round bales grown on farm)	$23
Winter round bales (25 does consumed 29 bales from midDec to midMarch, bales weighed ~600 lbs and might be valued at $10 each but would actually have been difficult to sell in our neighborhood.)[a]	$11.50
Salt (loose mineral salt for dairy heifers – contained coccidian control – fed ~ ½ lb daily to doe herd). Also range blocks fed to herd each year in late Dec while we're away out of state.	$6
Vaccine (1 dose Clostridium CDT per adult doe, 2 doses CDT per kid, 1 dose BoSe as a selenium supplement per kid at birth)	$1.60
Wormer & Lice	$10.80
Vet bills (kidding supplies, vet bills, first aid supplies, eartags)	$11. 60
Total	$64.50 (actual cash outlay $53)
Total for entire doe herd (25 does)	**$1612.50 (actual cash outlay $1325)**

[a] Round bales were harvested from our West Hay Field year by neighbors in exchange for keeping 2/3rd of the crop. Unlike East Hay Field, this field had been fallow when we bought the farm in 1995 and was primarily golden rod, native grasses, trefoil and vetch.)

Farm records for 2000 indicated the following upkeep costs per doe unit –

Item	Cost
Supplemental Feed (does not include round bales grown on farm)	$30
Round bales grown on farm (30 bales consumed by 30 doe units)	$10
Salt	$7
Vaccine, vet supplies, vet bills	$5
Wormer & Lice	$8
Total	$60.00 (actual cash outlay $50)
Total for entire doe herd (30 does)	**$1800 (actual cash outlay $1500)**

[a] Round bales were harvested from our West Hay Field year by neighbors in exchange for keeping 2/3rd of the crop. Unlike East Hay Field, this field had been fallow when we bought the farm in 1995 and was primarily golden rod, native grasses, trefoil and vetch.)

Other yearly costs that are not listed above include 1) supplies such as temporary fencing equipment, pasture seeds, feed tubs and 2) tractor fuel and minor repairs. These vary widely from year to year depending on emergencies and also how much of a shopping binge I stupidly indulge in. For example, supplies and tractor expenses per doe unit averaged $18 and $1.50, respectively, in 1999, but $5 and $3, respectively in 2000. Obviously if we needed a major repair on the tractor this figure could change drastically.

These costs do not include any of our capital expenditures. We built our goat barn from scratch and one of our hay barns. The materials for these were $700 and $400, respectively and we depreciated each of these 100% the first year after they were built. Locust trees from groves on our land provided the poles for these buildings and also provided corner posts for our perimeter fences. The rest of our perimeter fence posts were rebar cut in 5 ft lengths (purchased at $4 per 20 ft rod). Friends provided labor for

this fence during a "two weekend" party. The costs of these rods, the 6 strands of high tensile wire, fence charger (at that time a used Speedrite spliced into a voltage regulator), metal gates and insulators were also depreciated 100% the year we installed it. The only depreciation we carried over each year was the cost of our 8N tractor (5 yr), round bale spike (10 yr) and manure spreader (5 yr). Depreciation on these was $690 yearly during the study. Land taxes, farm insurance, and utilities are also not accounted for in the above list.

The herd started from 3 initial "foundation" dairy does. Thus, we never had a major layout for breeding does. We have also been able to recoup our purchase price on our herd sires. These were initially high percentage Boer bucks and later full bloods. We produce all our own herd replacements and need to replace herd sires regularly. Therefore, our herd sires are still in their prime when we resell them. Also, we have been extremely lucky to have other goat producers in the vicinity share breeding rights on bucks with us.

The only money the goats provide is from the sale of livestock or meat and from the home consumption of meat. During the study most of our breeding stock was sold through posting posters at goat extension events or through contacts in our state's meat goat producers association. Sales of slaughter goats were made by putting posters up at Cornell University at married student housing and laundry rooms, at the International Student Administration Building, at the Africana Center, etc. and again through other producers in our statewide meat goat association. We also make some cheese for home consumption each year and get manure for our garden and hay fields but the value of these last two items is difficult to quantify.

Livestock receipts for 1999 were:

Disposition	**Number**	**Price received**	**Total**
Older dairy does sold as milkers	4	$67.50 ($60 - $80)	$270
BoerX does sold as breeding stock	7	$121.42 ($100 - $150)	$850
Doe kids sold as breeding stock	3	$100 ($87.50 - $125)	$300
Male kids sold as breeding stock	7	$150 ($100 - $200)	$1050
Total Breeding Stock Sales	**21 goats**	**$117.62**	**$2470**
Suckling male kids	5	$59 ($55 - $60)	$295
10 wk old 4H wethers	2	$50	$100
Male market kids for direct freezer trade, delivered to butcher	5	$80 (73.5 lb – 95 lb) averaged 83 lb	$400
Home consumption of same	1	$80	$80
Total slaughter goat sales	**13 goats**	**$67.30**	**$875 ($795 cash received)**
Total livestock sales	**44 goats**	**$76**	**$3345 ($3265 cash received)**

Livestock receipts for 2000 were:

Disposition	Number	Price received	Total
Older dairy does sold as milkers	3	$80	$240
BoerX does sold as breeding stock	12	$112.50 ($100 - $150)	$1350
Doe kids sold as breeding stock	10	$107.50 ($75.50 - $150)	$1075
Male kids sold as breeding stock	9	$140.56 ($80 - $250)	$1265
Total Breeding Stock Sales	**34 goats**	**$115.59**	**$3930**
10 wk old 4H wethers	2	$50	$100
Male market kids to dealer, picked up on farm	5	$.95/lb or $78.95 each (81.5 – 86.5 lb) averaged 83 lb	$394.75
Male market kids for direct freezer trade, delivered to butcher	8	$80 (74 – 98 lb) averaged 84 lb	$640
Home consumption of same	4	$70 (took the lightest 4)	$280
Total slaughter goat sales	**19 goats**	**$74.46**	**$1414.75 ($1134.75 cash received)**
Total livestock sales	**53 goats**	**$102.25**	**$ 5344.75 ($5064.75cash received)**

Our goat when we started our meat goat operation was that income from it after adjusting for actual cash outlays in feed, supplies etc. would eventually be able to cover our property and school taxes and provide money for materials for capital improvements. We were able to achieve this in 2000 but not 1999. The better economic performance for 2000 is due in part to 1) increasing the herd from 25 to 30 doe units, 2) better reproductive performance on the part of mature does (2.15 kids versus 1.86 kids) which allowed us to sell more animals, 3) reduced upkeep costs per doe unit due to savings in feed and vet bills, and 4) less expenditures for temporary supplies.

Actual cash outlay or receipts	1999	2000
Total cash income	**$3265**	**$5064.75**
Herd upkeep	$1325 (25 doe units)	$1500 (30 doe units)
Supplies & tractor expenses	$487.50	$240
Depreciation on capital	$690	$690
Total expenses easily attributed to goats	**$2502.50** or $100.10 per doe unit	**$2430** or $81 per doe unit
Money available for taxes, insurance, improvements	**$762.50** or $35 per doe unit	**$2634.75** or $87.82 per doe unit

It is important to realize that our herd reached its maximum size in 2000 (we would need to expand our barn if we were to handle more goats at kidding). If we had still been in a major expansion mode, we would have had no income from the sale of does or doe kids. Also, we got into Boer goats fairly early thus we were able to sell much of our stock as breeding stock rather than slaughter animals and thus, received extra income.

Labor is not considered in any of these cash flow charts. Minimal labor caring for the goats and our miscellaneous other livestock averages 1 hr per day. Moving fence in the growing season and round bales in the winter averages a minimum of 1 hour weekly. We clean the barn twice yearly and this takes about 24 man-hours. Unfortunately, we did not construct the barn in a way to quicken this task. During this study, we were still able to clean our barn by having a one-day barn cleaning party. Alas, your friends can only use so much manure on their own gardens and after a few years we exhausted this resource! Another big labor drain during this study was weed-wacking our fence to keep the electric fence hot. We tried flaming the fence but that took similar amounts of labor. We manage the farmland organically so certain chemical options were out. However, we eventually invested in a more powerful fence charger and partitioned our electrical connections so that pastures are individually connected to the charger. Therefore, we can disconnect any pastures we do not have animals currently in. This has eliminated extensive weed control on fence lines. Kidding time takes a lot of time but each kid loss has a major impact on our herd income so it is hard to skim on this.

A small meat goat operation like our own probably even under the best scenario does not give an individual a realistic return on labor. I tallied up ~500 hours/yearly in the above paragraph without including any time for kidding or finding a market for your goats. Ideally, a small operation like ours is for someone who is going to want to be around animals anyway and loves the outdoors. I wear jogging shoes and carry hand weights when running my goats in and out to pasture in order to justify my time as healthy exercise. A small meat goat operation works for a family with unimproved farmland and limited opportunity for big capital expenditures. It provides enjoyable supplemental income for a family that enjoys working with sociable livestock easy for all family members to work with. It is not a viable option for someone needing to obtain a commercial hourly wage for his or her investment in labor.

FEED RATIONS

We rely heavily on locally grown feed and direct purchases from the farmers that grow them. We believe this keeps our feed costs down while possibly providing some value-added income to other local farmers. Our mature does perform very well on our diets. We suspect that our weaned kids (particularly twins from yearlings) might grow faster on a commercial scientifically balanced feed but are not sure this is economically justified. Rations during the study are given below. Some examples of how our feed rations compare to the 1982 NRC Goat Nutritional Requirements are in Appendices 2 and 3.

Feed rations 1999

Doe herd

Year round – Loose trace mineral salt formulated for replacement heifers offered at ½ per 25 goats/daily. Contained a coccidia control.

Winter – Dec 16th – March 18th consumed 1 round bale (~ 600 lb, only about 400 lb salvageable) per 3 days per 25 goats = ~ 5 lbs per day. Some obviously wasted. Two range blocks given as supplement for 2weeks when we were away for winter holidays.

Jan 3rd – ½ lb corn each daily

March 1st – ¾ lb corn and ¼ lb buckwheat middlings each daily

March 18th – started herd on alfalfa hay, started increasing grain

March 29th thru April - As does kidded they went on 2 lbs corn, ½ lb buckwheat and were offered on average 5 lb alfalfa hay daily.

May 16th – went on pasture

August 22 – does reduced to 1 lb of grain (1 part buckwheat middlings to 5 parts corn) each

Sept – kids weaned

October 1st – stopped grain in main herd until 2 weeks before buck brought in, then gave ½ lb corn each daily.

October 29th – buck put in herd

Nov 17th – grain stopped in main herd

Buck kids - weaned buck kids August 15th, gave 1 lb grain (1/6th Proright 40 and 5/6 corn) until Nov 15th then upped to 1 ½ lb.

Feed rations 2000

Year round -Loose trace mineral salt with coccidia control formulated for replacement heifers offered at ½ per 25 goats/daily.

Winter - Built feed manger for round bales and cut down on waste, used 1 round bale every 3 to 3 ½ days for 30 does (around 4 lbs each per day). Two range blocks given as supplement for 2 weeks when we were away for winter holidays.

Feb 19th – 1 lb corn each

March 4th – 1 lb corn & ½ lb whole raw soybeans. Too much soybeans, some does backed off feed, reduced level of soybeans. 1 ½ lb of grain (4 parts corn to 1 part soybeans)

March 15th – Alfalfa hay started

April - As does kidded put on 2 lbs of grain (4 parts corn to 1 part soybeans) and about 5 lbs of alfalfa hay on average.

May 13th – completely out on pasture, stopped alfalfa hay and changed to 2 lb corn with no soybeans.

August 4th – ½ lb corn per doe unit then reduced to ¼ lb corn each

August 16th – buck kids weaned

October 7 – doe kids weaned and all grain stopped until 2 weeks before buck put in when does started on ½ lb again for flushing.

Nov 15th – all grain stopped again

Buck kids –

weaned Aug 16th and put on ½ lb corn/soybean mix

upped to 1 ½ lb on Nov 17th – growing too slow

Dec 9th -remaining buck kids put on round bales (pasture gone) and 1 ½ lb corn and ½ lb high energy lamb pellets for last week prior to slaughter.

Since 2000

Winter – Feed ration has stayed about the same. However, as well as feeding a loose mineral salt we also feed "feed quality lime" year round.

April - Does receive 2 lb corn and ½ lb soybeans after kidding until moved to pastures.

Pastures – ration has remained the same out on pasture. However, we now have the ability to grain doe kids when they rejoin the breeding herd after weaning is complete by way of a small door opening that allows them to enter a separate holding area at night.

Table 22. Nutritional composition and costs of feeds fed during study

Feed Fed (price during study)	TDN (as fed)	NE (mcal/lb) (as fed)	Crude Protein (as fed)	Calcium (as fed)	Phosphorous (as fed)
Whole Corn ($80/ton)	78%	.83	8.7%	.02%	.27%
Buckwheat middlings ($100/ton)	71 %	.76	26.4%	.13%	.95%
Whole Raw Soybeans ($200/ton)	88%	1.02	36.9%	.20%	.59%
Winter Round bales (resale price $10 each – 600 lb)	51%	.45	5.7%	.58%	.15%
Alfalfa hay[a] 1999	54%	.51	12.3%	.89%	.21%
Alfalfa hay 2000 #1	52%	.51	15.6%	1.36%	.25%
Alfalfa hay 2000 #2	56%	.57	16.3%	1%	.34%
Alfalfa hay 2001 #1	53%	.48	8.3%	.47%	.19%
Alfalfa hay 2001 #2	52%	.50	12.5%	1.04%	.23%

[a] Our alfalfa hay is locally grown second cutting but does contain some grass each year. We pay $1.50 per bale for bales that usually average ~45 lbs.

7. Conclusions and Future Plans

a. Pasture Ecology –

We have not continued doing pasture surveys. Visually, the use of horses and goats appears to keep a good balance of forbs, grasses and legumes in our conventional pastures. Visitors often remark about the health of our pastures. Soil analyses have not indicated that the acidity of our soils has improved but organic matter and nitrogen content may have. Undesirable weeds are not observed with the exception of nightshade that has cropped up next to two shelters where the ground gets heavily compacted in winter. Thus far we have been able to control this very small amount of nightshade by hand removal.

Plans in 2004 include fencing off the wetland browse portion of Brush Pasture #7 and providing a fenced path through it. It will be rested for a year and then gradually exposed to limited, short duration goat browsing as it recovers.

b. Forage Productivity

We manage our conventional pastures more aggressively now than during the study. Both goats and the 2 horses are introduced to pastures starting May 1st. Goats move through the 5 pastures every 7 days and then move back through half sections of these pastures again every 7 days until the end of July. This change has resulted in less mature forage.

We have had to face that we are losing the brush in our brush pastures. We now put the horses into these pastures for a short time in June/July to delay maturity of the grasses, forbs and legumes in them. We plan to test if partitioning these pastures and only letting goats in each section for only 2 weeks each results in less defoliation.

c. Worm Control

The doe herd has had no bottle jaws since 1999. We worm the doe herd Dec15th as we come off pasture and March 15th prior to kidding. We monitor eye

membranes in June and July and occasionally worm a doe if her membranes are pale. Worm counts are always high by the end of July and we worm everyone as they move to brush pastures. We wean in the last brush pasture and worm kids at weaning. Does have eye membranes checked a week after weaning as they move onto the hay fields. We use those results to determine whether to worm entire herd or just individual animals. Buck kids are now grazed primarily on our west hay field after weaning or off farm on other brush pastures.

We have continued to use Ivermectin or Albendazole despite their incomplete control in our herd. We did use levamisole for one worming in 2003 and based on results plan to use it again in 2004. We are holding off on using the newest wormers for as long as possible. We use most wormers at twice the recommended sheep dose.

Doe Productivity –

Litter size has remained stable or increased. Health of the herd has also remained excellent. Prices of market kids and breeding stock have remained stable or increased. Yearling size of does seems smaller. This might be due to yearly management effects that compromised their handling after weaning. It may also be genetic. They are all high percentage Boers now rather than half-breeds who got a boost in size from hybrid vigor as well as from possible contributions from their Alpine or Nubian parents. Most of our kids achieve at least .5 lbs of gain (after subtracting birth weight) daily for the first 2 to 3 months after birth. We now make a coarsely ground corn/soybean mix supplemented with limestone available to the kids each day when we give the does their whole grain. We point this grain out to our slowest growing kids but do not offer a 24 hr. creep feed. We did have trouble two years with full blood buck kids who did not cover all the does during the breeding season. We have since returned to switching to a different cleanup buck in the herd in January to double-check that everyone is bred. We anticipated that the sale of male boerX kids for breeding purposes would eventually dry up. However, this has not happened yet. However, we notice much more competition when selling BoerX doe kids now and probably need to start advertising in regional farm newspapers. We have also started registering doe kids, but are hoping we do not need to increase our participation in goat shows to promote our breeding stock.

8. Outreach Program

Deborah Cherney presented data from the first year of the study during a goat pasture management workshop at the 1999 Caprine Outing.

Dan Demaine organized a pasture walk on October 6, 2001 that visited our farm in the afternoon and discussed the results from our study. More than 50 people preregistered for the walk but biting cold weather kept some away.

tatiana Stanton wrote a fact sheet, *Case study of a small meat goat operation grazing NY pastures,* that is handed out by the Cornell Animal Science Department as part of the "Cornell meat goat packet" to new meat goat producers in the NE US upon request.

We hope to make a much-abridged version of this grant report available on the web to meat goat producers either at www.sheepgoatmarketing.org or www.esmgpa.org.

Appendix 2. Sample rations for lactating does nursing kids at Hawk Hall Meat Goats

Nutrient requirements for lactating does

The first table in each example is based on the 1981 NRC publication on Nutrient Requirements for Goats. The second table in each example is based on a table of daily nutritional requirements for dairy goats that Dan Brown published in 1980 based on his doctoral research here at Cornell.

88 lb yearling doe milking 3 kg (~3 quarts) daily

NRC	TDN (g)	CP (g)	NE(Mcal)	Ca (g)	P(g)
Maintenance plus low activity	560	77	1.14	3	2.1
Lactation -3 kg of milk(3.5% fat)	1026	204	2.07	6	4.2
Total	1586	281	3.21	9	6.3

Dan Brown		CP (g)	NE(Mcal)	Ca	P
Maintenance		93	1.3	3.4	2.5
Lactation -3 kg of milk(3.5% fat)		222	2.37	7.8	5.7
Total		315	3.67	11.2	8.2

132 lb multiparous doe milking 4 kg (~4 quarts) daily

NRC	TDN (g)	CP (g)	NE(Mcal)	Ca	P
Maintenance plus low activity	760	105	1.54	4	2.8
Lactation -4 kg of milk(3.5% fat)	1368	272	2.76	8	5.6
Total	2128	377	4.3	12	8.4

Dan Brown		CP (g)	NE(Mcal)	Ca	P
Maintenance		120	1.7	4.3	3.4
Lactation -4 kg of milk(3.5% fat)		296	3.16	10.4	7.6
Total		416	4.86	14.7	11

Farm Ration for does nursing kids

Here were our rations in 2000 for mature does 2 to 4 yrs of age averaging 130 lb nursing twins that are hopefully gaining ½ lb/day. We assume that the does need to provide about 2 kg (2 quarts) of 3.5 % milk per kid.

Year 2000

Feed	lbs fed	g fed	TDN	CP (g)	NE(Mcal)	Ca (g)	P (g)
whole corn	1.6	726	567	63	1.33	.15	1.96
whole raw soybeans	.4	182	160	67	.41	.36	1.07
alfalfa hay #1	3	1362	763	222	1.71	13.62	4.63
alfalfa hay #2	3	1362	708	212	1.53	18.52	3.41
Total	8	3632	**2198**	**564**	**4.98**	**32.65**	**11.07**

This would be sufficient for does that are 132 lb. to milk 4 kg each.

NRC requirements

	TDN (g)	CP (g)	NE(Mcal)	Ca	P
Total	**2128**	**377**	**4.3**	**12**	**8.4**

Dan Brown requirements

		CP (g)	NE(Mcal)	Ca	P
Total		**416**	**4.86**	**14.7**	**11**

NRC requirements if 132 lb does milking 5 kg each.

	TDN (g)	CP (g)	NE(Mcal)	Ca	P
Maintenance plus low activity	760	105	1.54	4	2.8
Lactation -5 kg of milk(3.5% fat)	1710	340	3.45	10	7
Total	**2470**	**445**	**4.99**	**14**	**9.8**

Dan Brown's requirements for 130 lb doe milking 5 kg.

		CP (g)	NE(Mcal)	Ca	P
Maintenance		120	1.7	4.3	3.4
Lactation -5 kg of milk(3.5% fat)		370	3.95	13	9.5
Total		**490**	**5.65**	**17.3**	**12.9**

It looks like the ration for the year 2000, would not suffice if the aim was to have does milk 5 kg on average. Since this farm does have some litters of triplets and quads, it might be that does with larger litters need to have the ration increased somehow. In later years, grain ration for does nursing young kids was increased to 2 lbs corn, ½ lb soybeans.

Does were fed this same grain ration when they went onto pasture in peak lactation. Does seemed to have trouble maintaining weight as time progressed on pasture. Pasture went from having samples that were about 64%TDN,14.4%CP, 1.3%Ca,.24%P (8 weeks after kidding) to later samples (14 weeks into lactation) were more like 60%TDN, 7.9%CP, .58%Ca, and .24%P as a percentage of dry matter.

Year 2001 – in reality, the sample used for the analyses of the second hay was probably not very representative. However hay quality was definitely less than for previous year and goats cleaned up the ½ lb of extra grain with no hesitation.

Feed	lbs fed	g fed	TDN	CP (g)	NE(Mcal)	Ca (g)	P (g)
whole corn	2	908	708	79	1.66	.18	2.45
whole raw soybeans	.5	227	200	84	.51	.45	1.34
alfalfa hay #3	3	1362	708	170	1.5	14.16	3.13
alfalfa hay #4	3	1362	722	113	1.44	6.40	2.59
Total	8.5	3859	**2338**	**446**	**5.11**	**21.19**	**9.51**

Ration came very close to meeting the needs of a mature doe milking 5 kg of 3.5% butterfat milk daily. Note – yearling does in the same herd average ~88 lbs each and are assumed to eat same grain ration but 4 lbs of alfalfa hay.

Appendix 3. Sample rations for growing goat kids at Hawk Hall Meat Goats

1982 NRC requirements for growing kids

44 lb buck kid gaining 150g daily (1/3 lb or 10 lb per month). You may want to look at the NRC requirements yourself and see what the requirements would be if we assumed maintenance and medium or high activity instead.

	TDN (g)	CP (g)	NE(Mcal)	Ca (g)	P(g)
Maintenance plus low activity	334	46	.68	2	1.4
150g gain daily	300	41	.6	2	1.4
Total	**634**	**87**	**1.28**	**4**	**2.8**

44 lb buck kid gaining 200g daily (so between a 1/3 lb and a ½ lb). You may want to look at the NRC requirements yourself and see what the requirements would be if we assumed maintenance and medium or high activity instead.

	TDN (g)	CP (g)	NE(Mcal)	Ca (g)	P(g)
Maintenance plus low activity	334	46	.68	2	1.4
200g gain daily	400	56	.8	2	1.4
Total	**734**	**102**	**1.48**	**4**	**2.8**

66 lb kid gaining 200 g daily assuming low activity

	TDN (g)	CP (g)	NE(Mcal)	Ca	P
Maintenance plus low activity	452	62	.92	2	1.4
200 g gain daily	400	56	.8	4	2.8
Total	852	118	1.72	6	4.2

Farm Ration for weaned buck kids – 44 lb Boer X wethers with a goal of gaining 10 lb per month). All kids also received a top dressing of loose trace mineral salts containing Bovatec over their corn.

Corn with nice quality legume/grass pasture (64%TDN, 15%CP of Dry Matter)

Feed	lbs fed	g fed	TDN	CP (g)	NE(Mcal)	Ca (g)	P (g)
Whole Corn	.5	227	177	20	.42	.05	.61
High Quality grass/legume pasture	2 lbs DM	908	581	136	1.28	8.35	2.72
Total	2.5	1135	**758**	**156**	**1.7**	**8.85**	**3.33**

Below is an example using corn with a poorer quality, mature pasture (61%TDN, 7.2%CP of Dry Matter). Please note that with a mature pasture like this, kids might not be consuming as much as they would with the above hay. The 2 lbs of consumption may be too optimistic. Even assuming 2 lbs of pasture intake, the crude protein appears insufficient to support 200 g of daily gain. Also, if this pasture has few legumes in it, the Ca:P ratio may get lower than 2:1 , thus, predisposing them to urinary calculi.

Feed	lbs fed	g fed	TDN	CP (g)	NE(Mcal)	Ca (g)	P (g)
Whole Corn	.5	227	177	20	.42	.05	.61
Low Quality grass/legume pasture	2 lbs DM	908	554	72	1.16	4.9	2.09
Total	2.5	1135	**731**	**92**	**1.58**	**4.95**	**2.7**

66 lb Boer X wethers in this herd receive 1 lb of corn top dressed with a loose trace mineral salt containing Bovatec plus a high quality grass/legume pasture.

Appendix 1.
Farm Map