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

Farmer/Grower Grant Final Report

FNE99-276

Introduction

The overall objective of the study was to evaluate the sustainability and productivity of the meat goat management system that 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. 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 forage system on our farm relied on hay feeding our flock of about 30 Boer X breeding does from mid Dec through April, rotational grazing of conventional pastures (6 acres) from May through July, month-long grazing of two brush pastures Aug through Sept (3 acres), and strip grazing of hay field regrowth from Oct until mid Dec (7 acres). Two horses followed the goats through the conventional pastures and continued to rotate through these same pastures in August and September. The layout of our farm is available in Appendix I.

To evaluate how ecologically and economically sustainable our way of managing forage 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 dry lots 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?)

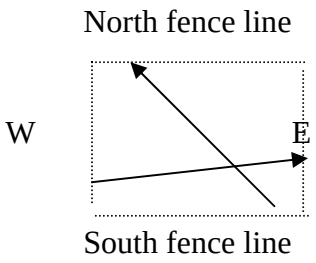
e) Major labor and financial costs of running a small meat goat farm.

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. Surveys were conducted in May and November each year. 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

The surveys revealed substantial biodiversity within our conventional pastures and hay fields. Orchard grass was usually the "tallest" forage sighted. However, sightings of red clover, dandelions, golden rod, bedstraw, poverty grass and birdsfoot trefoil were numerous. The timing of our sampling tended to miss the Timothy grass that is also prevalent in our conventional pastures. The pasture composition changed from spring to fall. However, these changes were not uniform over the dry growing season of 1999 compared to the wet growing season of 2000. Growing conditions from year to year and season to season probably explained much of the variation observed.

Our survey results indicated that goats do not appear to adversely affect the pasture ecology of conventional grass/legume pastures. There was no indication that the ratio of desirable plants was decreasing and the ecology of these conventional pastures seems very sustainable under our management system.

The sustainability of our brush pastures was dealt a blow in Spring '99 when a logging company accidentally 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. These pastures were primarily golden rod and other small forbs and grasses. 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 and decreased from 1999 to 2000. Dogwood, honeysuckle, multiflora rose, black willow, maple and poplar were also sighted. Undesirable forbs (in terms of toxicity to goats) were rarely sighted in either Pasture 7 or 8 and remained about the same between years.

We sighted one transect along the entire length of one large brushy wetland area located in Pasture 7. This area had not been mowed by the loggers. Eight equally spaced points were pinpointed along this line and marked with fiberglass posts. In August of each year 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 of the pole?

The results of the point intercept survey of the brushy wetland area of Pasture 7 are shown 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 3 to 12 inches from 1999 to 2000 at 5 of the 8 sample points. The brush plant at one sample point died. The height remained the same at one sample point and increased 2 inches at the remaining point.

Table 2. 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"

Density of the vegetation at 7 of the 8 sample points decreased from 1999 to 2000. 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.

The goats remain on each brush pasture for 21 to 30 days and completely defoliate the entire pasture. Results from the surveys suggest that the brush in these pastures is deteriorating rapidly and that these pastures will gradually become more like our conventional pastures. Under our management system we are gradually losing our browse plants. It would probably be better to graze these pastures until only about ½ to 2/3rds of the brush is defoliated if the goal is to maintain the woody species in these pastures.

Earlier work on our farm had indicated that grazing the brush pastures in May and June was detrimental because the plants had not yet undergone enough photosynthesis yet to replenish the reserves lost from budding out in the spring. Grazing the brush in the fall was also detrimental because the goats tended to girdle the brush either to get to the sugar reserves that were being transported to the roots for winter or because the brush leaves were getting less palatable as they matured and prepared to fall. Survey tables and results for each pasture are available by contacting Dr. tatiana Stanton at tls7@cornell.edu.

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 plant samples were used to calculate wet and dry matter weights. 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. 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. We anticipated little regrowth during a 7 day period. 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. The nutritional analyses of the pastures are available in Appendix II.

Nutritional Analyses –

The nutritional composition of the conventional pastures changed fairly predictably across the seasons. Due to the biodiversity of the fields, we observed substantial variation from sample to sample within a field depending on whether the sample was a big chunk of bedstraw or a nice mix of orchard grass and red clover. If I were to do this study again, I would take many more nutritional samples per acre and send bulk samples in for analyses. 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. The goats 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 though we attempted to represent the ability of goats to selectively choose the most nutritious plant parts, the nutritional analyses show that the value of the goats' forage diet changed substantially from season to season.

The nutritional composition of the conventional pastures was fairly good in May and June but dropped in July particularly when the goats encountered mature pastures that had not been previously grazed by either they or the horses. The pastures matured faster in the wet year of 2000. Mature pastures were characterized by lower crude protein percentages, higher NDF percentage and less variation across samples indicating less chance of goats being able to select an improved diet through selective grazing. Keep in mind that this deterioration would have been even higher if we included the coarse mature grass stems that the goats selectively avoided. Goats are small ruminants with a rapid rate of passage and thus cannot utilize high fiber forages efficiently. Our herd reacted to overly mature conventional pastures by repeatedly breaking out to graze regrowth from other pastures regardless of the large amount of forage left standing. The grass in the mature pastures was so tall and brittle in the wet spring of 2000 that the stems lodged when stepped on by the goats and much of it was wasted due to trampling and soilage. It is important to manage goat pastures aggressively early in the year and make sure that they either get grazed or mowed early on in order to delay plant maturity. For example, the nutritional analysis of a small section of Pasture 3A that had escaped the first grazing in 2002 indicates CP%=5.5 and NDF%=66% compared to CP%=11.9 and NDF% = 60% for the regrown pasture area. We now try to have both goats and horses out on pasture by May 1st and make sure that all our conventional pastures get grazed at least once in May. Even so, in wet years some pastures still get too far ahead of us by July.

Crude protein percentage decreased and NDF percentage increased in our predominantly golden rod "brush" pastures in August and September as the golden rod matured. However, mature

brush pastures tended to show more variation than mature conventional pastures, thus goats may be able to selectively browse for a diet well above the mean values. On the advice of the foresters helping with our study we chopped down several cottonwood trees in Pasture 7 during the last week the goats grazed it in 1999. Samples for these leaves contained 12.7% CP and 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 we hoped would help maintain the brush content of the pasture.

In general, woody browse plants neither deteriorate in CP% nor increase in fiber content to the extent noted for conventional grasses as the season progresses into late summer and fall. Plant analyses 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.

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.

Pasture yields and carrying capacity –

As expected, the conventional pastures yielded more dry matter in the wet spring of 2000 than they did in 1999. 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 field.

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) for its first grazing in 2000 despite having about 3 tons of dry matter per acre. Each ½ acre of it supported twenty five does with kids for 6 days. Over time we have found that from mid May through July, it takes about 6 to 7 days for our average flock of 30 does with kids to graze down a half acre of conventional pasture. Another way of saying this is that an acre supports about 360 to 420 Doe Unit Days. How soon the flock can be regrazed on the same field varies depending on how wet the year is and what other livestock you have rotating through the same fields. In wet years our pastures are usually ready to be grazed again by either the horses or goats within 2 weeks after the goat herd is moved out. 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 our brush pastures generally support about 350 DUDays per acre when grazed once in September or October until all the leaves are defoliated from the brush. However, as pointed out in the section on pasture ecology this management style does not seem to be sustainable and the brush in these fields is deteriorating and being replaced with conventional pasture

The hay field regrowth in the fall of 1999 and 2000 supported fewer DUDays per acre than the earlier growth on the conventional pastures or the brush pastures. This is in line with conventional wisdom that usually assumes you need about twice as much pasture in late summer/early fall to support the same number of animals as the same pastures in the late spring/early summer. 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 1/2 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. The kids probably start doing significant grazing by the time they weigh 30 lbs.

Our results indicated that it is not outrageous to suggest that a doe unit representing a lactating doe and her nursing/grazing kids could consume (including trampling etc.) 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 mature pasture that the goats completely trampled in 2000 and refused to stay in. Thus, 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 pasture dry matter used for this period averages about 4 to 5% of total herd body weight. Tables showing the dry matter yields, fresh yields, and carrying capacities of the pastures are available in Appendix III.

Worm Control

The pasture analyses discussed in the previous study indicate that the feed quality of 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. 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.

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 would avoid close grazing to feces and worm larva.

We planned to put the goats on our brush pastures in August through September. 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.

Table 16 shows that **w**orm counts were over 1000 eggs per gram on some of the does in early spring '99 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. 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 we decided that our primary worm of concern, Haemonchus, might be completing a life cycle during that time and re-infesting them. We questioned whether either Fenbendazole or Albendazole (both in the same chemical family) were having much effect 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.

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 it for 3 years) and see how resistant our herd was 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.

In mid March 2000 we wormed does due to kid first and moved them to the holding area. The worm loads on these goats remained low after worming. Late 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 likely were re-infested by grazing in the winter holding pen. 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 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 again seemed only mildly effective suggesting substantial resistance. 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 3. 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.

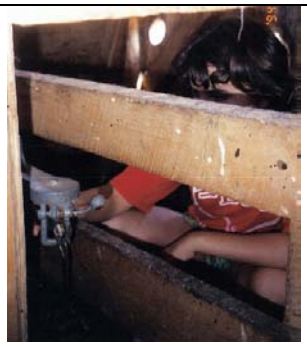
As of 2004, the doe herd has had no bottle jaws since 1999. We worm the doe herd Dec15th as we come off pasture and March 15th prior to kidding. We monitor eye membranes in June and July and occasionally worm a doe if her membranes are pale. Worm counts are always high by the end of July and we worm everyone as they move to the brush pastures. All kids are wormed 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.

We have continued to use Ivermectin or Albendazole at twice the sheep dose despite their incomplete control in our herd. We also started using levamisole at the end of 2003 and based on effective results it is now our primary wormer. We are holding off on using the newest wormers for as long as possible.

Doe Productivity

Does and kids were weighed and average daily weight gain (or loss) calculated 1) each time they were moved to a new type of forage (conventional pastures, brush pastures, hay fields, winter hay and 2) at least once monthly within these forage 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. Feed records and other financial expenses were recorded as well as price received for the sale of meat or goats.

Table 4. 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.

Performance parameters

Reproduction and mortality rates for the herd are given in Table 5. We were disappointed with the average litter size for mature does in 2000 but other than that the parameters are probably pretty good even for a small herd.

Table 5. Herd reproductive performance in 1999 and 2000.

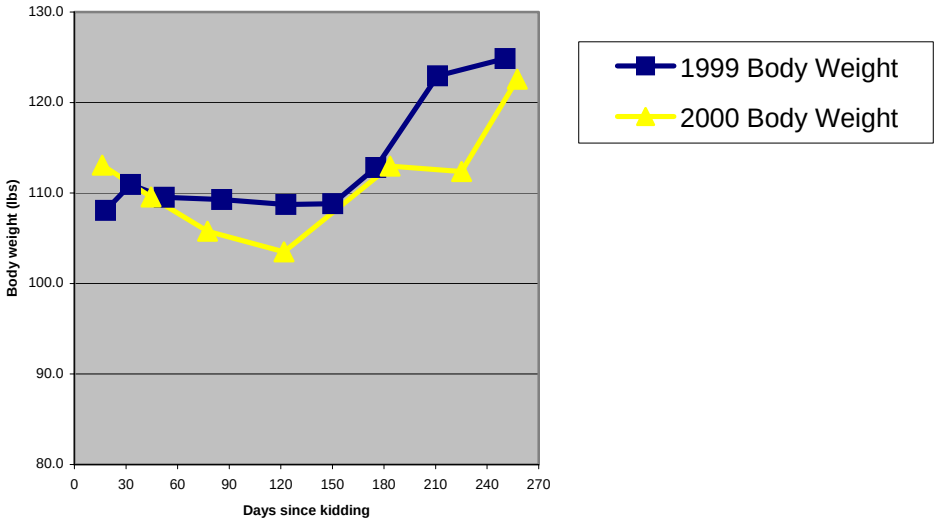
Parameter	Year one	Year two
Conception rate	25/25 = 100%	30/31 = 97%
Yearling litter size (live kids w/in wk of birth only)	17/11 = 1.46 kids	25/17 = 1.47 kids
Mature doe litter size (live kids only)	26/14 = 1.86 kids	28/13 = 2.15 kids
Kid mortality within 1st wk (includes kids dead at birth)	3/46 = 6%	2/55 = 4%
Kid mortality 1 wk through 8 mo of age or sale	0/43 = 0%	0/53 = 0%
Doe mortality	0/25 = 0%	1/31= 3%

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 maturity of the dam and litter size.

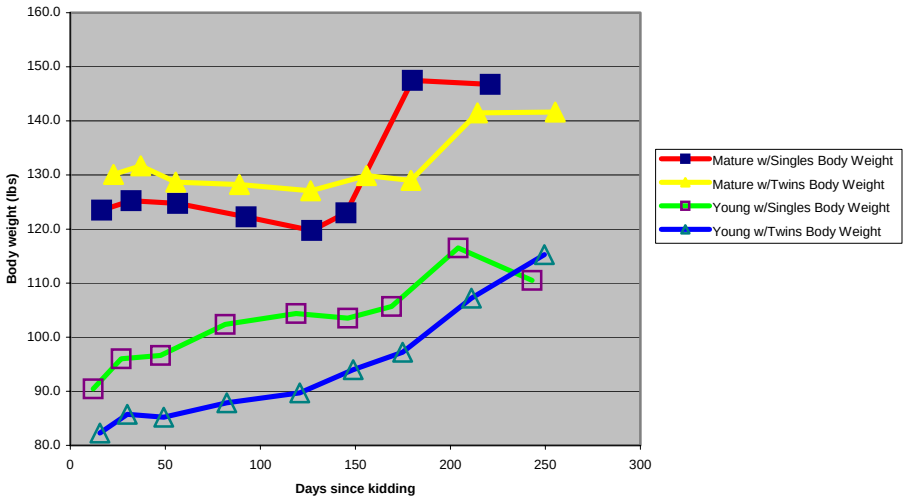
Chart 1. Weight Curves for Lactating Does by Year



The average weight of does was slightly less in 1999 than in 2000 despite a smaller proportion of the herd being first fresheners (Chart 1). However, doe weights stayed relatively stable in 1999 until weaning at about 150 days after kidding. Does gained weight rapidly after weaning and were rebred ~210 days 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 120 days following kidding. There was no sharp increase in weight gain after the doe kids were weaned at about 180 days of age (this may indicate that the doe kids had already weaned themselves naturally). Doe weights further improved about 240 days 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. There are only two mature does with single kids represented in Chart 2. 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 2. Weight Curve of Does from mid-April '99 to mid-Dec '99



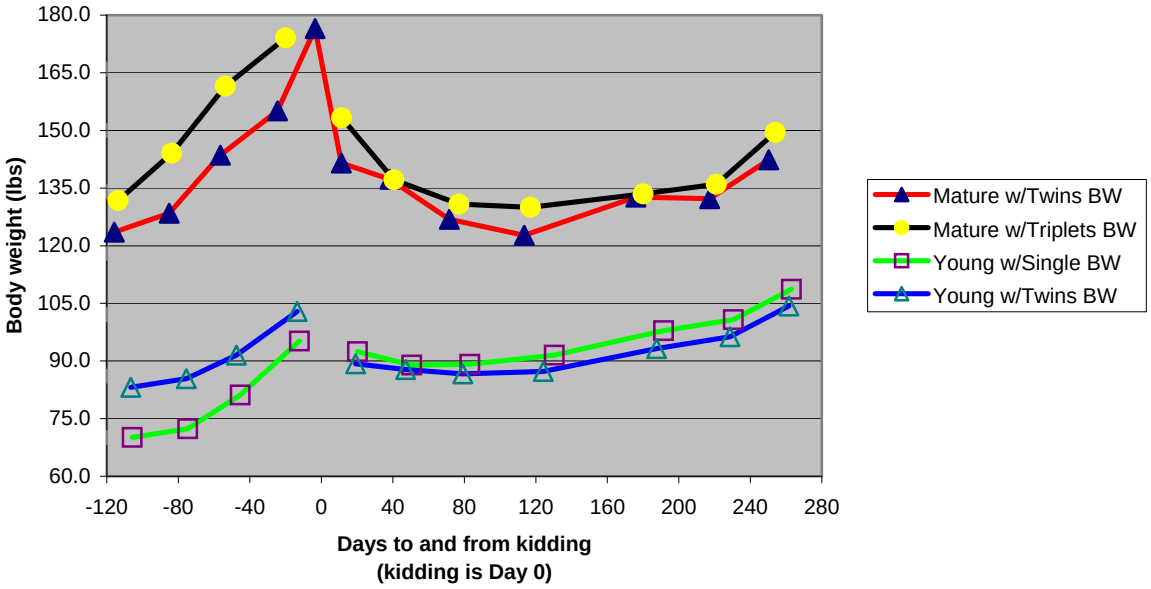
In 1999, doe weights from heaviest to lightest after kidding were: mature does carrying twins →mature does with singles→ yearling does with singles → yearling does with twins. Yearling does (even those nursing twins) gained weight during lactation while older does lost some weight (Table 6). All does put on compensatory weight after weaning.

Table 6. 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.

Chart 3. Weight Curve of Does
from mid-Dec '99 to mid-Dec '00



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. All does put on compensatory weight after weaning.

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 7).

Table 7. 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 258)
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 250)
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 254)
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 263)
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 262)

[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). 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.

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 8). 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 8. 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.

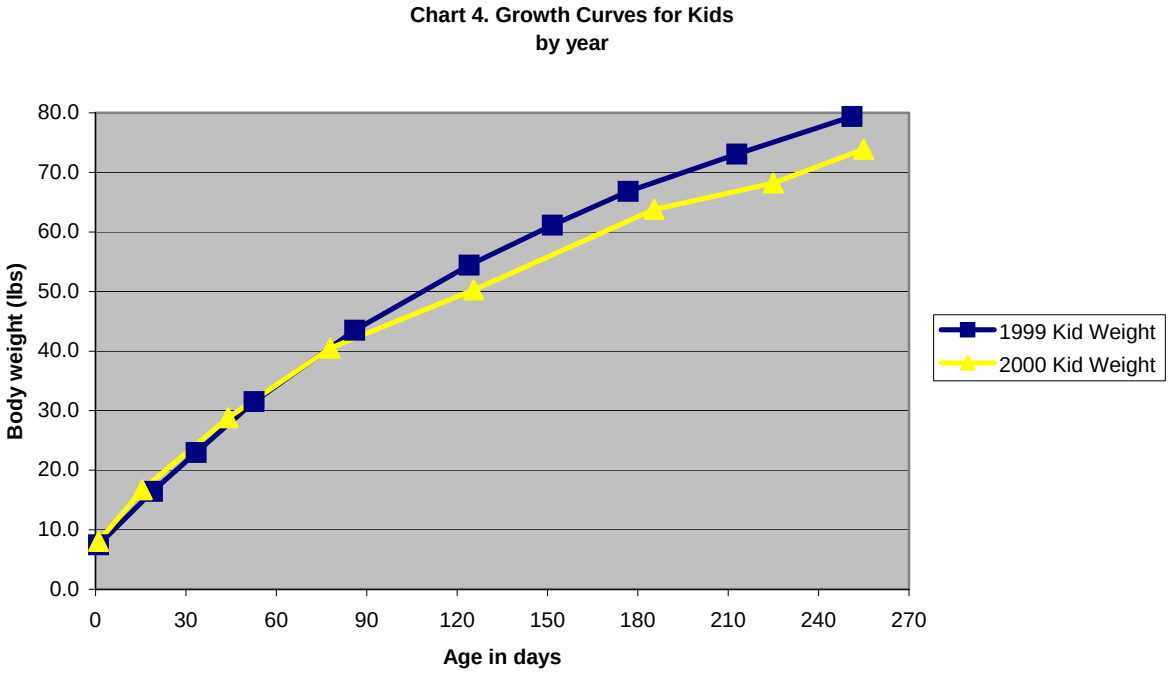
Average daily weight gains for goat kids in our herd under our management tend to start at ~ .5 lbs daily and decrease to ~.15 lbs daily as kids mature (Tables 9 and 10). The growth curve for kids in 1999 was remarkably smooth and showed no detrimental effect from weaning. Even though initial birth weights 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 4).

Table 9. Daily Weight Gains (DG) for kids in 1999, age range is in days and is in parentheses, i.e. (1 – 19) equals average daily weight gain from 1 to 19 days of age

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, age range is in days and is in parentheses, i.e. (1 – 16) equals average daily weight gain from 1 to 16 days of age.

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)



Male kids grew better than female kids until about the 8th month in 1999 (Chart 5). 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 6). 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 5. Kid Growth Curves for 1999 by sex of kid

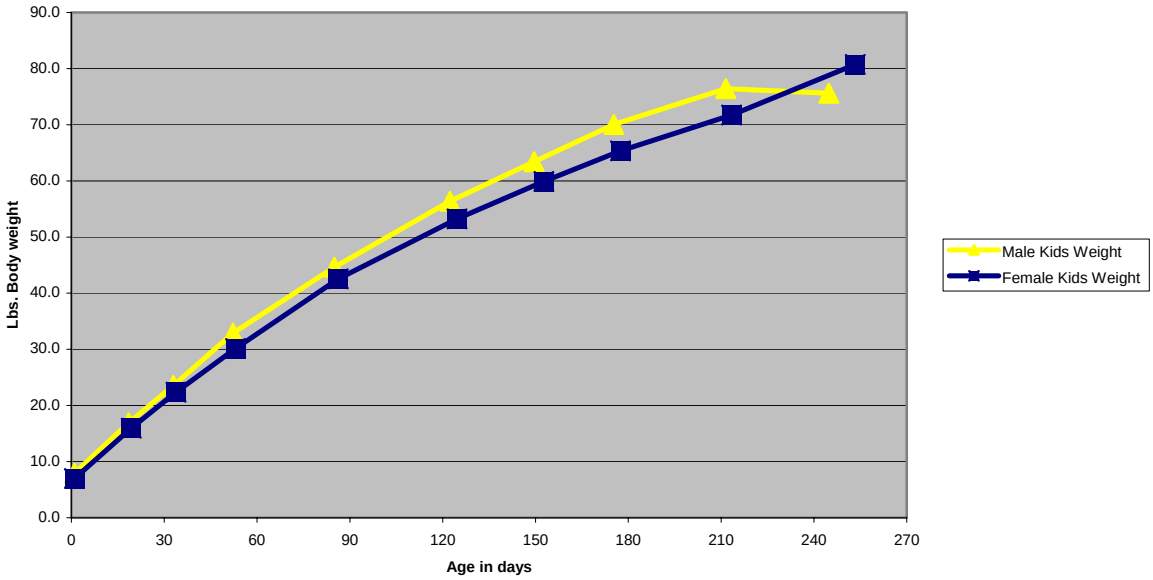
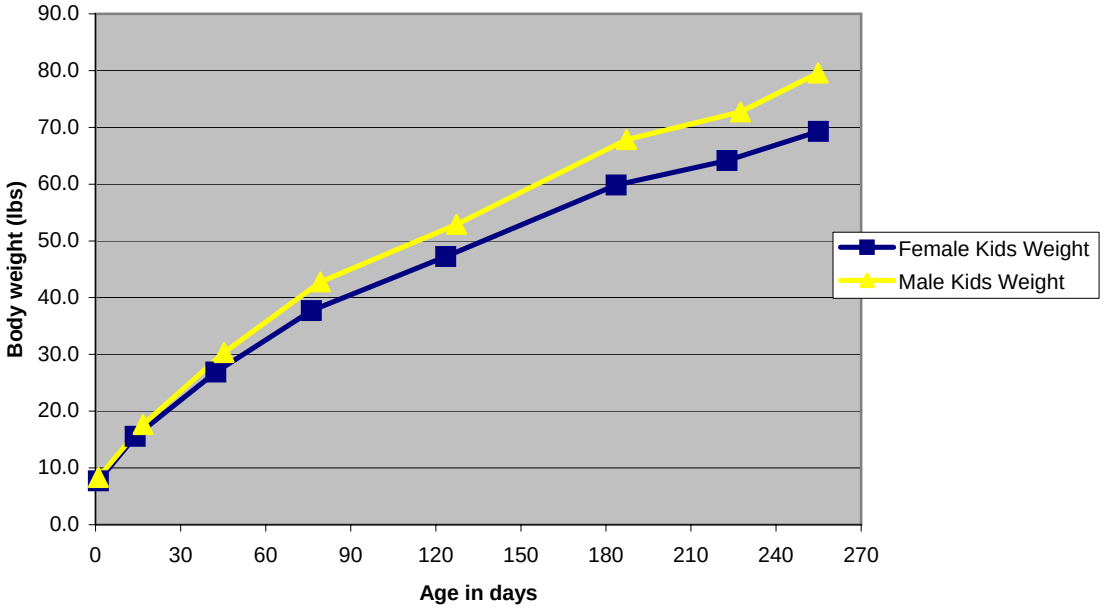
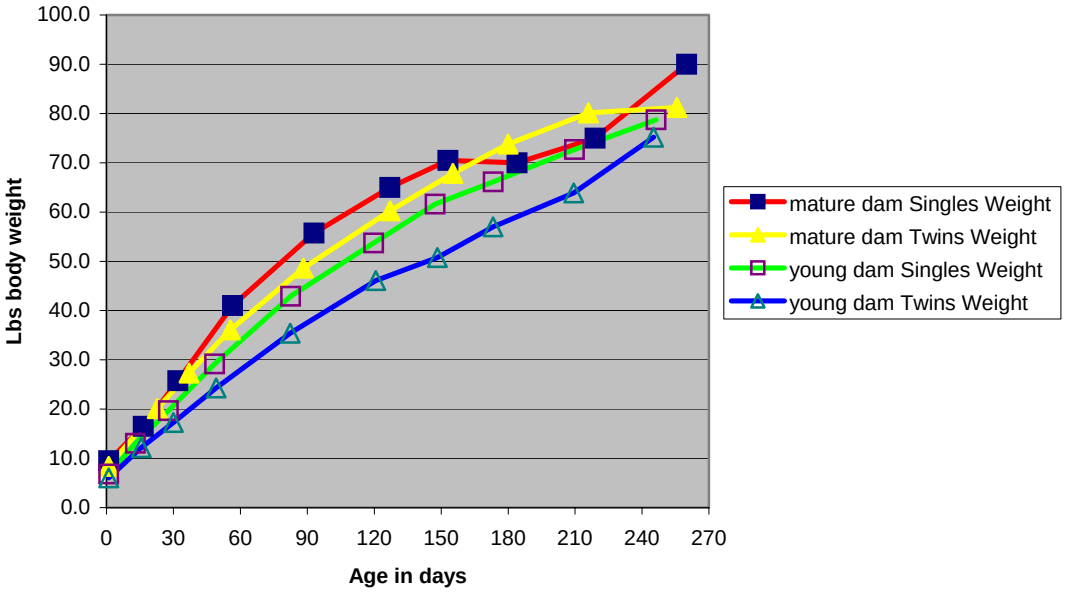


Chart 6. Growth Curve of Kids in 2000 by sex of kid



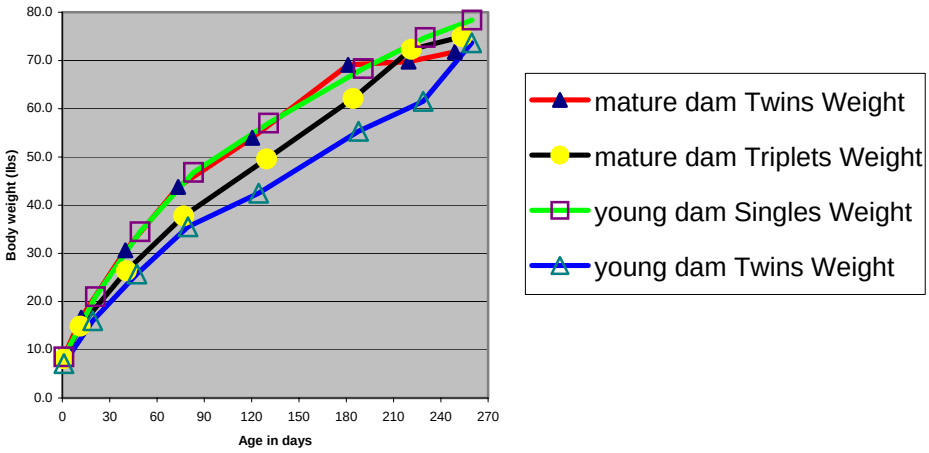
Litter size and maturity of doe affected kid growth similarly both years (Charts 7 and 8, Tables 9 and 10). In 1999, twins to yearlings grew slower than singles to yearlings particularly during the last weigh period prior to weaning. Singles to yearlings were slightly smaller than twins to mature does 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.

Chart 7. Kid Growth Curves for 1999 by litter size and maturity of dam



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 8. 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. In 2004 we also plan to wean kids at 3 months of age to see if this helps the does to recover their body condition faster prior to being bred again.

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 goal 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.

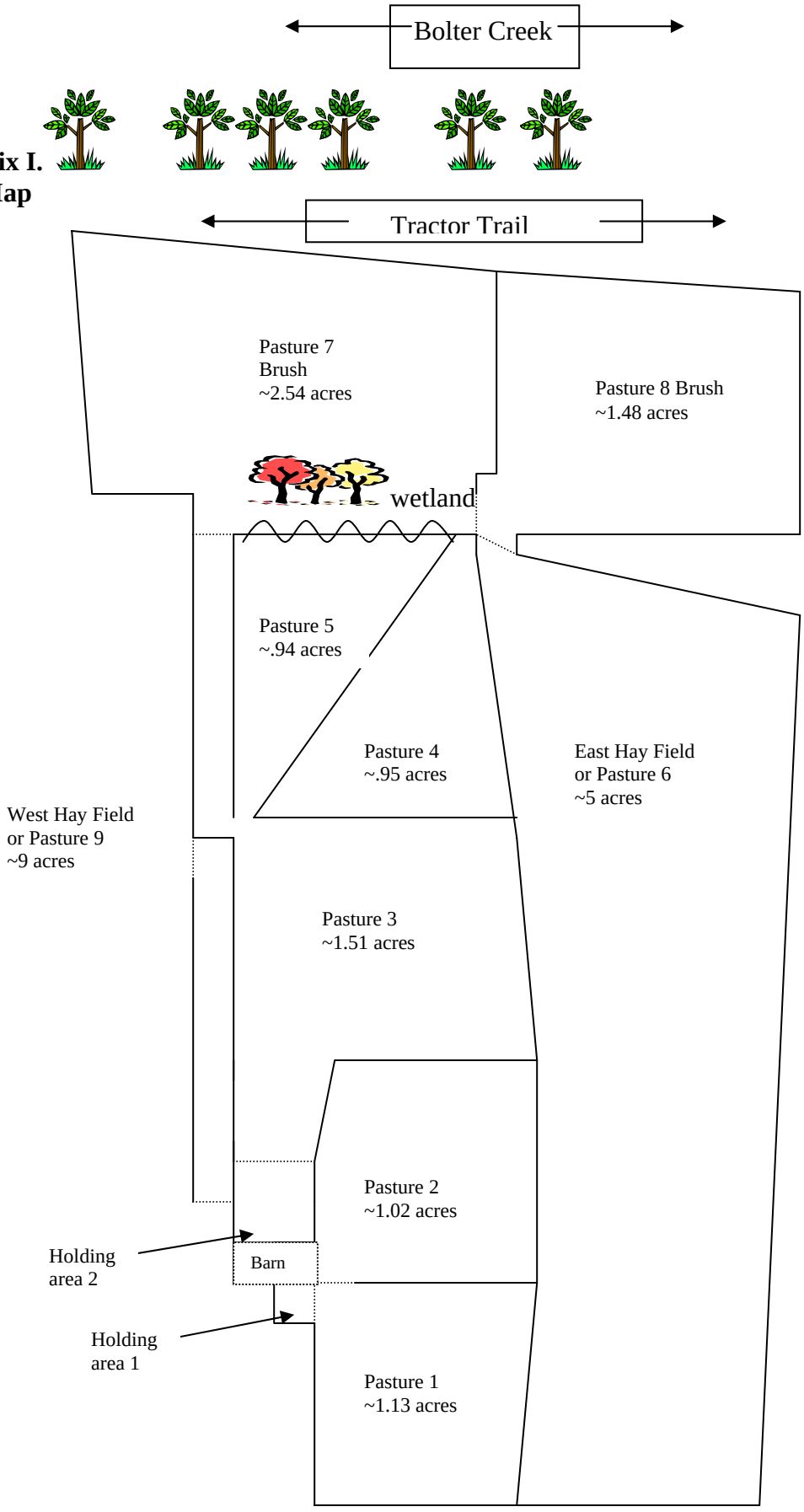
Actual cash outlay or receipts	1999	2000
Total cash income	**$3265**	**$5064.75**
Herd upkeep	$1325 (25 doe units)	$1500 (30 doe units)
Supplies & tractor expenses	$487.50	$240
Depreciation on capital	$690	$690
Total expenses easily attributed to goats	**$2502.50** or $100.10 per doe unit	**$2430** or $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, similar to many other farm enterprises, may 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. Like many farming enterprises, it may not be a realistic option for someone needing to obtain a commercial hourly wage for his or her investment in labor. Our goal was for our goat herd to generate sufficient income to pay our property taxes. This goal has been achieved in all years since 1999.

Appendix I.
Farm Map



Appendix II. Tables for nutritional analyses of pastures

Table A. 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

Table B. 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

Appendix III. Tables on pasture yields and carrying capacity

Table AA. 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 BB. 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 CC. 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 DD. Pounds (lbs) of dry matter (DM), crude protein (CP), total digestible nutrients (TDN) used per day per doe unit in 2000. 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.