

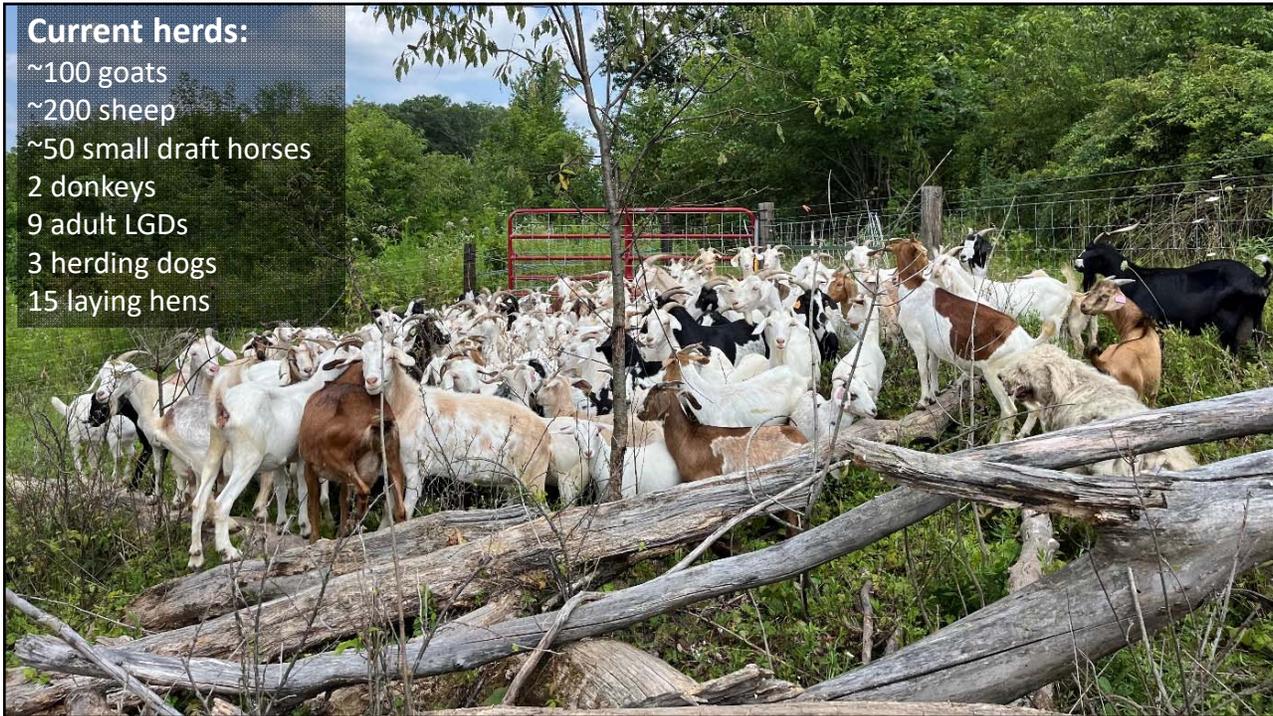
Developing Landscape-Adapted Small Ruminants

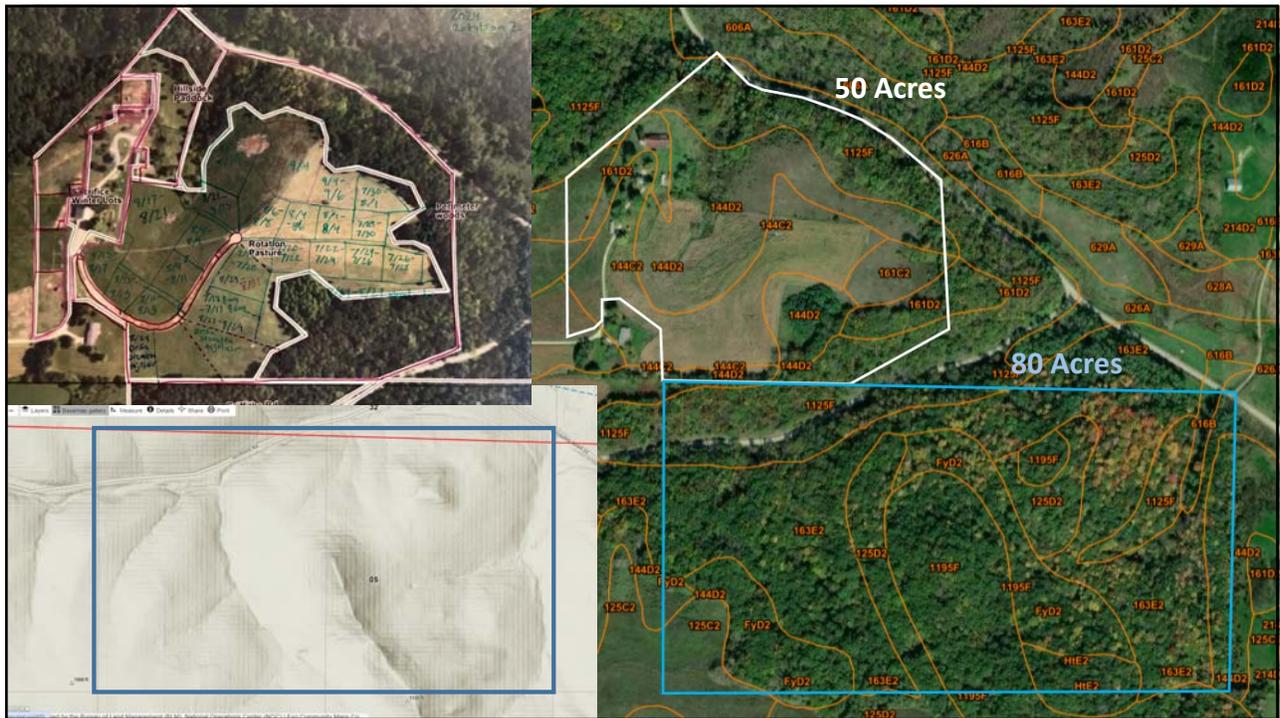
Cherrie Nolden
1dr Acres Farm
GrassWorks Grazing Conference
La Crosse, WI
January 24, 2026



Current herds:

- ~100 goats
- ~200 sheep
- ~50 small draft horses
- 2 donkeys
- 9 adult LGDs
- 3 herding dogs
- 15 laying hens





Intro

- Sheep & LGDs since 2001
- Goats since 2008
- Currently ~100 goats, 200 sheep
- Education
 - BS Wildlife Ecology 2000
 - KS Range School 2007
 - MS Agroecology 2019
 - Dissertator in Animal & Dairy Science 2020
 - Small Ruminant Management Certificates 2024, 2025
 - Grassland 2.0 Grazing Planner Certificates 2024, 2025
- Dozens of talks at conferences, Southwest WI Tech College
- Affiliate trainer for goat health and targeted grazing at GOTG, 2022
- WI School for Beginning Dairy and Livestock Farmers, speaker 2016-2022
- Grazing in KS, WI



Multi-species



Photos by Chèrrie Nolden





Master the Basics

- Optimal feeding of the animals you have
- Figure out minerals
- Health condition recognition and management
- Keeping fences hot, animals contained
- Winter management
- Protection from predators
- Learn functional structure
- Recognize reversible stress
- Identify and cull diseased animals (Johne's, CAE, OPP, etc)
- Identify herd/flock diseases to co-manage
- Goal: have the skills to handle problems from a challenging genetic basis, using management changes.
- Then you're ready to apply more selection



How to be Profitable

• Reduce Costs

- High fecundity – twins raised, low base herd:sales herd ratio
- Thrive on local forages – don't need supplemental energy
- Healthy – free from diseases, don't need deworming, treatments for lice, mastitis, hoof rot, respiratory
- Low labor – hooves, birthing assistance, shearing, stay in fences, maternal, doctoring
- Hardy to local weather – outwintering
- Easy to market
- Low cost infrastructure – handling facility, shelter, fences, feeders, waterers, mineral feeders, straw

• Increase Income

- Services
 - Brush management
 - Lawn mowing
 - Solar grazing
 - Dog trials/training
 - Agritourism – yoga, photo booth, petting
- Direct sales
 - Meat, hides, horns, bones
 - Fiber – wool, cashmere, mohair
 - Milk
 - Breeding stock
- Auction

Reduce Costs - Example

Infrastructure and Associated

Common:

- Lambing jugs (building, straw, individual feeder, individual water bucket, headlock, daily pen cleaning, filling, water defrosting, sleeping cot, video cameras, monitoring, heat boxes, towels, injections of BoSe, etc., be present to assist birth, hold kids/lambs up to nurse, tube weak lambs/kids, dip cords in iodine, provide this for at least 3 days per adult female)

Ours:

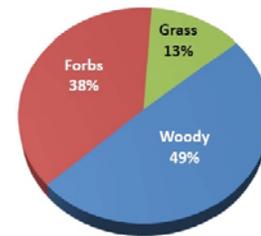
- Brush or pasture, electronet fence, energizer, bag for kid/lamb processing (ear tags and tagger, scale, sling, notepad, pen, binoculars, gun)



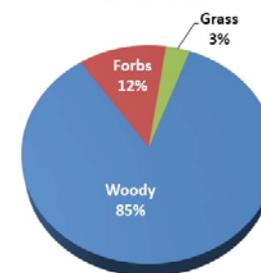
Reduce Costs

- Frequency of handling, treating
- Learn basic vet procedures
- Buy/use less expensive land – brush/degraded woodland vs pasture/cropland
- Control feed inputs better – don't feed grain, put up diverse spp baleage cut at appropriate maturity for the classes of your livestock, minerals/vitamins
- Select goats/sheep that outwinter bale grazing with minimal need for shelters

2011-2014 Ave Forage Availability



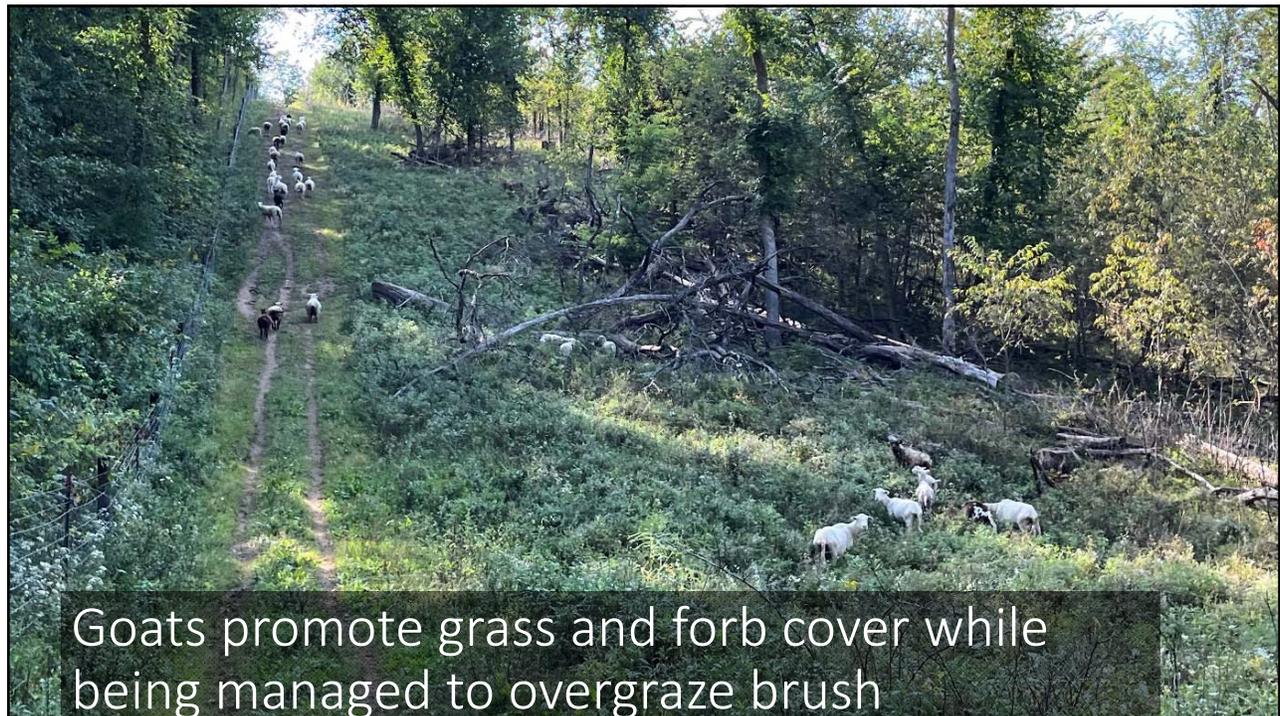
2011-2013 Ave Goat Forage Selections



(Nolden et al., 2019; R. Lemus, 2012; Harrington and Kathol, 2009)

Degraded woodland is less expensive to buy





Some Very Rough Numbers - Income

Sheep

- 'Rule of thumb': can add one sheep (or two or three?) per cow without compromising forage availability or quality
 - Yes? If the pasture is nice and diverse
- Take a mature (hair) ewe
 - Produces 2 offspring per year
 - Lambs finish grazing season at 60lb
 - Sell for \$2.50/lb liveweight
 - Gross profit per ewe \$300

Goats

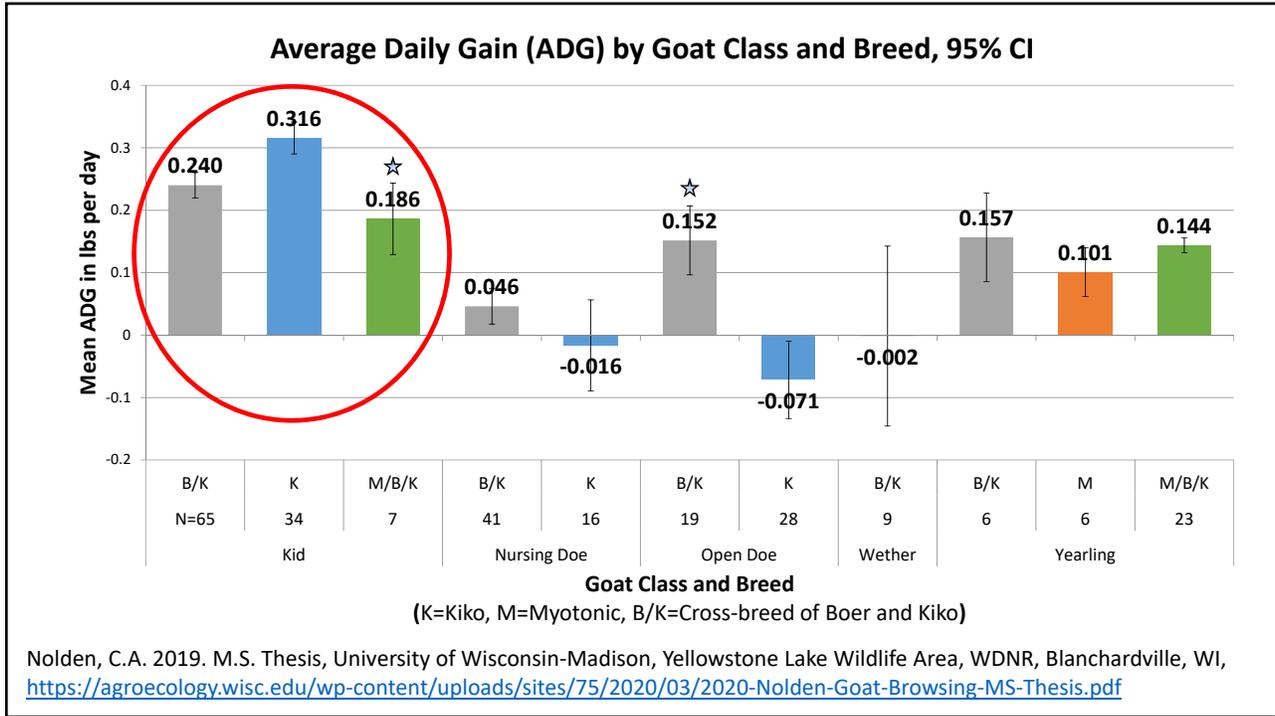
- Let's say you want to rotate goats through your timber.
 - 200 goat-days per acre for a single very intense browsing event
 - Let's assume we can get two browsings per year at a less intense rate (125 goat-days per acre each time, or 250 goat-days per acre per grazing season)
 - Grazing season is ~180d, so you want about 1.4 goats/ac
- Take a mature doe
 - Produces 2 offspring per year
 - Kids finish grazing season at 50lb
 - Sell for \$4/lb liveweight
 - Gross profit per doe \$400

By Margaret Chamas, GOTG, PFI

Increase Income

- Produce more kids/lambs to sell
- Increase survival to market
- Market at time when prices are high
- Don't aim for the highest prices (optimal grade)
- Use animals for targeted grazing contracting
- Sell meat directly to consumers
- Sell animals as breeding stock
- Provide agrotourism (goat yoga, fiber arts, tours, educational events, etc.)



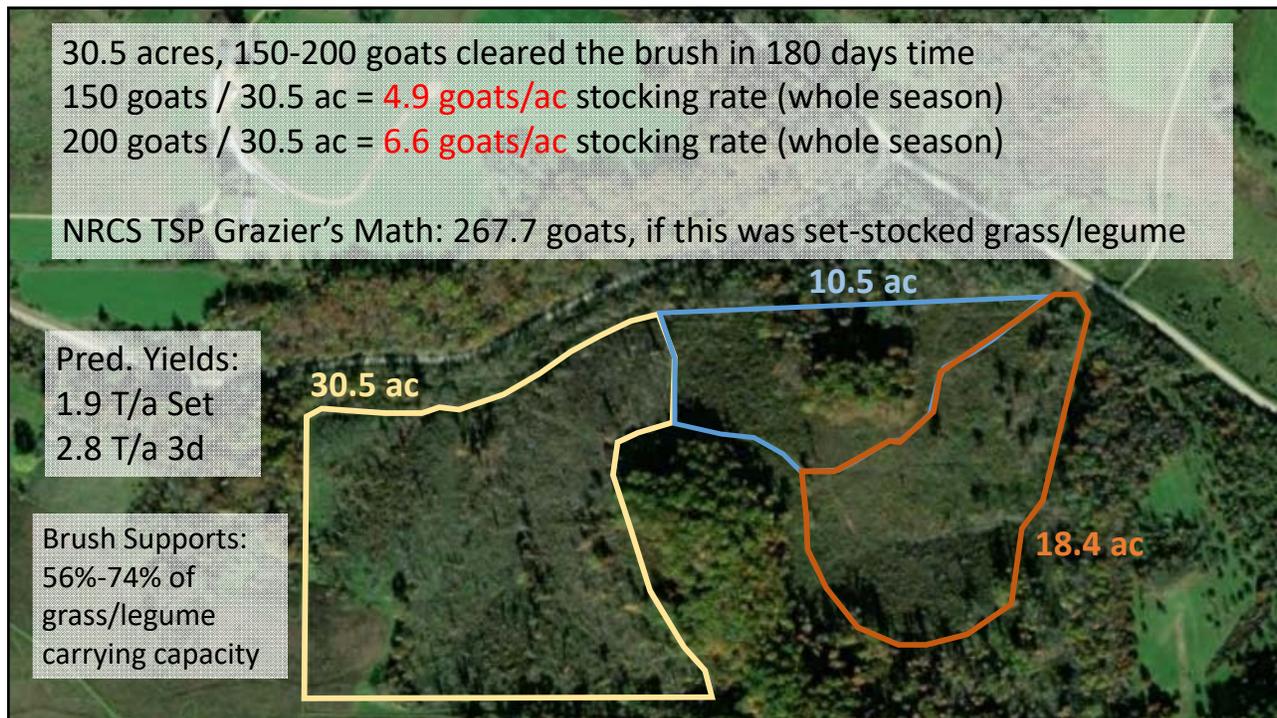
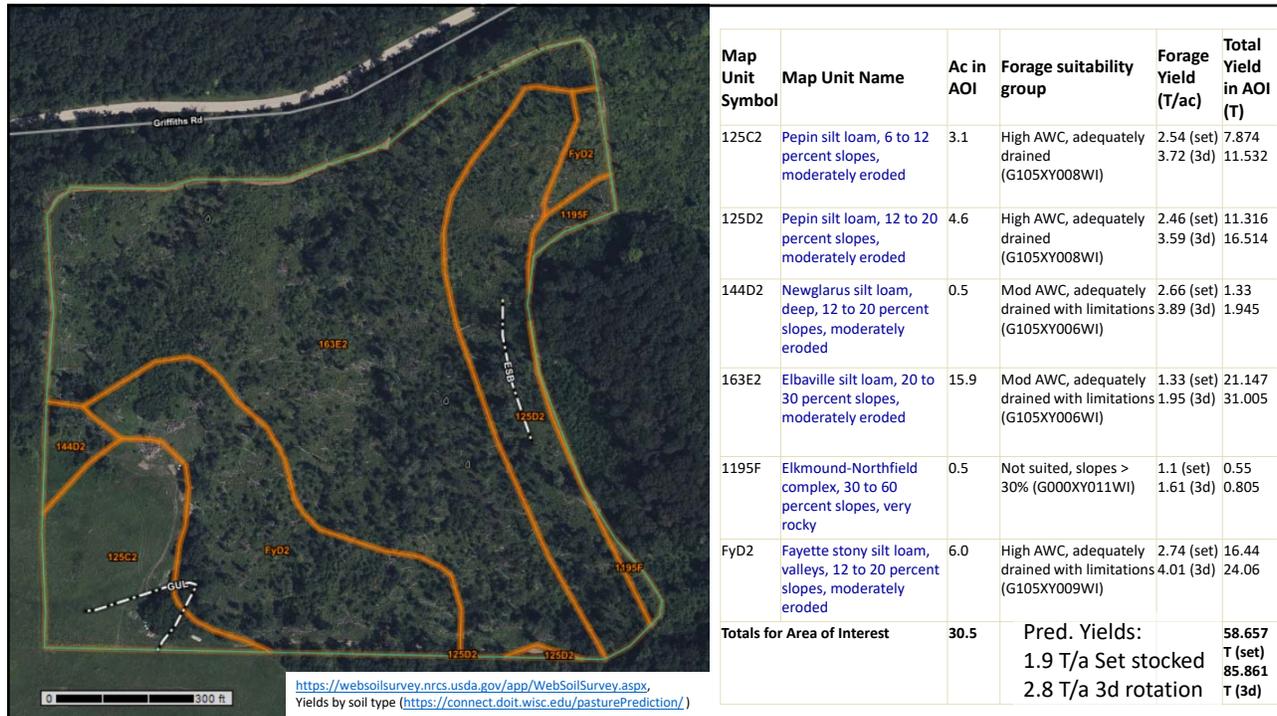


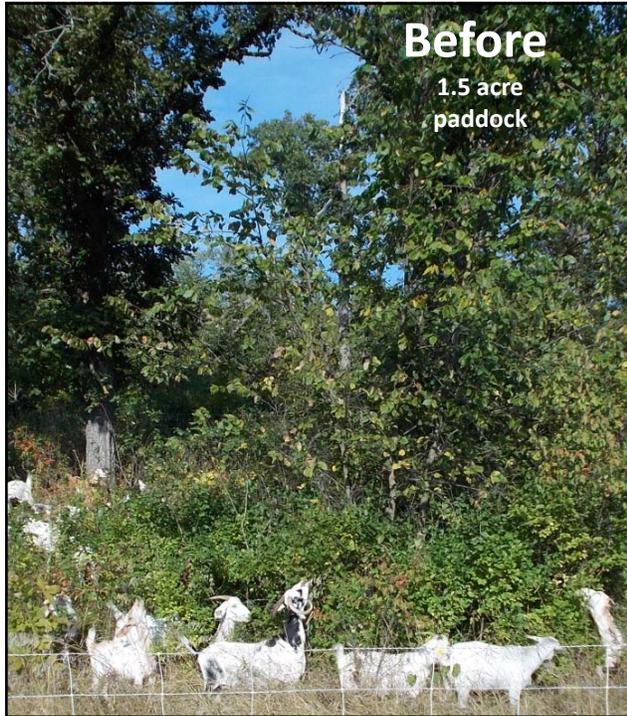
Goat Kid Sales

Slip#	Tag#	Hd	Bs	Description	Purchaser	Avg	Weight	Price	Amount
6684	1031	20	0	X-Bred Kid	4-2	57	1145	260.00w	2977.00
6684	1031	1	0	D-Kid	1600-	35	35	250.00w	87.50
6684	1031	2	0	D-Kid	1600-	48	95	240.00w	228.00
6684	1031	1	0	D-Kid	553-	35	35	162.50w	56.87
6684	1031	2	0	D-Kid	1600-	48	95	215.00w	204.25
6684	1031	6	0	D-Kid	115-1	80	480	140.00w	672.00
Total Wt						1885	GROSS		4225.62

INSURANCE GOATS	4.23	Descr	Hd	AvgWt	Avg\$CWT	Avg\$HD
SCOM	128.00	X-Bred Kid	20	57	260.00	148.85
	132.23	D-Kid	12	62	168.73	104.05
		Gross			4,225.62	
		Charges			132.23	
		Net Due			\$4,093.39	

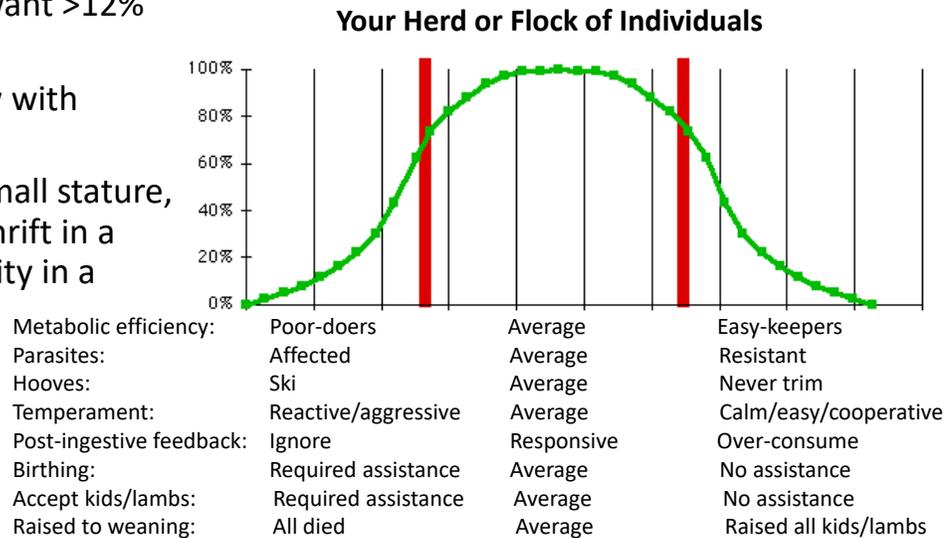
180 day browsing season (1 May - 30 Oct)	\$ 2.60	per lb live wt
8 lb kids born in May	\$ 148.20	per head (57*\$2.60)
57 lb kids by Christmas	30	acres
238 days old at Christmas	120	goats (does w twins)
49 lbs needed to gain (57-8)	80	Kids to sell
0.206 lbs per day in 238 days	\$ 11,856.00	from 30 ac
	\$ 395.20	Income per acre





Genetics, Genomics, Environment, Management

- Generally don't want >12% inbreeding
- Often don't know with purchased stock
- Small testicles, Small stature, Unusual lack of thrift in a cohort, Low fertility in a cohort
- NSIP Runs of homozygosity



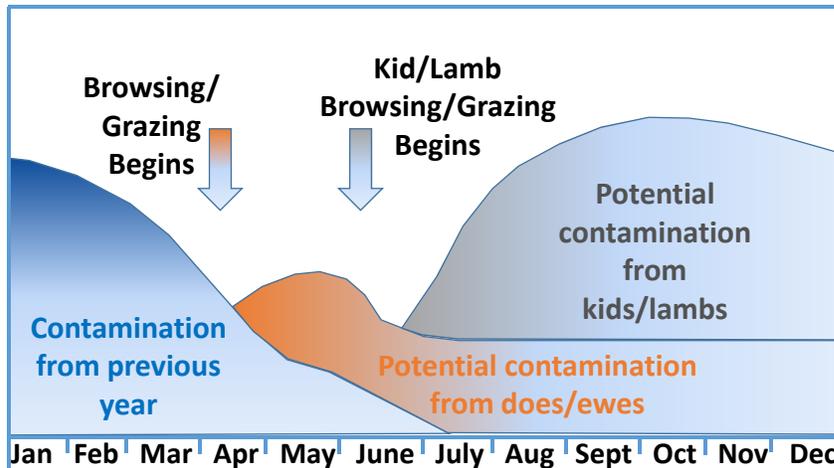
The Parasite Problem – Steals Income

- Goats > Sheep
- Resistance to dewormers
- Misconceptions
 - Must clean out animals
 - Rest periods and life cycles
 - Grass height
 - Heritability of resistance
 - Forage quality
 - Substitution vs weak link



2021 grain-free, chemical-free kids raised in brush, 1dr Acres Farm

Pasture Parasite Levels, Grazing Management



Factors

- Clean or safe pastures
- Pasture rest/rotation
- Forage quality
- Stocking rates
- Alternative forages
- Browsing
- Plant height
- Plant morphology
- Air moisture
- Multi-species grazing
- Bioworma
- Dung beetles

Adapted from Dr. David Thomas, UW-Madison, Sheep Production and Management 430, Spring Semester 2013

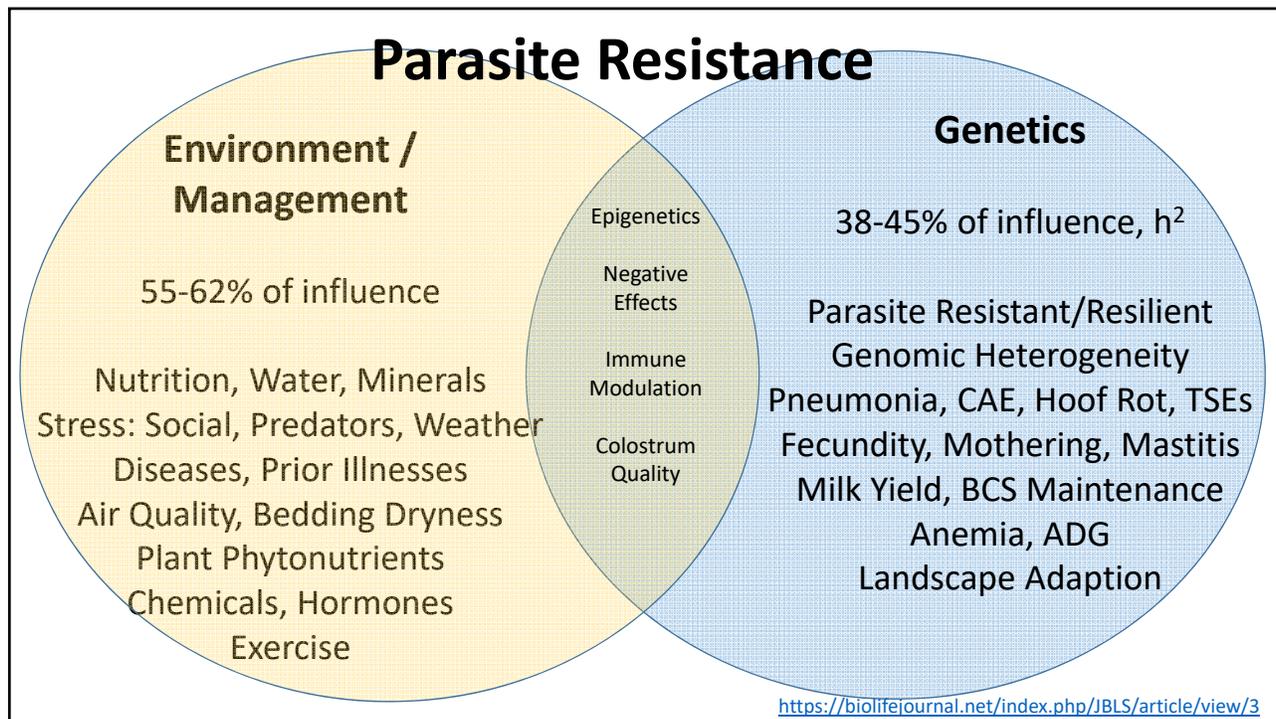
Resistance

- Goat/Sheep: resistance to parasites
- Parasites: resistance to chemicals in dewormers
- Resistant = Low fecal egg output
 - Problem: At least 2 ways to reduce FEC output:
 - Innate immunity prevents establishment of adult worms
 - Adaptive immunity significantly reduces adult worm egg output
 - Heritable: 0.48-0.54 for Katahdins
- Resilient = High FEC with very little negative impact (good eyelid, BCS)
 - Problems:
 - 5000-7000 EPG buck in our herd – contaminated pastures heavily; susceptible kids crash
 - One injury or stress could tip this type of animal into crisis
 - Can feed to resilience



https://katahdins.org/wp/wp-content/uploads/2023/02/notter_etal_historicepdforpr_2007.pdf

https://www.apsc.vt.edu/content/dam/apsc_vt.edu/extension/sheep/programs/shepherds-symposium/2010/04_strategies_for_genetic_improvement.pdf



Genetic Selection

501 Scottish Blackface lambs, 1 month old

Sampled monthly for 6.5 months

Ostertagia circumcincta predominant, 25/lamb measured

Worm fecundity limitation is heritable

- Host heritability of worm length is highly heritable at $h^2=0.62 \pm 0.20$
- Worm length is correlated with egg production ($r=0.7$, $P<0.0001$)
- Host heritability of number of parasite eggs per worm is highly heritable at $h^2=0.55 \pm 0.19$
- Host immune function limits worm length and fecundity, via quantity and specificity of parasite-specific IgA
- No evidence that number of worms is influenced by the host $h^2=0-0.14$

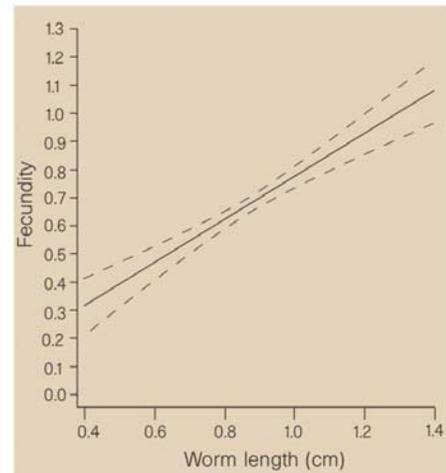


Figure 1 Relationship between worm fecundity and mean worm length. Fecundity was estimated from the log-transformed faecal egg count at slaughter divided by the log-transformed adult worm burden. The 95% confidence limits are shown.

Stear et al., 1997. How hosts control worms. Nature.

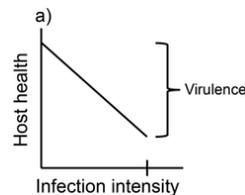
Image courtesy of Dr. Ruthanne McCaslin

Host and Parasite Sources of Genetic Variation

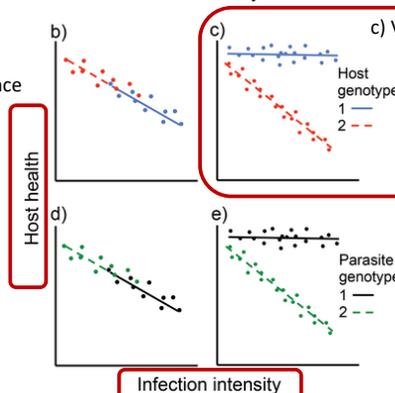
Dots are individual hosts. Lines represent reaction norms for different host or parasite genotypes

b) Variation among host genotypes for resistance

d) Variation among parasite genotypes for "exploitation."



a) Virulence is the reduction in health a host experiences when infected. It is a function of the infection intensity (the realized infection intensity in this case is indicated with a vertical line on the x-axis) and the slope of the relationship between health and infection intensity



c) Variation among host genotypes for tolerance

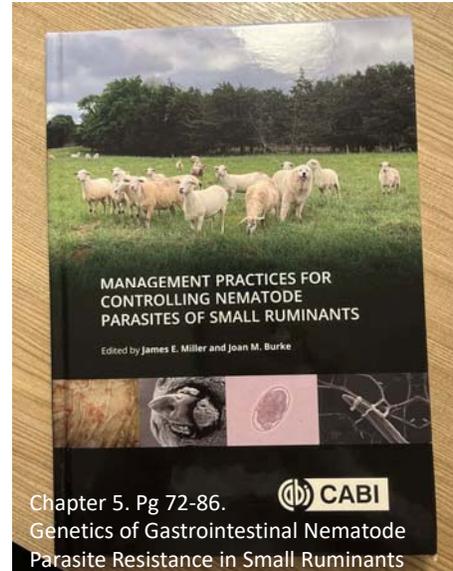
Tolerance is resilience. When stress happens, tolerance disappears. Resilience can be made through feeding.

e) Variation among parasite genotypes for "per parasite pathogenicity."

Råberg L (2014) How to Live with the Enemy: Understanding Tolerance to Parasites. PLOS Biology 12(11): e1001989. <https://doi.org/10.1371/journal.pbio.1001989>

Breed Differences, Parasite Response, Health

- Texel, Suffolk, St. Croix, Katahdin
- Low FEC mechanism
 - Prevent L3 larvae attachment, St. Croix
 - Prevent adult larvae egg production, Texel
 - St Croix and Texel have same FEC
 - Suffolk rarely have either strategy; high FEC
 - Suffolk and Texel had same L5 larvae count, St Croix hardly any
 - Better to have fewer adults – stress = increased egg shedding
 - Katahdins can have low or high FEC
- Low FEC sheep resist other diseases better
 - Hoof rot, clostridium, LPS injection recovery
 - Divergent FEC pairing – resistant sheep have higher Ab titer to vaccine, more Ab in colostrum (2.5x IgG)
 - Parasite resistant sheep are more immunocompetent; 20% difference in death loss – all causes
- Serum IgA important for resistance, Saliva test
 - High protein diet and minerals needed

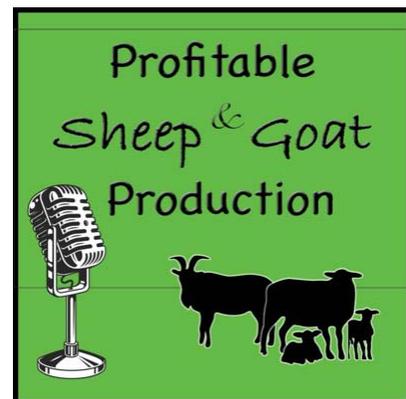


<https://onlinelibrary.wiley.com/doi/10.1111/pim.12876>, Dr Bowdridge research

1-21-2026: <https://podcasts.apple.com/us/podcast/episode-53-sheep-goat-parasites-with-dr-scott-bowdridge/id1732011474?i=1000746154151>

Polypay producer in the Midwest

- 4000 lambs produced each year, barn fed to finish - parasites
- Ewes average 2000 epg; tolerant/resilient, grazed
- 8 groups of 10 ewes each
- Dewormed with a different dewormer or combo, or not dewormed
- Not deworming NSD from treatments – drugs not working
- Dr. Bowdridge working with antibody response phenotype testing to identify breeding stock with better immunity within the flock



1-21-2026: <https://podcasts.apple.com/us/podcast/episode-53-sheep-goat-parasites-with-dr-scott-bowdridge/id1732011474?i=1000746154151>

Genomic SNPs Associated with Resistance

1. Five hundred goats representing three different breeds participated in the research which identified genetic regions that strongly link to diminished parasite loads. Low parasite levels were most strongly correlated with chromosome 5 markers while markers on chromosomes 5, 12 and 18 showed the highest significance in the GWAS analysis.

Chromosome	Marker ID	SNP Location (bp)	p-value	Association with Resistance Trait	Trait Details
5	GWAS_01	120,345,678	0.0005	High association with reduced <i>H. contortus</i> burden	Decreased parasite count
12	GWAS_02	324,567,890	0.0012	Moderate association with <i>T. colubriformis</i> resistance	Increased growth rate
18	GWAS_03	567,123,456	0.0021	Low association with both <i>Haemonchus</i> and <i>Trichostrongylus</i>	Reduced clinical signs

Table 1: Genome-Wide Association Study Results for Parasitic Resistance in Goats

<https://biolifejournal.net/index.php/JBLS/article/view/3>

Parasite Resistance = 20% Better Gain and Milking

Table 2 shows the phenotypic results of field experiments where genetically selected parasites-resistant goats receive comparison to normal goats. The performance of the selected group improved because they experienced reduced parasite burdens together with improved general health. The table summarizes results related to weight change together with milk quantities along with parasite measurement outcomes from each group. The goats in the selected group exhibited reduced parasite count by 30% together with increased weight gain up to 20% compared to the control population.

Trait	Control Group (n=50)	Selected Group (n=50)	p-value	Percentage Improvement
Weight Gain (kg)	12.3 ± 3.4	14.8 ± 3.1	0.002	+20%
Milk Yield (L/day)	2.4 ± 0.8	2.9 ± 0.7	0.045	+20.8%
Parasite Load (eggs/g faces)	500 ± 150	350 ± 130	0.013	-30%
Clinical Signs (score)	3.5 ± 1.0	2.0 ± 0.8	0.028	-42.8%

Table 2: Field Trial Results: Phenotypic Comparison Between Control and Selected Breeding Lines

<https://biolifejournal.net/index.php/JBLS/article/view/3>

Strategies

- Buy resistant goats initially
 - Buck tests
 - Herds with FEC EBV values – NSIP Kikos
 - Other goat graziers with similar selection criteria
- Improve existing flock
 - Breed to resistant bucks
 - Retain offspring that inherited parasite resistance
 - Provide a parasite challenge
 - Natural infected pasture
 - Coproculture and dose a known number of L3 larvae
 - Recover challenged goats
 - Deworm all and market those with high FEC
 - Deworm just the high count and retain low count lambs
 - Feed through bioworma or dedicate paddock to challenge area
 - Keep ewes exercising while pregnant

A quote to continue this discussion

"...after symptoms of this infection (Haemonchosis) have been seen, the time necessary for fattening lambs is greatly increased and requires the use of more expensive grains for finishing than in non-parasitized lambs...therefore the prime requisite of economical sheep production is raising sheep that do not suffer from parasitism."

Veterinary Helminthology (1949)

Same, and possibly even more important for goat production in the Upper Midwest

2015, Sustainable Appalachia webinar:
<https://youtu.be/IX9TT25A4VI> Dr Scott Bowdridge

Fecal Egg Count Procedure

• Supplies



McMaster Slide, \$22

<https://www.vetslides.com/2-chamber-slides>



Disposable Slides, coverslips, \$10, slightly different procedure, longer count time/animal or per sample

<http://www2.luresext.edu/goats/library/fec.html> Video on FEC procedure: https://youtu.be/ZZQymZKe_hs?si=gl8sKdc3nqWZMtNO

100x (10 x 10)
Adjustable stage
Light below stage



40x-1000x
Advanced ...
\$124.98
AmScope



Spoon

Cup

Gram Scale

Eye Dropper

Labs for Low Cost FEC testing

Texas A&M AgriLife Research and Extension Center

c/o Dr. Jake Thorne
7887 US Highway 87 N
San Angelo, Texas 76901
(325) 653-4576
\$5/sample

Virginia Tech

Ramirez Parasitology
Laboratory
c/o Roger Ramirez-Barrios
Center for One Health
Research
1410 Prices Fork Road
Blacksburg, Virginia 24061
parasites@vt.edu
\$7/sample

West Virginia University

Division of Animal and
Nutritional Sciences
c/o Dr. Scott Bowdridge
1194 Evansdale Drive
2213 Ag Science Bldg.
Morgantown, WV 26506
(304) 293-2003
\$5/sample

<https://www.wormx.info/lowcostfec>

Make Flock/Herd More Locally-Adapted

- Start removing high maintenance animals
 - Consider making a separate flerd with more inputs
 - Breed these to superior sires
 - Test offspring, move good ones to low maintenance group
- Manage low maintenance animals how you prefer
- Challenge the low maintenance animals
- Don't try to select for everything at once

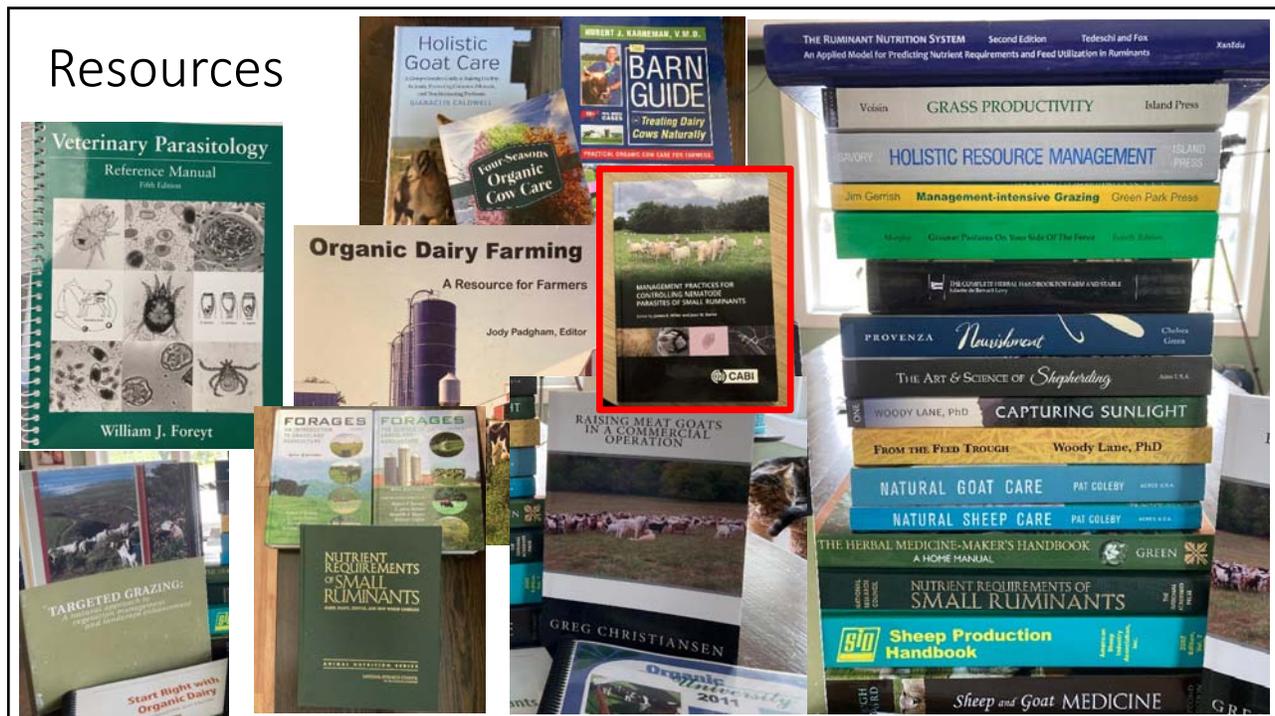


Summary

- It takes a holistic/systematic management approach to develop landscape-adapted goats/sheep, but doing so can reduce inputs and increase income
- Feeding right is very important
 - Forage quality
 - Body condition response
 - Pasture management
 - Minerals, vitamins, PSC
- Breed to parasite-resistant bucks/rams
- Selection for healthy adults that produce many healthy kids/lambs with low FEC
- Managing health in non-grazing season preps for healthy, low stress grazing season



Resources



Further Reading

- 2024 Parasite management of grazed goats
https://www.wormx.info/files/ugd/6ef604_dae47e49103341dbb260f69318397cd3.pdf
- H.contortus https://laboklin.com/wp-content/uploads/2025/08/LA_Juni_Pferd_2025_ENG.pdf
- Understanding when parasites are most infective:
<https://u.osu.edu/sheep/2019/03/26/understanding-parasites-when-are-they-most-infective-on-pasture/>
- 2025 Breeding Protocols for Parasite Resistant Goats: <https://www.aces.edu/wp-content/uploads/2025/03/UNP-2207-Breeding-Program-Protocols-for-Improving-Parasite-Resistance-and-Resilience-in-Small-Ruminants-03312025.pdf>
- 2024 Breeding program for GIN resistance benefits for goats:
<https://biolifejournal.net/index.php/JBLS/article/view/3>
- 2022 Genetic resistance to GIN in goats:
<https://www.veterinaryworld.org/Vol.15/October-2022/10.pdf>



Questions?

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