Portable Cold-weather Goat Shelter Development and Testing

By Cherrie Nolden
2014 Annual Progress Report

SUMMARY:

I tested goat preferences for portable shelters built on boat trailers with a hoop house structure covered with opaque (4 mil silage pile plastic) or transparent plastic (greenhouse SolarGuard, 6 mil), and with either a single deck or double deck with ramps for access. Replicated groups of goats were placed in pens with pairs of portable shelters to test their preference, with 7 goats per pair of shelters, and 6 pairs of shelters over the study period. Three replicates were conducted, testing opaque vs. transparent, and 3 replicates testing single vs. double deck. Goats readily used the trailers for shelter, but their preferences were not clear-cut. The average number of goats using opaque-covered shelters was greater than the average number of goats using transparent-covered shelters, and double-deck shelters were used more by the goats than single deck shelters. When the data were summarized based on outside light levels (sun, cloudy, night), goats seemed to prefer opaque shelter coverings at night, but the preference was mixed on cloudy days. The groups of goats liked the single deck shelters better than the double deck on cloudy days, and the reverse at night.

PROBLEM:

I sustainably produce and use goats for invasive vegetation control but, due to cold and wet weather, I cannot start them browsing until April, and typically have to bring them back to permanent shelter by October in southern Wisconsin. Goats are not hardy enough be outwintered without shelter in Wisconsin weather, and restoration browsing sites are rarely close enough to permanent shelters to efficiently keep goats in the brush during early spring and late fall, thereby decreasing their impact on invasive species. Additionally, city-dwelling small-scale goat producers are limited in their production ability and thus profitability due to access to and expense of land with goat-suited permanent buildings, and they are hesitant to invest in permanent structures on rented land. This limits access to high-quality goat forage and increases production costs due to additional months of stored forage feeding for both rural and urban goat producers in the NCR. It also restricts the environmental improvement that goat browser entrepreneurs can provide through invasive vegetation management.

PROPOSED SOLUTION:

To increase farm profits and environmental improvements by addressing this housing situation, I proposed to develop and test portable goat shelters to: 1) enable extended goat browsing of invasive plants earlier into the spring and later into the winter, 2) facilitate goat production on rented land without needing or improving permanent structures, and 3) enable goat producers to expand their herds through use of shelters that can be readily moved to new rented properties. Since tested portable goat shelter designs were not available, I proposed to apply my skills and knowledge to test goat preferences for cold-weather, portable shelters that I design and build.

GOAT BEHAVIOR CONSIDERATIONS:

* Goats are herd animals that, if sufficient space is available, prefer to sleep together.

* Animal Welfare Approved (AWA) requires 16 square feet of floor space per adult doe in covered shelter.

Nolden, C.A. 2014. Portable Cold-weather Goat Shelter Development and Testing. 2014 Annual Progress Report. NCR-SARE Farmer/Rancher Research Project FNC14-966.

* Goats enjoy climbing and sleeping on elevated platforms, so they are eager to jump into a trailer and climb ramps.

* Goats move readily toward well-lit spaces.

* Goats avoid getting wet if it is possible and seek draft-free shelters in bad weather conditions.

* Goats enjoy spending considerable time outside and will eagerly girdle thin-barked brush during the dormant season (fall through spring).

STRUCTURAL DESIGN CONSIDERATIONS:

* Open-sided livestock shelters are successfully used for housing many species of livestock in cold, windy and wet conditions.

* Purdue's publications on winter livestock housing recommends that the open side face S-SE, and the air vents be closed for natural ventilation without drafts.

* Heavy duty plastic over a hoop structure is an inexpensive, durable, water-proof, wind-proof design.

* Translucent plastic sheeting can provide natural light inside the structure, while an opaque tarp can provide greater durability.

* A single deck under a 6 foot hoop facilitates clean-out, while a double deck doubles the floor space for goats and gives them something additional to climb.

DESIGN ELEMENT TESTING:

Given the above considerations, I proposed to test goat preference for:

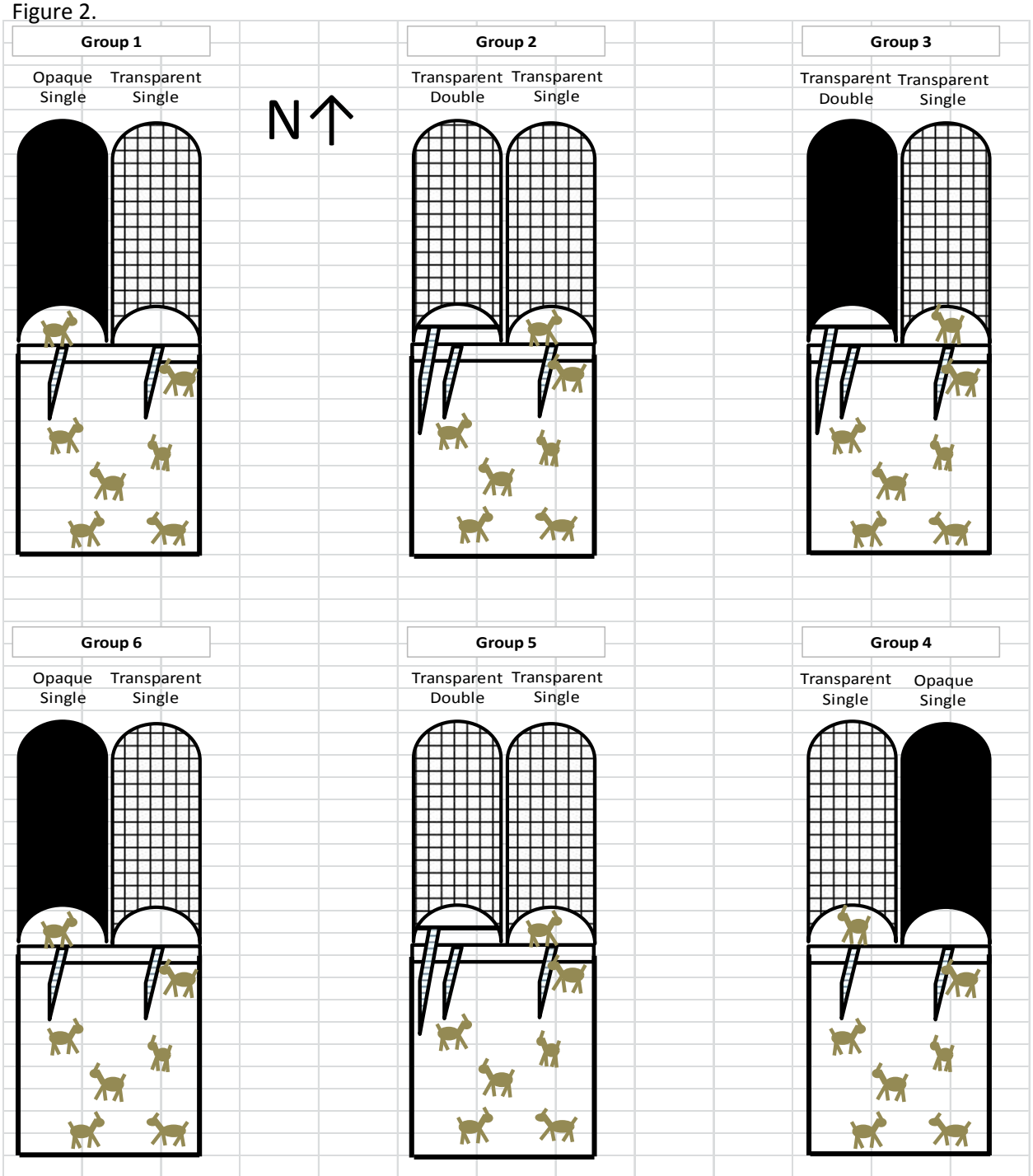
* two shelter structural elements (fall of 2014), and

* portable vs. permanent shelters at higher herd densities (fall of 2015)

Figure 1.
Single Deck portable shelter prior to plastic covering Double Deck shelter prior to covering

Structural elements: I constructed 7 portable hoop-style goat shelters (16'L x 7'W x 6'T) with combinations of the structural variables of Translucent (T) vs. Opaque (O) covering, and Single (S) vs. Double (D) deck: TS, TD, OS, OD. Figures 1 and 3 show the shelters in development. I tested goat housing preferences in paired access to the 2 structural variables (TS vs. TD, TS vs. OS), with 3 replicates each. A novel group of 7 goats per portable shelter pair (meeting AWA space standards) per replicate were photographed every 2 hours over a 9 day period in December 2014 with time-lapse game cameras. Groups 1, 2 and 3 ran concurrently in early December, and Groups 4, 5 and 6 ran concurrently 9 days later. Figure 2 shows the layout of the portable shelters. The number of goats in each

Figure 2.



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picture for each portable shelter was tabulated, along with outdoor temperature and light conditions (night, sun, cloudy). Data were summarized for differences in goat use of the portable shelters.

Figure 3.

PRELIMINARY RESULTS:

Goat preferences were not clear-cut. Table 1 is a summary of the average number of goats in each photograph using the portable shelters, by group. Zeroes are included in these data (photos where there were no goats in either shelter). This would indicate that goats preferred opaque shelters over transparent shelters, and double deck shelters over single deck shelters.

Table 1.

Average # Goats Using the Portable Shelters (Goats/Photo)				
Group	**Opaque Single Deck**	**Transparent Single Deck**	**Transparent Double Deck**	**Goat Preference**
1	2.93	1.37		Opaque
4	2.96	0.44		Opaque
6	2.89	0.50		Opaque
2		1.94	1.25	Single Deck
3		0.94	2.37	Double Deck
5		0.51	2.41	Double Deck

I noticed that outside light level seemed to make a difference in the portable shelter choices made by the goats. Table 2 is a summary of the photographic data, with zeroes removed, tabulated by light levels. There were very few sunny days during the study, so the preferences for shelter types is interesting but not likely significant. Cloudy days and night-time are the times when goats would likely seek shelter, so those data are more important for designing shelters for cold-season goat browsing. Goats seemed to prefer opaque shelter coverings at night, but the preference was mixed on cloudy days. The groups of goats liked the single deck shelters better than the double deck on cloudy days, and the reverse at night.

Table 2.

Portable Shelter Goat Preferences by Light Levels, Ave # Goats/Photo/Shelter Type

Light Levels	Group	Count of Photos (n)	Average Temp (F)	Opaque Single Deck	Transparent Single Deck	Transparent Double Deck	Goat Preference
Sun	1	12	34.8	0.50	2.83		Transparent
	4	2	33.5	1.50	0.50		Opaque
	6	2	34.5	0.00	2.50		Transparent
	2	8	33.3		1.25	0.38	Single Deck
	3	9	34.1		1.44	0.44	Single Deck
	5	2	32.5		3.00	0.00	Single Deck
Cloudy	1	28	29.8	1.46	2.46		Transparent
	4	26	33.0	1.69	1.12		Opaque
	6	32	34.3	0.90	0.97		Trans=Opaq
	2	23	27.0		1.91	0.65	Single Deck
	3	25	29.0		1.96	0.84	Single Deck
	5	29	33.2		1.29	1.75	Double Deck
Night	1	69	21.3	3.99	0.70		Opaque
	4	68	29.7	3.79	0.22		Opaque
	6	61	28.9	4.82	0.30		Opaque
	2	64	21.2		2.51	1.87	Single Deck
	3	64	21.1		0.64	3.64	Double Deck
	5	67	26.8		0.02	3.12	Double Deck

The structure type that is statistically most preferred by the goats will be the type I will use for the density testing in fall of 2015.

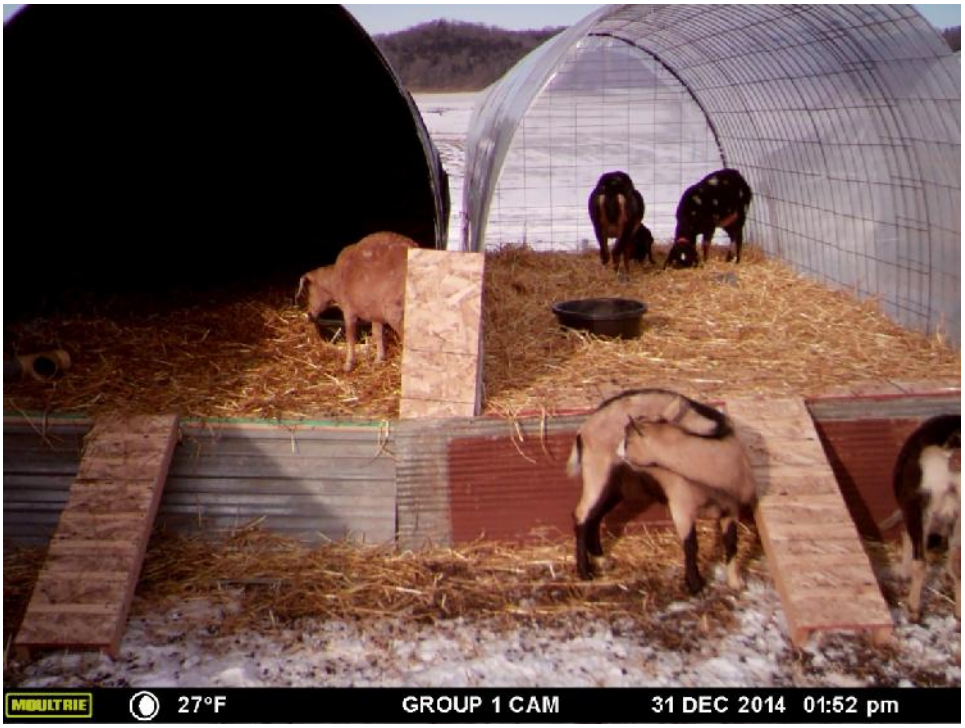
Despite the goats seeming to prefer the double deck trailers, only one goat climbed to the second deck. The others all stayed on the lower deck throughout the study. I'm guessing that the ramps were too narrow and the slats that were designed to provide traction on the ramps were too small to provide sufficient traction at the angle of the ramps. I will modify this for next year.

All goats remained healthy and behaved normally in their groups throughout the study. They received free-choice mineral, kelp and baleage and had heated water tanks throughout the study. The dry dairy goats in Group 1 received a daily ¼ lb/hd of 16% protein grain mix. I've selected my meat goats to thrive on 100% forage diets, thus they needed no supplemental energy or protein.

Photographs from the game cameras are attached to show the structures. The date stamp was set incorrectly on the Group 1 and Group 6 camera. Black and white pictures are a result of the infrared flash at night, and color photos are captured during the day.

Average numbers of goats per shelter type appear to be low, given that 7 goats were in each group. The game cameras capture a flat image, where individual goats may not be visible if they are behind another goat. Thus, if I could only see 3 goats in the photograph of the shelter, 3 was the number I entered into

the data set. There likely were more goats in the preferred shelter than were visible in each photo, due to the gregariousness of goats. The important distinction is of which trailer in the offered pair that the goats select to use in each photograph. This was readily visible.

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33°F
GROUP 2 CAM
08 DEC 2014 12:40 pm


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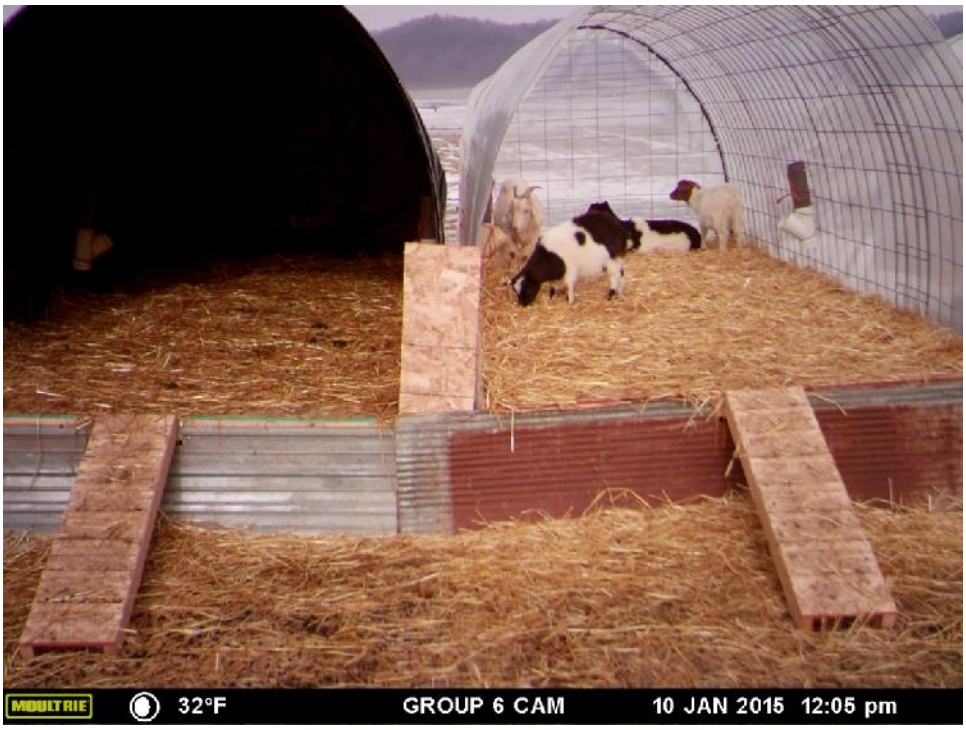
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