

Utilization and Management of Invasive Plants in Pastures Using Bio-Control Agents

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Executive Summary

A Conservation Innovation Grant (CIG) project to evaluate the usefulness of small ruminants to control and to utilize invasive plants, especially brush species such as multiflora rose and autumn olive prevalent in Appalachian pastures, was carried to completion between 2007 and 2010 in north central West Virginia. The project funds were used primarily to simulate a cost-share program in which the participating cooperators with an identified resource-concern of an invasive brush species in his/her property was provided with supplies needed to contain the animals in return for costs towards purchase of animals and miscellaneous maintenance supplies. A two-day workshop was organized to familiarize the novice with all aspects of targeted grazing using small ruminants. The nutritional value of the invasive brushes in this project was quantified and was determined to be comparable to that of typical forage species in the Appalachia. A transect-line method to evaluate the changes in brush density over a period of three years by adopting this grazing practice recorded a significant reduction in the density of invasive plants. A market pool was successfully organized to enable the cooperators sell their produce at a regional market with the intent of initiating direct-marketing strategies. Feedback from the participating cooperators was documented with the aid of a survey instrument and face-to-face interviews. Documentation included participant perceptions, motivations, impact, barriers, and level of satisfaction with this project. The economics of this practice was compared to that of conventional brush management based on feedback from a pesticide applicator. Costs toward brush management using goats (~\$121) was calculated to be approximately \$50 higher per acre compared to that with chemical control (~\$75). Benefits beyond the farm-gate such as sustainability of the practice and environmental attributes were not taken into consideration while comparing this practice with conventional brush management. Finally, a practice standard with the potential to be developed as a National Practice Standard was drafted based on the outcome of this project. Eighteen cooperators signed up for the project, 15 of whom successfully completed it.

Project Narrative

A project coordinator Ms. Sigrid Teets was recruited shortly after the project was initiated. Subsequently, promotional documents were developed to publicize the project and recruit cooperators to participate in it. Documents included a tri-fold explaining the intent of the project which was distributed to NRCS and WVU-Extension offices, a FAQ document with a set of questions with answers, numerous newspaper articles published by local newspapers, West Virginia Department of Agriculture, WV Farm Bureau, and Conservation Districts. Meetings were held with WVU Agricultural Extension Agents in the two districts explaining the concept and discussing the implementation of the project. USDA Field offices were contacted and they agreed to participate with promotion and recruitment of cooperators. A set of ranking criteria was developed in order to screen the applicants along with sign-up sheets.

Once a pool of applications was identified, the spring and summer of 2007 was spent visiting potential cooperators farms to evaluate the suitability of the cooperator to follow a targeted grazing protocol, if the farm had a resource concern and if that resource concern could be controlled using small ruminants. Prevalence of invasive weed species especially brushy weeds such as multiflora rose, autumn olive, and Japanese barberry affective pasture productivity was considered to be the predominant resource concern. Finally eighteen farmers selected to participate in the project¹.

A two-day workshop was planned and organized with speakers nationally reputed in the area of small ruminants. The intent of the workshop was to provide the attendees with hands-on training and background information related to all aspects of this targeted grazing practice, including grazing strategies, animal husbandry and fencing systems. The eighteen selected potential cooperators were invited to attend this workshop apart from 60 others who attended the workshop. The entire workshop was recorded and reproduced on or a DVD, copies of which were distributed to all workshop attendees. Evaluations from the 2-day workshop and demonstrated a high degree of acceptance of the material presented and confidence of the attendees to be able to initiate a targeted grazing program.

Cooperator contracts were developed, the contracts were executed and each farmer was provided with a fencing system to conduct the targeted grazing evaluation program. Based on literature and prior experience, we developed a protocol to provide fencing materials based on the number of animals each cooperator planned to purchase. The cooperators received four temporary portable fence sections, for every six animals, from Kencove Company, PA. Each fencing section was 162' long and 42" tall. The participants signed contracts ranging in value from \$927.00 - \$1509.00 based on a 50/50 cost-share agreement. The former amount included a four section fencing system, a solar panel, charger, and ground rod, the latter, a ten section fencing system and the accessories.

¹ Note: Two project participants became terminally ill, one of whom deceased, and hence were not able to complete the project; one participant moved out of the area.

The fall of 2007 and winter of 2008 period was spent conducting the remainder of site visits to cooperators farms, evaluating the resource concerns and assisting the farmers with targeted grazing plans. Prior to the beginning of the grazing season, project participants were mailed a newsletter to remind them of their responsibilities and to provide targeted grazing recommendations. Project members met a number of times to plan spring visits and to install transects along sections of woody invasive plants to document the effectiveness of targeted grazing, develop a checklist for spring visits and a questionnaire to evaluate the cooperators ability to manage small ruminants while controlling invasive species.

During fall and winter 2008, project members were invited to attend a presentation given to WV members of the Soil and Water conservation Society at the State Conservation Partnership Conference in Charleston, WV, and to a regional workshop conducted by a small ruminant group from the Western States on Targeted Grazing at State College, PA. The project leadership was invited to present preliminary results of our project and to participate on a contract grazing panel. The Sheep Industry newsletter editor interviewed the project coordinator and an article was published in the October issue of the Sheep Industry newsletter about our project activities and results.

The project participants entered the marketing phase in 2009. To assist them with the sale of lambs and kid goats, a marketing questionnaire was developed and sent to each cooperator. Based on responses received and the advice from WVU-Extension Specialist and Director of West Virginia Small Farms Center, Mr. Tom McConnell, we decided to organize a marketing pool to deliver animals to New Holland Market in Pennsylvania. The cooperators who expressed interest in this event pooled their animals at the WVU Animal Sciences Farm in November 2008. A trucking company was entered into contracted to transport the animals and facilitate the sale of the animals at New Holland. Proceeds of the sale were distributed appropriately to the cooperators.

In March of 2009 surplus fencing supplies were distributed to cooperators who demonstrated the need for additional materials and was able to cost-share based on additional expenses they incurred. The additional materials provided were used to expand their capability to manage the targeted invasive weeds. Contracts were modified accordingly. A grazing summary sheet and purchases of cost share material document were developed and sent to all cooperators. A spreadsheet was later developed of cooperator responses and summarized to determine the effectiveness of the initial grazing effects and initial cost.

The spreadsheet of responses from the seventeen participants at this point was documented and compared to current costs of chemical brush control. We asked Mr. Tim Fullen of Fullen Fertilizer Co., Inc., Union, WV to estimate the cost per acre of chemical application for comparison purposes. Our calculations indicated that the average start-up costs for treating 3.3 acres of bush using sheep or goats were \$890.00/acre, excluding fence material. Many participants did not indicate selling livestock which would have decreased their cost per acre during the first year. If the cost per acre would have included the cost of the fence that was given, the cost would have been \$1267.00/acre (the cost-share included supplies other than costs towards purchase of animals by the cooperators, e.g., medical and other husbandry supplies). One farmer from Upshur County, an experienced cattle farmer indicated his costs within \$17 of

breaking even without including the fencing value. It is estimated that the cost per acre for maintenance would be less than \$890.00 and may even indicate a profit. Tim Fullen estimated that for chemical control applied by his company would cost \$120.00/acre for brush under 3ft. and \$145.00/acre for brush over 3ft. He pointed out that this needed to be repeated every two to three years and did not take into consideration herbicide loss due to the weather. Also, when the brush “hardens up” in a dry spell, poor weed control is obtained, warranting repeat applications. When Tim was asked about the topic of brush control he said, “I am very seriously thinking something else besides chemicals”.

During spring 2009, a sampling plan to determine the nutritional value of the invasive brushes in this project, was created with the assistance of Dr. Ed Rayburn. Four cooperators were chosen to participate. The target species included multiflora rose and autumn olive. Sample analyses were carried out at Dairy One Laboratory at Cornell University.

During late spring, spreadsheets were completed which represented both cost-share data collected for the previous year as well as targeted grazing practices for the previous growing season. A pasture walk was held at one of the cooperators’ farm on June 11, 2009, where a group of 40 professionals and farmers gathered. The afternoon began with a lesson about small ruminant veterinarian concerns by Dr. Margaret Minch. The host participant led the guests for a tour of her farm sharing her experiences as a participant in this targeted grazing project; she described the changes that were being seen in the targeted grazing areas. A meal was provided by the Tygarts Valley Conservation District.

To determine the feasibility and transferability of targeted grazing using small ruminants it was necessary to document changes in multiflora rose stands over period of three years of grazing. A transect-line method to evaluate the effectiveness of goats to control multiflora rose was initiated at three cooperator locations in this project. Out of the three locations where transects were laid out and initial data were collected, only one location was successfully carried over to the third year to generate results. At one location, cooperator did not let the selected area to be browsed. The second cooperator had to move out of state during the study period. In the third location, significant reductions in multiflora rose infestation levels were noted as a result of targeted grazing using small ruminants.

During 2010, plans were put in place to obtain feedback from the participants. To materialize these plans, a rural sociologist, Dr. Jennifer Steele, WVU, was hired on a part-time basis to design a survey instrument to evaluate participant’s perceptions, motivations, impact, and level of satisfaction with this project. In-person interviews were conducted with 14 project participants during the summer of 2010. A set of interview questions was designed to assess participants’ expectations going into the project, their activities during the three-year duration, assessment of its outcomes, experiences with agriculture, and related social networks. The interviews were semi-structured. While a standard interview protocol was utilized, participants were free to elaborate on their experiences from their own perspectives. Interview length ranged from 30 minutes to two hours according to the level of detail they provided, with an average length of about one hour. Interviews were recorded and transcribed to capture the details of their responses.

Finally, an economic analysis was carried out to analyze the profitability of this as a small farm-enterprise. Mr. Tom McConnell carried out the analyses taking into consideration the inputs (costs) and outputs (returns) of the cooperators enrolled in the project.

Documentation of Brush Management Using Small Ruminants

MATERIALS AND METHODS

To determine the feasibility and transferability of targeted grazing using small ruminants it was necessary document changes in multiflora rose stands over period of three years of grazing. A transect-line method to evaluate the effectiveness of goats to control multiflora rose was initiated at three cooperator locations in this project. At each location, two transects were laid prior to introducing animals into the pasture. Each transect was 100 feet long and included stretches of pasture infested with brush. The presence or absence of brush was noted in each location based on bush size. Rose bushes above shoulder height was considered as “Large”, waist to shoulder height as “Medium”, and below waist height as “Small”. PVC pipes were buried at ground level to mark each transect along with appropriate maps. Counts of multiflora rose were recorded each year in each transect.

RESULTS

Out of the three locations where transects were laid out and initial data were collected, only one location was successfully carried over to the third year to generate results. At one location, cooperator did not let the selected area to be browsed. The second cooperator had to move out of state during the study period. In the third location, significant reductions in multiflora rose infestation levels were noted as a result of targeted grazing using small ruminants (Figure 1). Roughly 50% of the selected areas were infested with “Large” multiflora rose bushes before introducing the animals. After a three-year period this was reduced to 5%. About 22% of the area had “Medium” rose bushes prior to targeted grazing and had 2.5% cover towards the end of the third year. Similarly, 10% of the area infested with “Small” brushes was reduced to 2.5% after three seasons of browsing.

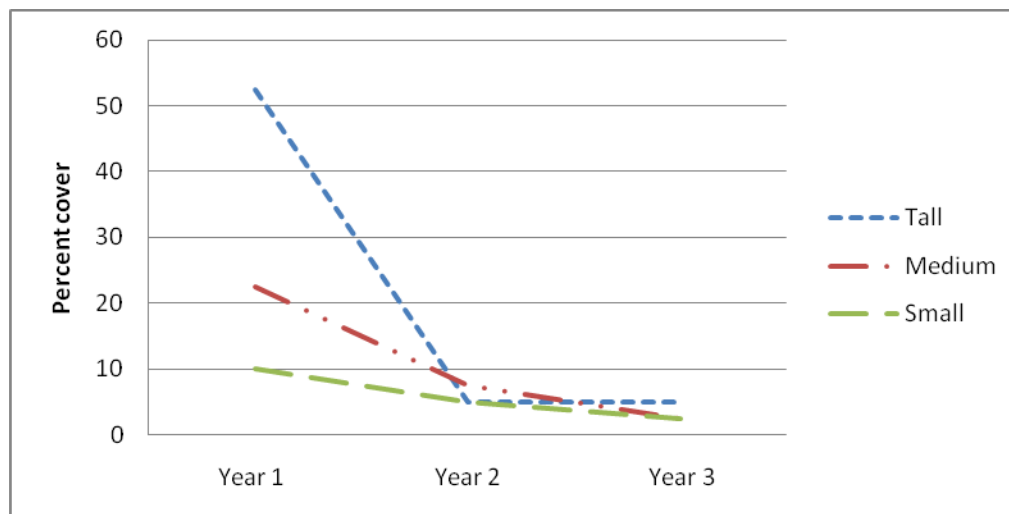


Fig. 1. Reduction of multiflora rose stand in a pasture as a result of targeted grazing using goats from 2008 to 2010 (Average of two transects).



Fig. 2a. Photograph taken June 2008, prior to introduction of goats at a cooperator location in Elkins, WV.



Fig. 2b. Photograph taken August 2010, at the cooperator location in Elkins, WV.



Fig. 3a. Photograph taken June 2008, prior to introduction of goats at a cooperator location in Elkins, WV



Fig. 3b. Photograph taken August 2010, at the cooperator location in Elkins, WV.

Nutritional Value of Multiflora-Rose and Autumn Olive

ABSTRACT

Forage samples consisting of multiflora rose and autumn olive were collected from participating farms in 2009. Samples obtained from multiflora rose bushes were 8"-12" of terminal growth and included leaves, stems, some flower buds or fruit (10% or less of sample). Samples obtained from autumn olive plants were 45% leaves only, 45% 6"-10" stems with leaves, and 10% buds or fruit. Representative samples were collected from each farm, air-dried for one week, and shipped to a commercial forage testing laboratory (Dairy One, Ithaca, NY). Average fiber, protein and digestibility of pasture in WV is 30.9%, acid detergent fiber (ADF), 52.1% neutral detergent fiber (NDF), 18.6% crude protein (CP), and 64.1% total digestible nutrients (TDN). Average macro mineral content of pasture in WV is 0.64% Ca, 2.53% K, 0.24% Mg, 0.33% P, and 0.22% S. Compared to average pasture, multiflora rose was lower in ADF and NDF, similar in CP and TDN. Autumn Olive was similar to pasture in ADF, NDF, and TDN in general higher in CP. Compared to average pasture multiflora rose was higher in Ca, lower in K, P, and S, and similar in Mg content. Compared to average pasture, autumn olive was similar in Ca and Mg, lower in K and P and higher S. Most of these minerals were adequate for the maintenance or moderate growth of goats. Overall, our results indicated that forage quality of both multiflora rose and autumn olive was comparable to that of an average pasture in WV.

METHODS AND MATERIALS

Forage samples were collected monthly from four participating farms. On all four farms multiflora rose samples were collected. On one farm autumn olive samples were collected. With the exception of the samples collected during May 2009 of new growth leaves and flower buds, all samples represented observed goat consumption. Samples obtained from multiflora rose bushes were typically 8"-12" and included leaves, stems, some flower buds or fruit (10% or less of sample). Samples obtained from autumn olive plants were 45% leaves only, 45% 6"-10" stems with leaves, and 10% buds or fruit. No flower buds or fruit were obtained from samples collected after 09/11/2009 from either multiflora rose or autumn olive. Several samples were taken from each farm during each visit from several different plants. Forage samples were then air dried for one week before packaging for shipping. Forage samples were analyzed by wet chemistry at a commercial forage testing laboratory (Dairy One, Ithaca, NY).

RESULTS AND DISCUSSION

Forage quality of both multiflora rose and autumn olive was often as good as or better than average pasture in WV (Table 1). The only problem with these brush species is that cattle do not browse them readily. However, goats do readily consume the leaves, succulent stems, and fruits making use of the nutritive value of the forage to the point of eliminating them from the pasture if grazing pressure from the goats is adequately high. Forage nutritive components did

differ by species and plant part with a few components having an interaction between species and plant part (Table 2).

Average fiber, protein and digestibility of pasture in WV is 30.9% ADF, 52.1% NDF, 18.6% CP, and 64.1% TDN (8). Compared to average pasture multiflora rose was lower in ADF and NDF, similar in CP and TDN. Autumn Olive was similar to pasture in ADF, NDF, and TDN in general higher in CP.

Average macro mineral content of pasture in WV is 0.64% Ca, 2.53% K, 0.24% Mg, 0.33% P, and 0.22% S (8). Compared to average pasture multiflora rose was higher in Ca, lower in K, P, and S, and similar in Mg content. Compared to average pasture, autumn olive was similar in Ca and Mg, lower in K and P and higher S. Most of these minerals were adequate for the maintenance or moderate growth of goats (Table 3).

Many plants that are considered weeds have a high nutritional value (1,2,3,4,5,6,7). In some cases they may have a higher nutritional value than the crop being grown, such as many weedy grasses and forbs growing within a toxic tall fescue pasture. When weeds have lower nutritional quality than the crop it is usually due to it maturing earlier than the crop, therefore having lower quality due to maturation, or being a grassy weed within a leguminous crop such as alfalfa, since grasses have higher NDF than legumes. In some cases removing weeds will actually decrease forage utilized by livestock (7) and/or decrease forage quality available to livestock. Due to these factors it is not advisable to just eliminate plants from pastures because they are not conventional forage crops. Rather the manager needs to assess the plants for livestock consumption and forage nutritive quality. Those that are of high nutritive value and readily consumed by livestock should be considered part of the forage supply in the paddock.

Table 1. Number of samples analyzed (N), mean, and standard deviation (SD, left blank when N=1) for nutritive components of multiflora rose and autumn olive plant parts selected by foraging goats.

Analysis	N	Mean	SD	N	Mean	SD	N	Mean	SD	N	Mean	N	Mean
	Leaves buds stems			Leaves fruits stems			Leaves stems			Buds		Leaves	
MULTIFLORA ROSE													
ADF	4	26.9	2.4	9	29.1	4.6	9	28.7	4.7	1	19.1	1	25.5
NDF	4	36.2	4.3	9	38.2	4.1	9	39.2	6.1	1	30.1	1	28.4
CP	4	15.7	1.8	9	12.4	1.4	9	14.2	3.6	1	21.6	1	19.2
TDN	4	65.3	1.0	9	65.6	1.3	9	63.0	1.9	1	66.0	1	65.0
NEL	4	0.69	0.02	9	0.69	0.03	9	0.66	0.04	1	0.71	1	0.71
Ash	4	7.15	0.54	9	5.93	0.74	1	6.57		1	8.77	1	9.45
Ca	4	1.29	0.16	9	1.12	0.17	9	1.21	0.32	1	1.60	1	1.71
K	4	1.69	0.13	9	1.39	0.12	9	1.27	0.18	1	1.99	1	2.03
Mg	4	0.26	0.01	9	0.23	0.03	9	0.22	0.03	1	0.28	1	0.43
P	4	0.24	0.06	9	0.18	0.02	9	0.17	0.03	1	0.32	1	0.40
S	4	0.18	0.02	9	0.14	0.01	1	0.13		1	0.23	1	0.22
AUTUMN OLIVE													
ADF	1	33.2		3	34.4	2.7	1	31.2					
NDF	1	51.9		3	51.6	2.0	1	34.8					
CP	1	27.7		3	23.0	0.6	1	11.3					
TDN	1	63.0		3	62.7	3.2	1	64.0					
NEL	1	0.61		3	0.61	0.04	1	0.68					
Ash	1	5.54		2	4.16	0.57							
Ca	1	0.56		3	0.51	0.01	1	1.77					
K	1	1.57		3	1.27	0.13	1	1.23					
Mg	1	0.18		3	0.21	0.03	1	0.28					
P	1	0.22		3	0.16	0.01	1	0.15					
S	1	0.39		2	0.30	0.02							

ADF - acid detergent fiber

NDF - neutral detergent fiber

CP - crude protein

TDN - total digestible nutrients

NEL - net energy lactation

Ca – calcium

K – potassium

Mg - magnesium

P - phosphorus

S -sulfur

Table 2. Statistical differences in mean values for nutritive value components based on species, plant part, and interaction between species and plant part (* - significantly different at $P < 0.05$, n.s. - not significantly different).

Analysis	Species	Part	Species x Part interaction
ADF	n.s.	n.s.	n.s.
NDF	*	n.s.	n.s.
CP	*	*	*
TDN	*	n.s.	n.s.
NEL	*	n.s.	n.s.
Ash	*	*	n.s.
Ca	*	*	*
K	n.s.	*	n.s.
Mg	n.s.	*	*
P	n.s.	*	n.s.
S	*	*	n.s.

Table 3. Goat Nutritional Requirements adapted from NRC Nutrient Requirements of the Goat. 1981						
Body Wt lb	TDN lb	DE Mcal	CP oz	Ca oz	P oz	DMI lb
Maintenance plus medium activity (50% increase over maintenance hilly pastures)						
22	0.53	1.05	1.162	0.035	0.025	0.79
44	0.88	1.76	1.936	0.070	0.049	1.32
66	1.19	2.39	2.605	0.106	0.074	1.78
88	1.48	2.96	3.274	0.141	0.099	2.22
110	1.75	3.51	3.872	0.141	0.099	2.62
132	2.01	4.02	4.435	0.176	0.123	3.01
154	2.25	4.51	4.963	0.211	0.148	3.37
176	2.49	4.99	5.491	0.211	0.148	3.72
198	2.72	5.45	5.984	0.246	0.172	4.07
220	2.94	5.89	6.477	0.246	0.172	4.42
Additional requirement for late pregnancy (all size goats)						
	0.87	1.74	2.886	0.070	0.049	1.30
Additional requirement for weight gain (all size goats)						
50 g/day	0.22	0.44	0.493	0.035	0.025	0.33
100 g/day	0.44	0.88	0.986	0.035	0.025	0.66
150 g/day	0.66	1.32	1.478	0.070	0.049	0.99
Additional requirement for milk production (all size goats)						
% Fat						
2.5	0.73	1.47	2.08	0.070	0.049	
3.0	0.74	1.49	2.25	0.070	0.049	
3.5	0.75	1.51	2.39	0.070	0.049	
4.0	0.76	1.53	2.53	0.106	0.074	
4.5	0.77	1.55	2.71	0.106	0.074	
5.0	0.78	1.57	2.89	0.106	0.074	
5.5	0.79	1.59	3.03	0.106	0.074	
6.0	0.80	1.61	3.17	0.106	0.074	

Experiences of Project Participants and Implications for Expanding the Use of Sheep and Goats for Bio-control of Invasive Plants

INTRODUCTION

In-person interviews were conducted with 14 project participants during the summer of 2010. A set of interview questions was designed to assess participants' expectations going into the project, their activities during the three-year duration, assessment of its outcomes, experiences with agriculture more generally, and related social networks. The interviews were semi-structured. While a standard interview protocol was utilized, participants were free to elaborate on their experiences from their own perspectives. Interview length ranged from 30 minutes to two hours according to the level of detail they provided, with an average length of about one hour. Interviews were recorded and transcribed to capture the details of their responses. A copy of the interview protocol is attached, along with certification of approval by the Institutional Review Board at West Virginia University. This summary is organized as follows. First, background on the participants and their motivations for involvement in the project are described. Next, their target treatment areas and practices are described before presenting their assessment of the benefits and challenges of using goats or sheep as bio-control agents. Finally, the outreach implications of these findings are discussed.

THE PARTICIPANTS AND THEIR MOTIVATIONS FOR INVOLVEMENT

Participants varied in their degree of prior experience with agricultural activities. Six indicated that they had been involved with agriculture their whole lives (in some cases on and off), with the remainder ranging from five to 35 years. Three participants specifically noted that they had moved to their current locations from more urban locales. While only two identified farming as their primary occupation, 12 derived income from selling agricultural products (excluding the sheep or goats that they added). Seven had beef cattle or cow-calf operations of varying sizes, while others were involved solely with products such as eggs, produce, and various value-added products.

All but three participants had contact with either Extension Service or NRCS personnel before the start of the program. Their involvement ranged from having requested information about farming/ conservation practices, to participating in conservation assistance programs such as EQIP, to working with these agencies as part of their professional job responsibilities. Some heard about this program directly through these connections, while others read about it in the Market Bulletin or local newspaper.

When asked what interested them in the program, all but one participant stressed the potential benefits for controlling invasive weeds and/or brush. Species of concern included multiflora rose, autumn olive, barberry, Japanese knotweed, miscellaneous brambles, poison ivy, ironweed, goldenrod, and more. All but three of the participants had previously tried to control these species using a variety of mechanical methods (brush hogging, cutting, and pulling) and four had also used chemical methods. Participants saw sheep and goats as a way to reduce the

amount of time and physical labor required to control weeds and brush, reach areas that were inaccessible due to steep terrain or other factors, and/or avoid using herbicides that were seen as posing health and environmental risks:

“I’d do a little section at a time, and once I got it cleared, I’d say I was on top of it, but if you had two people, it would be a lot better – you run the tractor and somebody hooking up and pulling it out – I’ve had that done, I’ve hired some people to help me a couple different times, but it’s a lot easier with the goats – they can clean it.”

“You could keep it under control in the fields where you can get the tractor but on fence rows and stuff like that, no you couldn’t control it. That’s what we’ve got on the farm now. It’s in the fence rows and you just can’t get to it. But what I want to do with the goats, I’m going to bring this fence out so they can get into the fence row.”

“Well sometimes they grew so high I couldn’t even run over them, you know. Now I have the goats, it’s not a problem. The goats are really highly effective. And I don’t believe in all these herbicides, and all that. I mean, I believe they work, I just don’t want them on my property, that’s all.”

Ten of the 14 participants had additional interests in raising and marketing sheep or goats to diversify and stagger their income sources, though for some this remains a future goal. The one participant who did not identify weed/brush control as a reason for getting involved in the program had a unique situation in that he was interested in raising sheep and goats to supply meat for a Middle Eastern restaurant that he managed. Another unique situation involved a couple that was very involved in 4H and supplied kids and lambs for 4H projects.

The cost-share for temporary fencing was seen as a major draw of the program, with all participants identifying that as somewhat or very important. While all participants were highly complementary of the educational workshop and some even indicated they would have preferred more such workshops, most characterized it as a benefit of the program rather than as a reason for getting involved. As one put it, “I thought that was a necessity, but that isn’t what initially brought me to it.” The marketing pool was least important to their involvement, with only four participants among the interviewees. Although more had been interested in the pool than were able to participate, they characterized it in a similar manner as the educational workshop – as more as a benefit than a primary draw of the program.

Were the participants early adopters in general? When asked, “Other than using goats or sheep for brush control, have you adopted any other practices that are not widely used?” eight participants identified such practices.² The most commonly-mentioned were using rotational grazing practices and producing herbicide and pesticide-free products. Despite their willingness to try new things, most did not go into the program “cold turkey” in the sense that they knew someone personally or knew of someone with experience raising sheep or goats (a few had

² This question was phrased in this way in an attempt to avoid the social desirability bias implicit in directly asking participants whether or not they characterize themselves as innovators. It cannot be concluded that the six participants who did not identify any other practices are necessarily less innovative, as they may have different perceptions of rare and common practices.

experience of their own). Though these contact people had not necessarily used sheep or goats for the purpose of brush control, their experiences provided insights for participants. Further, five specifically indicated that they read information about using sheep and goats as bio-control agents prior to their involvement.

Eight participants indicated that they had heard negative information about sheep and goats before getting involved in the project. For example, the animals were characterized as hard to fence in and indiscriminating in what they eat. The participants largely dismissed this information as stereotypical, suggesting that the challenges they reflect could be managed:

“Well you get the typical stereotypes about goats that, you know, they're troublemakers, they won't stay in, that sort of stuff. There's some merit to that, but if you give them the management that they require, you can control that. Sheep, you know everybody has the same joke about sheep, they're looking for some place to go and die. But they're a lot more fun, really, than a cow, I think a sheep is. Because you can have a lot more interaction with them.”

“That would be one thing that discourages a lot of people is that they've tried goats with their typical cattle or horse or other type of animal fencing set-up, and they spend most of their time chasing them back from the neighbor's property or they never see them again. So that's something that's kind of discouraging to people and a barrier to entry into goats for brush control.”

In sum, while participants varied in terms of their experience with agriculture and level of interest in deriving income from their sheep and goats, they shared a willingness to experiment with these animals to cut down on their invasive weeds or brush. Most went into the program with some knowledge of the experiences of other people, though not necessarily of people who had used sheep and goats for weed and brush control purposes, and a sense that the negatives had been over-stated.

TREATMENT AREAS AND PRACTICES

Table 4 summarizes each participant's target species, acreage, and stocking. Some respondents reported their number of animals as a range over the three year period, as numbers varied year to year. Targeted areas for grazing ranged from two to 30 acres, for a total of 175-182 acres. Eleven of the 14 participants characterized the area as having 40% or more weed or brush cover. Once they added the sheep or goats, only four supplemented the treatment with additional cutting or mowing (not shown on table). Several took steps to make the brush more accessible to the animals, however, by cutting paths through heavy brush areas, snapping branches so they would hang down within reach of the animals, or laying planks to help them reach the tops of taller bushes.

Table 4. Target species, acreage, and stocking rates.

	Target weed/brush species	Estimated acres grazed	Initial weed/brush cover	Number of animals
1	Multiflora rose, autumn olive, barberry	3-5	About 40%	4-6 goats
2	Multiflora rose, autumn olive	3	10-40%	3-6 goats, 3-15 sheep
3	Multiflora rose, unidentified saplings	8	> 40%	12 goats (added sheep later)
4	No species of concern, aware of multiflora rose	15-20	> 40%	4 goats, 9 sheep
5	Multiflora rose, poison ivy	20+	> 40%	15-40 goats, 2 sheep
6	Ironweed primary concern, goldenrod secondary	30	> 40%	6 goats, 13 sheep
7	Multiflora rose, autumn olive	2	> 40%	12-13 goats
8	Multiflora rose	5	> 40%	12-15 goats, 3-4 sheep
9	Multiflora rose, autumn olive	15	> 40%	8-18 goats
10	Multiflora rose, autumn olive, Japanese knotweed	11	> 40%	13-20 goats, 29-70 sheep
11	Wingstem, ironweed, multiflora rose	20	About 10%	12-25 sheep
12	Unknown herbaceous species	4	> 40%	13-42 sheep
13	Multiflora rose, blackberries	9	> 40%	6-13 goats, had sheep from before
14	Multiflora rose, autumn olive	30	10-40%	12-60 goats

BENEFITS OF THE SHEEP AND GOATS

Every participant was very satisfied with the weed and brush control. Most observed at least a 50% reduction in weed and brush cover, and several observed a nearly full reduction:

“Cleaned them, cleaned them bare, you couldn’t even see through areas and now you can see through them. And after they left I was going to go ahead and pull or cut with the chain saw and keep cleaning up myself as they left it, but I’ve just been leaving it for them, when I come back you see a little more deterioration in the shrubs or whatever.”

“Left with a large enough number of animals per amount of acreage, you could over relatively short periods of time get a 90-100% reduction. Because we had, like we said, woods that you couldn’t walk through, but now we have nothing but the trees and the dead bushes of briars. You could walk through them and they had grass – it was actually just as clear as out in the pasture would be.”

“Well where they [multiflora rose] were, I don’t see any. It’s like 95%, I mean there may be some little ones, but...they’re super effective with multiflora rose.”

A couple people noted that the animals seemed to prefer multiflora rose over autumn olive, but that they ate on both species. There were no obvious differences in the success of participants who engaged in supplemental mowing/cutting and those who did not. Nearly all said that they had observed an increase in grass cover since the introduction of the animals. Other benefits noted included: Additional source of income, fertilizer/soil improvement, and even greater interest by neighbors and others who stopped (often with children) to see the animals.

The four interviewees who participated in the project’s marketing pool were very satisfied with the process and results. They noted that it was well organized, that they received much higher prices than they could in this area, and that the checks came very quickly. One in particular (who identified farming as his primary occupation) suggested a need for more sustained attention to developing cooperative marketing strategies. Those who did not participate in the pool either had not sold their animals or had sold elsewhere, including local livestock sales, 4H sales, and the Bulletin Board (for brush goats). A few indicated that they would have participated in the pool if the timing had better fit their situations.

CHALLENGES EXPERIENCED

Temporary fencing

Thirteen participants identified challenges with the temporary fencing. The most common complaint was that it was heavy and cumbersome to move around, particularly in areas of heavy brush, and difficult to insert the two-prong stakes in rocky soils. Most were satisfied with the fencing once it was installed, noting that it worked well as long as it was fully charged and the surrounding area cleared of weeds, but some found that small animals got tangled up in it. Some suggested that changes in fence design (especially single-prong stakes) and brand were

helpful in rocky areas, and one suggested that simply having additional panels would make it easier to contain the animals while moving the sections.

“If you're dragging it through the brush and everything, it doesn't work that easily. A friend of mine has...well you saw the Caterpillar up there, he went through the woods so that I could put it in, because I couldn't really...on any little tree limb or something sticking out, it would hang up. But once I got the fence put in, other than them getting caught in it, it was pretty good. Like I say, it's the younger ones versus the older ones that don't do so well with it.”

“It's awkward to move, and it's a nightmare to try and move this time of year with dry soil, getting the posts out and putting them back in. I usually wind up on my rear end, because I usually wind up tangled up in it. But it works, it works very well.”

“They're heavy, once you get start picking them up, your arms get a little tired by the end of it. But it would be so much easier if you had that extra panel, you could go do that on a day that you had a few extra hours and go set it up, it's real easy to lay it out there and go put it in the grass, especially after it rains. But when it's a drought, they're hard to get in the ground.”

The challenges of dealing with temporary fence were compounded among those participants who felt that they had insufficient permanent, perimeter fencing. They felt that with more permanent fencing in place, it would be easier to manage the temporary fencing as divisional fencing.

Animal health

Nine participants had challenges with parasites and other animal health problems. Although most did not specify the diseases, those who did mentioned meningeal worm (in goats), lymphadenitis (in goats), bottle jaw (in sheep), and fly strike (in sheep). Several characterized their losses as “normal” for sheep and goats:

“Goats are not a hardy animal, by no means. I found that out real quick. If a goat gets sick, you can pretty much say bye bye.”

“I learned that, it seems like sometimes with sheep it doesn't matter what you do, they've got their mind made up that they're gonna die!”

“You know, as my veterinarian says, goats are just four legs looking for a place to die. So I don't really know that it was anything unexpected, you know, any health problems.”

One experienced an early loss of 25 goats for which he never determined an explanation, but now has a stable herd. He and a few others mentioned that it was difficult to find sufficient veterinary expertise and other animal health resources and recommended that outreach providers focus on addressing that concern:

“There aren't too many vets that care anything about goats. You know, there weren't that many who would come out and even look at them. If you look at the

dollar amount of the animal and the price of the call, people say it's not worth it. That's where I think the research needs to go in if we're going to be raising goats.”
“In my opinion, that would be the biggest help, to have someone who was familiar with the day-to-day activities and these animals, and say, ‘This is what you are experiencing.’ I didn't know what bottle-jaw was until I lost one.”
“But I think probably some sort of an animal health website or at least the ability to call for some help on some of those issues because the average vet we have...they don't care about a sheep. They care about cows, calves, dogs...”

One even suggested that the university or another entity could broker healthy animals:

“People could bring them in, and then they could be vetted and kept there for a couple weeks to...until their lab work came back on different kinds of infections and stuff. And then the people who would be buying would know what they get ahead of time, they would know sort of what they would be paying, but probably a more reliable product than just going and getting them from different places.”

Another suggested that outreach providers explore cooperative arrangements for shearing sheep, a task which he found physically challenging but critical for animal health.

Predators

Several participants were aware of coyotes in their area, and two experienced sheep kills. One participant described a domestic dog attack. All attacks occurred outside the temporary fencing (i.e., among animals that got out). Participants were generally positive about the performance of the temporary fencing in terms of keeping out predators:

“I've never had a predator get through netting ever. If you keep a charge on it, it's wonderful for that. And we have coyotes, and we have bears, we have dogs.”
“The netting...I'm sure that netting is helping. I can't imagine a dog would want to mess with that stupid stuff. They'll jump over I'm sure, but if there's something easier for them to go after, they're going to go after that.”

Some participants noted that they used guardian dogs or donkeys, and they were positive about the experiences with these animals as well.

Changes in neighbor relations?

Participants were asked whether they experienced any change in neighbor relations, positive or negative, as a result of having sheep or goats. No one indicated that they had experienced any problems with neighbors. If their animals did get out, they either did not wander far or did not upset the neighbors. Some even said that having the sheep or goats has increased neighborly interaction as people stop by to look at them. As one put it, “The only thing I can say is that it would improve relations with our neighbors, because they love to come

down and bring their kids. You know, they bring their kids to come down and see the sheep and stuff.”

A couple of participants – despite noting that they haven’t experienced any problems with neighbors – did say that they felt more traditional cattle farmers joked about their activities. One bluntly said, “They make fun of us because we don’t have cattle.” Another said, “We continue to be the source entertainment for our neighbors.” It is unclear how much this reflects an enduring prejudice against sheep and goats and how much it reflects attitudes toward “city people” who move to the country, as these particular participants were.

DID BENEFITS OUTWEIGH CHALLENGES?

While only half of the participants indicated that the benefits of the sheep or goats outweighed the challenges, the other half believed that the benefits would eventually outweigh the challenges with some adjustments on their part. In particular, they noted the importance of expanding their fencing:

Respondent who is currently losing money because of having to purchase hay:

“To be totally honest, I'm neutral [on the benefit to cost question]. We're in it, we're probably going to be in it for a few more years, maybe as long as I live here, but I like it when it's on automatic pilot. And I'm not there yet, meaning you can tell, or you'll be able to tell, that these sheep have pretty much exhausted their food that they have access to, they've over-grazed. And I'm working to get this set up so I'll be able to rotate them. You know, open a gate, they go here, open another gate,... I'm not there yet. And I'm hoping when I get there that it will just become less of a burden. Now I'm going out and tossing hay and playing doctor and whatever.”

Respondent who found it physically challenging to move the temporary fencing:

“It was real good at first, it was real good. They [the goats] served their purpose. That's a real individualized question too, because what might have been a pain for us wouldn't necessarily be a pain for someone else. For us, it got to be more work than it was worth. But if we were a lot younger, and we were like really set up for it...if we had that back pasture all fenced in, if we had a fence around the rest of the way out there...”

Respondent who feels they don't have currently have enough time to devote to rotating their animals:

“We would like to rotate them every couple of weeks to keep the parasite control down. But it's a lot of work... I would like to continue if we can get the fencing so that all I have to do is open a gate.”

A couple of participants are adjusting their approach with goats in order to reduce the challenges. They are planning to or have already switched to using them strictly as brush goats:

“I think what I'll do with the goats is go to the market and buy a half a dozen of them and keep them a few months and take them back and get rid of them and not try to manage the goats other than just for some brush control for a short time. And I think in that regard, I think the goats would be a lot more rewarding.”

“To kind of adjust our purpose is not to like try and raise meat goats but just to let them eat the brush, it's cost us a ton less. They may have had a little grain for the couple weeks they were in the barn, because they kidded in April, they only had to be in the barn for about 2-3 weeks, which it's a lot less grain. And then there was all kinds of fresh brush and stuff for them to eat. So that worked out better.”

Twelve of the 14 interviewees still have their animals, and four of them plan to increase their sheep flocks. The two who no longer have sheep or goats said they simply do not have the time to devote to it right now, and one is also trying to eliminate disease after culling the herd. Both of them plan to get back into it in the future.

CONCLUSIONS AND OUTREACH IMPLICATIONS

Based on the experiences of participants, it is clear that sheep and goats are effective bio-control agents that reduced the time and effort required to control weeds and brush by other means. At the same time, they are not maintenance-free. Expanding the use of these animals will require alleviating challenges identified by participants and determining “target audiences” for outreach efforts aimed at engaging more landowners.

Alleviating challenges

Based on the interview results, the following actions warrant consideration:

1. Improve temporary fencing designs for rocky and hilly territory. Though participants noted that the two-prong stakes provided more stability, they were simply not suited for all kinds of terrain.
2. Promote the use of temporary fencing in complementary cost-share programs (for example, EQIP). Because the need for adequate fencing and the associated cost is a concern, ensuring coordination between programs with complementary objectives is critical.
3. Explore the most efficient and effective means to increase the availability of animal health resources. This may include building not only a stronger referral network of animal health experts, but also stronger networks of **peers** who have had experience raising sheep and goats. Although the participants in this program can contact each other, a more expansive peer network could be beneficial to both existing and prospective new users of sheep and goats. In considering forms that such a network or networks may take, it must be recognized

that sheep and goat owners are not a homogenous group. For example, those who are experienced in other forms of agriculture may not consider new farmers or those who use sheep or goats only for brush control as true “peers” when it comes to valuing their advice.

4. Explore the feasibility of “contract grazing” systems for those landowners who desire weed/brush control benefits but who would prefer not to deal with managing and marketing their sheep and goats. A question about the feasibility of such a system was incorporated in the interview schedule, but it was not asked consistently because it was originally designed to be asked only of those who did not plan to use sheep or goats again (i.e., whether they might consider it under a contract type of system). As it became clear that most were still using their sheep or goats, we began asking the question in a more general way that was not specific to each landowner’s situation. Some participants believed the concept had merit, but they had questions about the practicalities of outside management in the face of possible animal health and predator problems. The participant who was most enthusiastic about the concept suggested that fencing challenges and general negative information about goats were the largest barriers:

“I think there absolutely is [potential for contract grazing systems in West Virginia]. I know it happens in other parts of the country. Of course I think it's a little easier to stretch any type of fence on flat ground out West as opposed to our local terrain. But I drive by farms where you see guys year after year out there spraying, you know the same brush that I have been able to manage to eliminate with goats. So I think it's just getting rid of the stereotypes of the goats and of breaking over the barriers of how do I make my existing fence work for the goats as opposed to having to strip it all out and rebuild from scratch, because of the cost associated with it.”

5. Explore cooperative marketing possibilities for those landowners who wish to derive income from their sheep and goats. This would enable them to take advantage of better markets that may be inaccessible to them as individuals, increasing the benefits side of the equation and potentially alleviating financial challenges.

REACHING NEW AUDIENCES

The motivations of participants in this program suggested that there are two underlying bases of appeal for using sheep or goats. These include the prospect of controlling weeds and brush in a matter that reduces mechanical and chemical control efforts (and presents an alternative to herbicide use), and for some, the prospect of diversifying and staggering income sources. Using broad information dissemination strategies, outreach providers could appeal to these motivations while describing the benefits, challenges, and lessons learned through participants’ actual experiences. This would capture the attention of prospective users of sheep and goats and help them make more informed decisions.

Experiences could be publicized in a variety of outlets, including traditional agricultural channels and newsletters, organizations and publications related to “alternative agriculture,” and possibly recreation and wildlife outlets that capture the interest of a wider range of landowners.

Further, developing peer networks as previously described would provide a means for prospective sheep and goat users to connect directly with those who can provide experientially-based advice.

Such broad-based strategies might be combined with more targeted workshops and programs in areas with a sufficient critical mass of interest. For purposes of both efficiency and effectiveness, efforts should be made to capitalize on related landowner workshops when possible. For example, because invasive plants present concerns for forest management and wildlife management, attempts to put information and referral resources in the hands of people who attend these kinds of workshops (if not provide more active programming) might lead to greater interest and participation.

ECONOMIC ANALYSIS OF BRUSH CONTROL USING GOATS

To determine the cost-effectiveness of using goats to control brush, requires the investigator to choose the level of eradication and also to estimate the degree of cover the brush presents. For the sake of comparison it is assumed that if mechanical control were an option it would be used. It is also assumed that there is no option but animal eradication if the slope is too severe and the manager wants to use non-chemical means of brush control.

There are three points that have impact on the cost comparison of animal versus chemical brush control.

- The farmers in this study reported an initial brush cover of 40% with a stocking rate of 1.5 per head per acre or animal cost of \$85 which equals a per acre expense of \$131. The annual costs associated with feed, supplies, supplements, and medication totaled \$85 per head or per/acre cost was \$128.
- The capital expenses per head equaled \$23 or \$34 per acre.
- Annualizing the animal expense over 5 years and the equipment over a seven year life paints a different picture. The per acre cost of includes Animal cost of \$131 / 5 years or an annual cost of \$26 and a shelter and equipment expensed over 7 years equals \$34/7 or \$5.
- The data reveals \$6800 of livestock sold from the study that would equate to \$25 sales per head and \$38 per acre.

(Note: Labor was included in this part of the study)

Table 5. Summary of economic analysis based on expenses and revenue generated by all participants of a CIG project using goats to control brushes in Appalachian pastures.

	Number of Animals	Total Expenses	Cost per head	Cost per acre	Cost per year
Animals	267	\$23405	\$88	\$131	\$26
Feed/Supplies/Medical		\$22765	\$85.26	\$128	\$128
Capital Expenses		\$6028	\$23	\$34	\$5
Sales		\$6807	\$25	(\$38.34)	(\$38)
Annual cost per acre					\$121

To compare this with chemical control is difficult. It's logical to assume that the heavier the cover the more expensive it is to manage the brushes. It is also important to consider the impact of the slope of the land, as spraying requires more time. This variable can cause the application to be expensive as all application would be done on foot. Comparing to regional custom application rates, the baseline for level ground with machine is \$12.30 per acre.

Spraying from the ground invariably uses more material and could require 2-3 hours of labor; and at \$9 per hour, labor would cost up to \$27 per acre. There is also expense associated with a sprayer and most farmers would have to buy a sprayer that will be under-utilized because of small acres to treat. This suggests that spraying by hand with the high rate could cost \$73 per acre. This corresponds to West Virginia's NRCS agency cost shares at \$77 per acre to spray brush. Using a high rate of 4% of a commonly used herbicide formulation would cost \$46 per acre and a medium rate would require 2% or \$23 per acre. A West Virginia University field staff herbicide expert suggested a figure of \$25 per acre for herbicide, roughly \$25 for labor, and another \$25 for ATV expense which totals to \$75 per acre.

Overall, brush management using goats was calculated to be approximately \$50 higher per acre compared to chemical control. However, this does not take into consideration the need for repeat application in the case of unsatisfactory weed control or other environmental costs associated with use of herbicides.

The animal-side of the equation presents many variables too. Early work at West Virginia University studying goats for brush control suggested that goats could either be used to maximize brush control or they could be used to produce kids. The researchers suggested that there was no opportunity to do both. This study did not clarify the farmers' intention toward a brush or production preference. This is important, because if that were true, the brush goats would be depreciated thus increasing the cost of the brush control. In this scenario the operator would be denied the equity building or income opportunities associated with the does raising kids, although there was some off spring income. So it might be a worthwhile management point to consider a longer eradication period that would allow the does to reproduce. This dual use option would require a higher stocking rate or a longer time to eradicate brush. The husbandry skills of the manager are critical; goats are not miniature cows and they require a different set of management skills. It is important to keep in mind the potential impact of predation on these operations. Effective fencing and careful management, combined with a thorough understanding of predators will reduce losses.

Targeted Grazing with Small Ruminants in Appalachian Pastures³

USEFULNESS OF TARGETED GRAZING

Brushes such as multiflora rose and autumn olive may limit the productivity of pastures. Chemical and mechanical methods to control these weeds may not be feasible and effective in pastures located in undulating slopes such similar to the Appalachia. Alternatively, small ruminants such as goats and sheep can graze such pastures infested with brushes utilizing the biomass towards a marketable produce and opening up such areas with more desirable forage. The benefits of using small ruminants to manage woody invasive species in pasture systems have been documented. Apart from multiflora rose and autumn olive such small ruminants have been documented to graze woody species such as blackberry, buckbrush, cedar, locust, oak, persimmon, sassafras, sumac, winged elm, and forbs such as chicory, curly dock, greenbrier, honeysuckle, ironweed, kudzu, ox eye daisy, pigweed, sericea lespedeza, thistle, wild carrot, etc.

WHAT WAS DONE

This Integrated Pest Management (IPM) strategy was evaluated in 14 cooperator pastures in West Virginia 2007 to 2010. Personal interviews at the end of the evaluation period documented satisfactory progress in brush reduction up to 80% (?) and improved pasture productivity. Renovated pastures were able to produce better forage for cattle and horses with reduced brush load. Some participants were able to profitably market their produce to generate additional farm income. This method of brush control is feasible and reproducible by any farmer interested in a mixed-herd grazing system. In a different West Virginia study, goats reduced brush cover from 45% to 15% in one year while it took sheep three years to achieve the same results. In a study in North Carolina, multiflora roses were practically eliminated after four grazing seasons with 95 to 97% dead canes. Portable, solar-powered electric netting step-in fencing systems capable of containing the animals in the targeted grazing area of participating cooperators kept predators at bay. Such fences also allowed the cooperators to increase the browsing pressure selected areas with high brush pressure and eliminate these weeds quicker.

PLANNING

Prior to introduction of animals goals may be identified, which include, reduction of brushes or management, eradication, or maintaining sustainable levels. This would serve as a basis for number and species of animals that may be introduced into the pasture and the use of other control methods. An inventory of brushes and their densities in the pasture may be recorded prior to animal introduction. Such an inventory will help with determining stocking

³ Adapted from “Prescribed Grazing with Goats” – Conservation Practice Information Sheet (IS-MO528gg), NRCS Missouri, Dec. 2005, potentially to be developed to a National Standard

rates and formulating contingency plans should forage availability become limited. Removal of brushes may impact wild-life and should be taken into consideration while setting goals. If the targeted species is anew forage, the animals will have to be conditioned in order to consume the desired forage.

GRAZING REGIMES

In cases of high levels of brush infestation, it is recommended to cut the brushes down to the animal’s browsing height prior to introduction. Introduce animals in spring when brushes in the priority pasture have attained 2/3 leaf growth and defoliate the brushes 80% using sufficient number of animals. Then rotate animals through remaining pastures till brushes in the priority pasture grow back 50 to 75% full size before reintroduction. Repeat this process till the desired level of reduction has been achieved.

If two pastures with similar brush infestation levels, a 30-day rotation can be effective. Stock with adequate number of animals to achieve 2/3 defoliation in one month and rest the pasture for a month while rotating the animals to the second pasture during that period. Alternate the starting pasture each year.

Grazing alone may not eradicate a particular weed species but can reduce it to a manageable or economic level. Combining grazing with chemical and/or mechanical control methods can achieve better results. Overgrazing can reduce desirable plant cover and lead to soil erosion and spread of weed seeds, hence grazing management is critical for optimum results. If small ruminants prove to be an economically viable practice, the client may not want to eradicate the targeted plant.

STOCKING RATES

In West Virginia studies, a stocking rate of 5-10 animals per acre was deemed to be adequate in pastures with medium to high levels of brush infestation. Table 5 may serve as a general guide for stocking rates. The animals may be introduced into the area after the weeds have started to grow actively. Animals can be moved from one infested area to another when approximately 90% defoliation is achieved in the problem area.

Table 6. Stocking rates to be used as general guide for brush control using a mixed-herd of animals.*

Pasture Type	% Brush Canopy	Cows/A	Goats /A	Cows (+ Goats)/A
Excellent	<10%	1	6 to 8	1 (+ 1 to 2)
Brushy	10 to 40%	1	9 to 11	1 (+ 2 to 4)
Brush	>40%		8 to 12	0.5 (+ 6 to 8)
Eradication				
Sustainable	Maintaining 10 to		1 to 3	0.25 (+ 1 to 2)
Brush	40%			
Management				

*Based on Conservation Practice Information Sheet, NRCS Missouri, December 2005.

RECORD KEEPING

Routine monitoring will also help measure progress towards goals. This may include canopy counts, grazing records, JS-Agron-24, Pasture Condition and Trend Worksheet, or other measures that provide a trend analysis. If brushes are too tall, the goats may clear the understory providing access for mechanical control. Predators such as coyotes and dogs, internal parasites, and certain animal husbandry practices unique to small ruminants may have to be considered while adopting this strategy. Following FAMACHA protocols, use of antihelmentics, and rotational grazing practices can help manage internal parasites in small ruminants. Husbandry practices unique to small ruminants can be mastered with some training and experience. Allowing small ruminants to graze close to the ground is a means by which they pick up internal parasites. Therefore, maintenance of forbs and brushes at a threshold level may be a good strategy to prevent internal parasite problems in small ruminants.

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APPENDIX

Exhibit A. Press Release – Project Announcement

A New Cost-Share Project to Control Weeds in Pastures

West Virginia University Extension Service (WVU-ES) has received a grant from USDA-NRCS for a new cost-share project to control invasive woody and herbaceous weeds using sheep and goats. Thirty qualifying livestock producers from the Monongalia and Tygarts Valley Conservation Districts will be selected to participate in this three year pilot project.

If you are a livestock producer with problem weeds in your pastures such as multiflora rose, autumn olive, Japanese knotweed, Japanese stiltgrass, mile-a-minute, tall ironweed, along with many others, and you have limited access to these fields, this project may be perfect for you. Small ruminants such as goats and sheep are known to feed actively on most brushes and forbs that cattle stay away from. Incorporating goats and sheep into the traditional West Virginia cattle and horse farms offers an excellent opportunity for agricultural producers. The renovated pastures will produce better forage for cattle and horses and the reduced brush load will require less mechanical or chemical removal by the farmer (saving labor and fuel costs). In addition, the increasing demand for meat and other products may generate income for participants.

This project will provide a cost-share incentive. Each producer will be provided with fencing supplies valued at no more than \$1250.00. Matching funds are expected from the cooperator towards the purchase of animals and supplies. Technical assistance will be provided by WVU-ES in partnership with USDA-NRCS.

If you have had no prior experience with sheep and/or goats, no problem. This project is beginner-friendly. Producers who participate in the project can attend a free two-day workshop covering the basics of incorporating goats and/or sheep into a farm's grazing system. This workshop will discuss forages, carrying capacity, stocking rates, and brush ecology. Also covered will be watering systems, fencing needs, goat and sheep nutrition, herd health, predators, livestock guardians, and lamb and goat marketing strategies. The participants will also have the option of participating in the pilot project's marketing pool which will be facilitated towards the end of the second year of the project.

If you are interested in this project, you can sign-up at your local Natural Resources Conservation Service office until March 31, 2007. The following counties are in the above mentioned conservation districts: Marion, Monongalia, Taylor, Preston, Barbour, Tucker, Randolph, and Upshur. Existing sheep and goat producers are eligible to apply.

APPENDIX (Continued)

Exhibit B. Ranking Criteria to select eligible participants

Utilization and Management of Invasive Plants in Pastures Using Sheep and Goats

Ranking Criteria

1. Current Operation

Beef and/or horse	20
Sheep and/or Goat	0
Other (pasture poultry or swine)	5

2. Weed Density of most infested pasture field

Greater than 33%	30
20% to 33%	20
10% to 20%	10
5% to 10%	5
0% to 5%	2

3. Weed Composition of most infested pasture field (refer to table 1)

Invasive and Noxious Species (List 1)	10
Other Problem Weeds (List 2)	5
Other (Not Listed)	0

4. Species Suitability (How well does the animal species selected by producer to use match the problem weed species identified?)

Manage brush with goats	10
Manage forbs and/or grasses with sheep	10
Manage brush with sheep	1
Manage forbs and/or grasses with goats	2

5. Beginning Farmer

Farmers with less than 10 years of experience in agriculture	5
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TOTAL :

APPENDIX (Continued)

Exhibit C. Handout Explaining the Project

A New Conservation Project

UTILIZATION AND MANAGEMENT OF INVASIVE PLANTS IN PASTURES USING SHEEP AND GOATS

Frequently Asked Questions

What is the problem?

Invasive plants and other problem weeds limit the productivity of West Virginia pastures. Introduced species like multiflora rose, autumn olive, Japanese knotweed, Japanese stiltgrass, mile-a-minute, tall ironweed, etc., are commonly encountered in pastures. Difficulty for farm machinery to access weed-infested areas limits chemical control.

Is there a solution?

Small ruminants such as goats and sheep are known to feed actively on most brushes and forbs that cattle stay away from. Incorporating goats and sheep into the traditional West Virginia cattle and horse farms offers an excellent opportunity for agricultural producers.

What are the benefits of this strategy?

This Integrated Pest Management (IPM) strategy has not been studied in great depth in West Virginia pastures. Use of small ruminants as biocontrol agents will result in energy conversion, reduced pesticide use, and improved pasture productivity.

The renovated pastures will produce better forage for cattle and horses and the reduced brush load will require less mechanical or chemical removal by the farmer (saving labor and fuel costs). The increasing demand for meat and other products may generate additional income for growers.

What is being evaluated here?

The prescribed grazing section will evaluate and demonstrate the feasibility of three grazing regimes in pastures: (1) stocking of goats alone; (2) stocking of sheep alone; and (3) stocking of sheep and goats in combination.

How will this be accomplished?

The animals will be contained by mobile solar-powered electric netting that can be moved around easily. The size of area to be grazed each time will depend on weed pressure and topography. The animals will be introduced into the area after the weeds

have started to grow actively. Animals will be moved throughout the infested areas of the farm according to prescribed grazing methods.

Can I do it?

This prescribed grazing and pest management practice standard is feasible and reproducible by any farmer interested in a mixed-herd grazing system. The project will include an eight-county area within the Tygart Valley and Monongalia Soil Conservation Districts, located the in the highlands of West Virginia.

Is there a cost-share program?

This pilot project will provide a cost -share opportunity to 30 cooperators in the two soil conservation districts and will involve a collaborative effort by WVU Extension Service (WVU-ES) and U.S. Department of Agriculture - Natural Resources Conservation Service (USDA-NRCS). Each cooperator will be provided with fencing and supplies worth no more than \$1250. Matching funds are expected from the cooperator towards purchase of stocking animals and other supplies. WVU-ES will record invoices of purchases during the project period. Technical assistance will be provided primarily by WVU-ES in partnership with USDA-NRCS.

What if I had no prior experience?

This project is beginner-friendly. Producers who sign up for the project will attend a free two-day workshop covering the basics of incorporating goats and/or sheep into a farm's grazing system. This workshop will discuss forages, carrying capacity, stocking rates, and brush ecology. Also covered will be watering systems, fencing needs, goat and sheep nutrition, herd health, predators, livestock guardians, and lamb and goat marketing strategies.

How will I market the animals?

The cooperators will have the option of participating in the pilot project's marketing pool which will be facilitated towards the end of the second year of the project.

Who will qualify for this project?

The target cooperator group will be cattle and horse operations with grazing lands infested with invasive woody and herbaceous weeds, who have none or limited previous experience with goat and/or sheep production. A ranking system will be used to select cooperators with the greatest need for improved grazing management.

What is the duration for sign ups into this program?

Sign ups will commence on November 1st 2006 and will last through March 30th, 2007.

APPENDIX (Continued)

Exhibit D. Workshop Announcement

**West Virginia University Extension Service – Agriculture and
Natural Resources
and
The Davis College of Agriculture, Forestry, and Consumer Sciences
Announces a Two-Day Workshop**

**Integrating Sheep and Goats into Grazing Systems for Pasture Improvement and
Sustainability**

July 18 -19, 2007

Room 125 A&B NRCCE Building

Evansdale Campus, West Virginia University 26506-6108

DAY 1 (July 18, 2007)			
Introductory Topics			
Title	Duration	Instructor	Time
Registration	60 Min	-	8:00 -9:00
1) Conference Introduction, CIG Grant, Cont Invasive Plant Species	15 Min	Rakesh Chandran, WV	9:00 to 9:15
2) Keynote Speaker: Vegetation Management using Small Ruminants in North Carolina	60 Min	Jean-Marie Luginbuhl, NC State Univ.	9:15 to 10:15
3)Keynote Speaker: Vegetation Management Small Ruminants - WV Experience	45 Min	Bill Bryan, WVU	10:15 to 11:00
Break period	15 Min	-	11:00 to 11:15
4) Planning and Assistance from NRCS	15 Min	Jason Teets, Rick Heas NRCS	11:15 to 11:30
5) Panel Question Period:, Vegetation Management, CIG and CTA	45 Min	Above speakers, and Ed Rayburn, WVU	11:30 to 12:15
Lunch	60 Min	-	12:15 to 1:15
Small Ruminant Husbandry			
5) Introduction of Sheep and Goat Husbandry	15 Min	Paul Lewis, WVU	1:15 to 1:30
6) Goat 101	60 Min	Nicky Whitley, Univ. MD Eastern Sho	1:30 to 2:30
7) Sheep 101	60 Min	Brad Smith, WVU	2:30 to 3:30
Break	15 Min	-	3:30 to 3:45

8) Health Management	45 Min	Margaret Minch, WVU	3:45 to 4:30
9) Panel , Question Period, Husbandry Issues	30 Min	Above Speakers	4:30 to 5:00
DAY 2 (July 19, 2007)			
Production and Marketing			
10) Reproductive Management, Lambing and Kidding	45 Min	Keith Inskeep, WVU	9:00 – 9:45
12) Marketing Strategies: Direct, Market Po	30 Min	Tom McConnell, WVU	9:45 to 10:15
Break	15 Min	-	10:15 to 10:30
13) Contract Grazing	45 Min	An Peischel Tenn. State Univ./ Univ. Tenn.	10:30 to 11:15
14) Predator Management	45 Min	John Houban USDA/Wildlife Service	11:15 to 12:00
Lunch at Hort. Farm and Travel to Animal Science Farm via	60 Min	-	12:00 to 1:00
Hands-on Husbandry, Fencing, and Watering Systems			
14) Introduction of Animal Science Farm	15 Min	Paul Lewis	1:00 to 1:15
17) Fence Systems	60 Min	Bill Erwin, Kencove Fence Supply	1:15 to 2:15
18) Watering Systems, Soil Fertility	30 Min	Jason Teets, Joe Hattori NRCS; Tom Basden, WVU	2:15 to 2:45
19) Practical Husbandry, De-worming, Feet trimming, Injection Sites and Methods	1 hr 45 Min	Brad Smith, Margaret Minch, Sheryl Jarvis, WVU	2:45 to 4:30

For More information please contact:

Rakesh Chandran or Tom Basden

Extension Specialists

Ph (304) 293-6131 x 4210, 4225; Email: RSChandran@mail.wvu.edu; tom.basden@mail.wvu.edu

Registration fee \$45.00 / person.

Includes Meals, Breaks and a Small Ruminant Management Manual

Make checks payable to West Virginia University

Send payment or credit card information by 07/01/2007 to:

Becky Casteel

WVU PO Box6108

Agricultural Sciences Building

Morgantown, WV 26505-6108

Ph: (304) 293-6131 x 4231; e-mail: Becky.Casteel@mail.wvu.edu

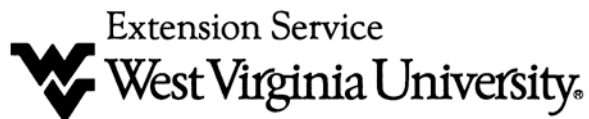
Mark Your Calender



Cooperative Extension Service
U.S. Department of Agriculture
PO Box 6031
Morgantown, WV 26506

APPENDIX (Continued)

Exhibit E. Workshop Evaluation



WORKSHOP EVALUATION

Integrating Sheep and Goats into Grazing Systems for Pasture Improvement and Sustainability July 18-19, 2007

Please evaluate the workshop by circling the number which best describes your response to each question.

	Low	1	2	3	4
5 High					
1. How useful was the information presented? 5		1	2	3	4
2. Will the information presented help you improve your skills as a livestock operator? 5		1	2	3	4
3. Were the presenters effective? 5		1	2	3	4
4. Relative to your needs, was the technical level of the information too high or too low? 5		1	2	3	4
5. What was your confidence level in husbandry practices prior to the workshop? 5		1	2	3	4
What is your confidence level in husbandry practices now? 5		1	2	3	4
6. What was your confidence level in vegetation management prior to the workshop? 5		1	2	3	4
What is your confidence level in vegetation management 5		1	2	3	4

	now?				
7.	What was your confidence level in marketing livestock 5 prior to the workshop?	1	2	3	4
	What is your confidence level in marketing livestock now? 5	1	2	3	4
8.	What was your confidence level in health management 5 prior to the workshop?	1	2	3	4
	What is your confidence level in health management now? 5	1	2	3	4
9.	What was your confidence level in utilizing 5 portable electric fencing prior to the workshop?	1	2	3	4
	What is your confidence level in utilizing 5 portable electric fencing now?	1	2	3	4
10.	What was your confidence level in creating 5 watering systems prior to the workshop?	1	2	3	4
	What is your confidence level in creating 5 watering systems now?	1	2	3	4
11.	What was your confidence level in predator management 5 prior to the workshop?	1	2	3	4
	What is your confidence level in predator management now? 5	1	2	3	4
12.	Did this workshop help you set brush management goals for your operation? 5	1	2	3	4
13.	Did this workshop help you set nutrient management goals for your operation? 5	1	2	3	4
14.	Did this workshop help you set improved forage goals? 5	1	2	3	4

15. Did this workshop help you set financial goals? 1 2 3 4
5

16. Is contract grazing one of your goals? 1 2 3 4
5

Additional Comments:

APPENDIX (Continued)

Exhibit F. Evaluation for Project Participants

Evaluation for Project Participants

1. Were you able to obtain the necessary fence materials?
2. Estimated number of weed infested pasture acreage:
3. How many of these acres would you like to see improved in two years?
4. Number of animals you plan to purchase for the project:
5. Current weed management practices (Please list):
6. Would you recommend this project to others?
7. Are you aware of any predator problems in your area?
8. Would you like to see NRCS adopt a practice which uses portable electric fencing to control targeted grazing animals?
9. Would you like to see NRCS adopt the use of temporary electric fencing as a cost-share practice for brush management in farm bill programs such as EQIP?
10. What topics would you like to learn more about?

RANK THE FOLLOWING TOPICS	Low	1	2	3	4	5
High						
Hands on husbandry		1	2	3	4	5
Lambing/kidding		1	2	3	4	5
Shearing		1	2	3	4	5
Extended grazing		1	2	3	4	5
Pasture lambing		1	2	3	4	5
Nutrient management		1	2	3	4	5
Weed Identification		1	2	3	4	5
Marketing		1	2	3	4	5
Other _____		1	2	3	4	5

11. Would you like the ability to contact speakers and other specialists via email with questions?
12. Your e-mail address:
13. May we share your email address with other project participants?

APPENDIX (Continued)

Exhibit G. Application for Participation

**Utilization and Management of Invasive Plants in Pastures Using
Sheep and Goats
Application for Participation**

- A. Landowner/Operator Name: _____
Phone# _____
- B. Address: _____

- C. Farm # _____ Tract # _____
County: _____
- D. When is the best time to reach you?

- E. Directions to Farm:
F. _____

- G. Current operation: type(s) and number(s) of animals:

- H. Total Pasture Acres: _____
- I. Estimated Percent of Pasture Acres Infested: _____
- J. I graze my animals on a (Circle one) continuous grazing / rotational grazing system.
- K. Are you currently a cooperator with the local Conservation District or willing to sign a District Cooperator Agreement?
__Yes__No
- L. Do you agree to have a Conservation Plan written by NRCS? __Yes__No
- M. Do you agree to work with WVU Extension? __Yes
__No
- N. Do you agree to a 5 year maintenance agreement? __Yes
__No
- O. Do you agree to attend the sheep and goat grazing workshop? __Yes
__No

P. Do you agree to participate in this project for 3 consecutive years?

Yes No

Q. Do you agree to share documentation/receipts for purchases made for

R. sheep/goats for economic analysis? Yes

No

S. Are you EQIP eligible? (to be determined by conservation planner) Yes No

T. If the answer is no for any of the above producer is not eligible

U.

V. Owner Signature

Date

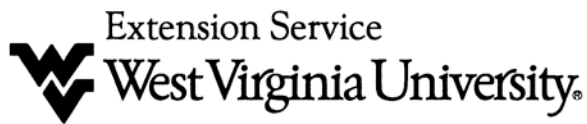
W. Operator Signature

Date

Programs and activities offered by the West Virginia University Extension Service are available for all persons without regard to race, color, sex, disability, religion, age, veteran status, political beliefs, sexual orientation, national origin, and marital or family status.

APPENDIX (Continued)

Exhibit H. Market Pool Questionnaire for Project Participants



**HOW DO YOU MARKET YOUR LAMBS AND/OR GOATS CURRENTLY,
AND WHAT ARE YOUR INTERESTS AND INTENTIONS FOR
MARKETING FUTURE ANIMALS?**

1) How many animals do you expect to market annually directly to the consumer?

- 1-5
- 6-10
- 11-20
- 21-30
- 31-50
- Over 50
- Not Applicable

2) Do you currently use a USDA inspected processing facility?

- Yes
- No

3) Do you currently use a Custom or WVDA processing facility?

- Yes
- No

4) If you use a processing facility for direct marketing, what is the name?

5) Circle the products that you raise?

- Sheep
- Goats

6) How do you currently market your animals? Rank from 1 to 11, 1 being the most common. Place a 0 to indicate non-applicable.

- _____ Local Livestock Auctions
- _____ Collection/Specialty Sales or Auctions
- _____ Livestock Dealers, Brokers and Meat Packers
- _____ Market Pooling
- _____ Cooperative Marketing
- _____ Wholesale or retail of butchered animals
- _____ On Farm Sales/Direct Sale to Consumers
- _____ Farmers Markets
- _____ Community Supported Agriculture (CSA)
- _____ Internet Sales of Livestock
- _____ Internet Sales of Meat

7) What marketing interests do you have for future sales? Rank from 1 to 11, 1 being the most desirable.

- _____ Local Livestock Auctions
- _____ Collection/Specialty Sales or Auctions
- _____ Livestock Dealers, Brokers and Meat Packers
- _____ Market Pooling
- _____ Cooperative Marketing
- _____ Wholesale or retail of butchered animals
- _____ On Farm Sales/Direct Sale to Consumers
- _____ Farmers Markets
- _____ Community Supported Agriculture (CSA)
- _____ Internet Sales of Livestock
- _____ Internet Sales of Meat

8) Topics of interest: Indicate your top three choices with 1's, next three with 2's, next three with 3's.

- _____ Cuts of meat/Taking orders
- _____ Pricing
- _____ Meat Preparation/Cooking Demonstrations
- _____ Recipe development for Value-Added Meat
- _____ Processing and Meat Quality
- _____ Meat Animal Breed Variations
- _____ Ethnic Slaughter
- _____ Finding customers
- _____ Labeling for retail sales
- _____ Rules/Regulations related to direct sales, farmers markets, CSAs
- _____ Liability/Insurance Needs
- _____ Choosing a Processing Facility

COMMENTS:

APPENDIX (Continued)

Exhibit I. Purchase Records Form

PURCHASE RECORDS July 2007- October 2008

ENTER actual (preferred) or estimated dollar amount for project related expenses and income for each of the following categories. Please endorse at bottom of form.

NAME: _____

Livestock Purchased \$

Livestock Sold \$

Medications/Veterinarian Expenses \$

Supplies \$

Equipment \$

Shelter \$

Supplements \$

Hay and Grain \$

Other : _____ \$

NOTES:

SIGNATURE OF PARTICIPANT

DATE

APPENDIX (Continued)

Exhibit J. Field Day Announcement &
Human Subjects Exemption Letter

PASTURE WALK AND DINNER

Highlights

- Q&A Small Ruminants with the Veterinarian - Margaret Minch
- Q&A Weed Management - Rakesh Chandran
- Bermudagrass/Forages - Ed Rayburn
- Targeted Grazing—Sigrid Teets
- Tractor Safety Demonstration
- Tygarts Valley Conservation District Update - Teresa Gerard
- New Cost-Share Opportunity for Cattle Farmers—Tom Basden

Date: Thursday

June 11, 2009

Time: 5:00

Directions: Approx. 4 miles west of Grafton on Rt. 50 (Pruntytown), past Toothman Ford on left. Look for signs.

Address: Rt 5 Box 345

RSVP: (304) 457-3026

Sam and Teresa Gerard are inviting you to join them for a pasture walk on their 72 acre cow/calf operation. A hayride tour of the farm will include stops to look at a biological control of multiflora rose site, portable fencing system, bermudagrass test plot, installed conservation practices, and veterinarian small ruminant Q&A session in the barn. Dinner made with local beef will be provided by the Tygart Valley Conservation District at 6:00PM.



Tygart Valley Conservation District

A Conservation Innovation Grant Activity funded by





Expedited-IRB Protocol-Exemption

To: Chandran, Rakesh
From: WVU Office of Research Compliance
Date: Wednesday, June 23, 2010
Subject: Exemption Acknowledgement

Tracking #: H-22528
Title: Evaluation of: Utilization and Management of Invasive Plants in Pastures Using Biocontrol Agents

The above-referenced study was reviewed by the West Virginia University Institutional Review Board (IRB) and was granted exemption in accordance with 45 CFR 46.101(2).

This protocol was reviewed using the following:

Exemption Checklist (210r)

This research study was granted an exemption because the Research involves educational tests, survey procedures, interview procedures or observation of public behavior and (i) information obtained is recorded in such a manner that human subjects cannot be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could not reasonably place the subjects at risk of criminal or civil liability or be damaging to the subjects' financial standing, employability, or reputation [45 CFR 46.101(2)].

The following documents have been acknowledged for use in this study and are available in the BRAAN system:

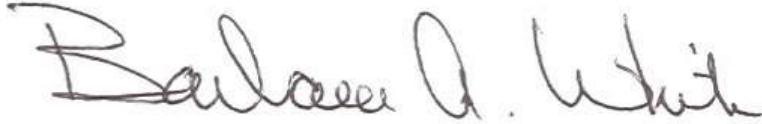
Surveys, Questionnaires, Interviews
Attachments
interview-questions.pdf

Miscellaneous Attachments
Attachments
information-form.pdf Introductory text to be read to participants prior to the

start of the interview.

recruitment-script.pdf Recruitment script to be read to potential participants when contacted by telephone.

Thank you.

A handwritten signature in black ink that reads "Barbara A. White". The signature is written in a cursive style with a large initial 'B' and a distinct 'A'.

Board Designee: White, Barbara

Letter Sent By: White, Barbara, 6/23/2010 2:21 PM

Once you begin your human subject research, the following regulations apply:

1. Any modifications to the study protocol must be reviewed and acknowledged by the IRB prior to implementation.
2. You may not use a modified form until it has been acknowledged by the IRB.