# GOATS IN THE WOODS - FINAL REPORT
# COVER PAGE

Project number: LNE01-148
Project title: Enhancing Meat Goat Production Through Controlled Woodland Browsing
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- Peter Smallidge, project leader and director, NY Extension Forester at Cornell University
- Dan Brown, co-project leader and co-director, Associate Professor at Cornell University
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- Jim Finley, co-project leader, PA Extension Forester
- Mike Jacobson, co-project leader, PA Extension Forester
- Colleen Parsons, herd manager (year 1 & 2)
- Mike Ashdown, herd manager (year 3)
- Matt Crumb, farm hand 2001
- Jessia Austin, farm hand 2002
- Kate Duyssen, farm hand 2003
- Jamie Wisniewski, undergraduate intern 2001
- Anne Pfeffer, undergraduate intern 2002
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**Off-Site Collaborators:**

- Cattaraugus County (2002, 2003): Charlie & Marian Mowatt, Joann Cockle, Elizabeth Cockle, Joann Kurtis, Don Wild
- Chemung County (2002): Chris Parsons, Jeff Jeneski, Mark Watts
- Schuyler County (2003): Jeff and Ann Gardner, Jim Ochterski
- Sullivan County (2002): Chris Tcimpidis, Paul Layton, Alix Dench-Layton, Joe Walsh
- Sullivan County (2003): Marc and Sue Jaffe, Joe Walsh, Jack Abrams, Kate Schmidt
- Tompkins County (2003): Bob Lieberman, Joern Seigies, Jim Ochterski

TOTAL BUDGET

| | SARE | Non-Federal | Federal |
|---|---|---|---|
| First Year | $30,143 | 18,877 | |

| | | | |
|---|---|---|---|
| Second Year | $44,056 | 27,535 | |
| Third Year | $45,861 | 28,090 | |
| Total Request | $120,061 | 74,502 | |

Project Duration: 3 years (5/01/01 – 12/31/03)

Overview: This 3-year project was initiated to determine how to enhance meat goat production while using the goats to control woody interfering plants in mature forests. Goats were placed in hardwood forests, with a well-developed understory of interfering woody species (i.e., American Beech and Striped Maple). During the 3 years, goats were sorted into Arnot goats (n=555) and off-site goats (n=180). Goat health and weight gain were good, control of vegetation varied by species and depended on animal age and the quality of the supplemental feed. With supplemental feed at 2% of body weight, juvenile goats can gain weight while consuming interfering vegetation, and weight gains that include post-woods compensatory gains are comparable to control animals. Preferences for plant species are reflected in varying degrees of control. When pressed, goats will strip bark from most species, but with appropriate protocols, bark stripping (i.e., girdling) can be controlled. Goats can be managed to emphasize girdling of: stripped maple, eastern hophornbeam, alternate-leaf dogwood, hemlock, red maple, and some diameters of American beech. Under most circumstances, goats will not girdle: sugar maple, red oak, black cheery, or aspen. The cost per acre for control of vegetation depends on the number of goats and how they are managed. Net costs (including labor) are comparable to herbicide treatment with a range of $100 to $150 per acre depending on the specific treatment the goat producers uses. Forest owners with small parcels (less than 10 acres of treatment per year) or those with a desire or need to minimize the use of herbicides should consider using goats for vegetation control. Goat producers with inadequate land and adequate time to manage off-site herds, or goat producers with mature herds and who seek added income, are the most likely prospects for providing goat control of vegetation. Goat producers can use goats in their own woods, without damaging the long-term health and sustainability of the forest by providing a daily supplement if forage quality is poor and with regular movements of the herd to portions of the forest with adequate forage.

Date of Report: February 2004 (final report for 2001 - 2003)

**FINAL REPORT**
**Enhancing Meat Goat Production Through Controlled Woodland Browsing**

## 1. SUMMARY

This project was initiated to determine how to enhance meat goat production while using the goats to control woody interfering plants in mature forests. Goats were placed in mature hardwood forests, with a well-developed understory of interfering woody species (i.e., American beech and striped maple). During the 3 years, procedures for handling goats were established at the Cornell University Arnot Teaching and Research Forest and trialed with 6 different off-site collaborators.

Goat health and weight gain were good. Control of vegetation varied by species and depended on animal age and the quality of the supplemental feed. Goats can gain weight if fed a daily supplement while consuming interfering vegetation, and weight gains that include post-woods compensatory gains are comparable to control animals.

Preferences for plant species are reflected in varying degrees of control. When pressed, goats will strip bark from most species, but with appropriate protocols, bark stripping (i.e., girdling) can be controlled to avoid damage to commercially valuable species. Goats can be managed to emphasize girdling of: striped maple, eastern hophornbeam, alternate-leaf dogwood, hemlock, red maple, and some diameters of American beech. Under most circumstances, goats will not girdle: sugar maple, red oak, black cheery, or aspen.

The cost per acre for control of vegetation depends on the number of goats and how they are managed. The cost for a goat producer to transport and manage goats in an off-farm woodlot, and thus the minimum fee that might be charged a landowner, are comparable to herbicide treatment with a range of $100 to $150 per acre depending on the specific treatment the goat producers uses. Forest owners with small parcels (less than 10 acres of treatment per year) or those with a desire or need to minimize the use of herbicides should consider using goats for vegetation control.

The tendency of goats to not damage sugar maple suggests the strong potential for goats to be used in controlling brush in sugar bushes. Goat producers with

inadequate land and adequate time to manage off-site herds, or goat producers with mature herds and who seek added income, are the most likely prospects for providing goat control of vegetation. Goat producers can use goats in their own woods, without damaging the long-term health and sustainability of the forest by providing a daily supplement if forage quality is poor and with regular movements of the herd to portions of the forest with adequate forage.

## 2. INTRODUCTION

Wisely controlled browsing of Northeast woodlands by goat herds could increase revenue and reduce costs to goat owners, decrease woody plant control costs to woodlot owners and reduce the forest area treated with herbicides. The goal of this project is to eliminate the last information and communication barriers to widespread adoption of wise browsing by Northeast goat and woodland stewards. This project uses a combination of university research facilities and on-farm collaborators to develop trial protocols, test those protocols, and share results with practitioners.

## 3. PERFORMANCE TARGETS

- The Cornell University Arnot Forest is serving research and extension needs with experiments that assess goat feeding systems and stocking rates in woodlands.
- Within the Twin Tiers region, seven "off site" teams of goat producers and woodlot owners collaborated through field-trial of management protocols and expanded the demonstration/extension capacity of the project during the second and third project years.
- Twin Tier goat producers, woodlot owners, foresters and county agents and agency personnel will visit a site and learn about woodland goat browsing with 10% initiating similar projects within a year of their visit.
- An economic analysis will consider the effectiveness of goats as a vegetation management tool relative to herbicide applications and for different levels of efficiency that correspond to various forest owner objectives.

## 4. MATERIALS AND METHODS

a) *Goat Acquisition* – To accommodate the large number of goats needed for the project, we solicited the purchase of goats from throughout south

central NY and north central PA. We used the CU small ruminant marketing listserve, Country Folks newspaper, and word of mouth via extension educators to alert producers to our needs. We purchased goats at local market value, typically $45 to $60 per head. Goats were purchased from approximately 40 – 50 different producers over the course of the project. This interaction permitted a "teachable moment" for both project goals and goat health more broadly.

b) *University research* – Cornell University's Arnot Teaching and Research Forest provided the home base for field research. The facility and project were registered and approved through the university's animal welfare protocol procedure. During each of the three years, 100 to 180 goats/year were maintained at the Arnot for use on the project. In year one and two goats were assigned randomly to treatment groups. In year three goats were assigned for homogeneity within a treatment group. The typical group included 20 goats, except in year 1. In years 1 and 2 all goats were less than 12 months old, typically 2 – 3 months at the beginning of the summer. Juvenile and adult animals were used in year 3. Treatments were factorial combinations. Year 1 included a comparison of 20 vs. 5 goats per group and daily supplement vs. rotational (woods and pasture) with duplicates of all four combinations. Year 2 treatments included normal vs. low protein in feed and normal vs. low fiber in feed, with one replicate group per treatment. Year 3 treatments included total mixed ration vs. home mixed ration (soy-corn dominated) for adults and juveniles on total mixed ration. In all cases the experiment response variables for goats was change in weight and for vegetation was the percent mortality in the sapling and seedling layer.

c) *Farmer collaborators* – On-farm collaborators were solicited through trade publications and especially through extension educators. Collaborators were part of a team that included goat (or livestock) producers, woodlot owners, and agency personnel. The team provided all on-site work. The project provided all materials and supplies and made 2 – 3 visits per month to inspect animals and evaluate activity. We solicited primarily private owners. Candidates completed an application. On-farm collaborators didn't conduct experiments, but rather field tested and reacted to our current best protocols. There were no collaborators solicited for year 1. In year 2 we had 3 collaborators. In year 3 we had 4 collaborators. All collaborators were in NY, although extensive effort was invested to find candidates in PA.

Applications were received from PA, but either the candidate didn't meet criteria or we could locate complementary team members. We continued to advertise extension activities through PA. All teams worked with project personnel to offer a field day in August or September.

## 5. MILESTONES

Consistent with our targets, we established off-site research & extension collaborators in the southern tier of NY. The collaborators field-trialed procedures developed at the Arnot Forest and hosted a field day for other goat producers and forest owners.

Seven locations and collaborative teams worked with the project and represented a range of forest owner objectives from mature forest to suburban "forest-scaping to vineyard reclamation. The teams consisted of a woodlot owner, a goat producer and an agency person. Agency representation included Cooperative Extension, Soil Water Conservation District, and RC & D. Our target included sites in Pennsylvania, but we could not locate combinations of producers and forest owners that met our criteria.

There was enthusiastic interest among people who contacted us about the project from outside the geographic range within which we could operate (e.g., Albany, NY, Pittsburg, PA) or we were unable to locate other team members in their vicinity. We selected locations with maximum geographic dispersion so we could optimize efficiency in field days and maintain logistical access in a day-trip for project management activities. Each team received a day-long training session, a "team workbook", 20 goats, all necessary equipment, and feed. The teams were instructed to follow the necessary health and safety protocols established, but to think creatively about how to refine the efficiency of the project in a "real world" setting.

## 6. OUTCOMES

Note – the outcomes presented here apply to the use of goats in mature hardwood forests, with the woody understory dominated by species such as American beech, striped maple, hophornbeam, and other species of low nutritional quality. The forage quality of shrubs and other species in higher-light conditions, such as recently abandoned agricultural fields, is better than in mature woods and may

affect the procedures necessary to achieve objectives for the goat herd and vegetation.

A) The project demonstrated that goats can be used effectively to control woody understory that has developed in the partial shade of mature hardwood forests. Effectiveness, used here as an integrated result, is defined by the maintenance of goat health, goat weight gains that are comparable to animals feed *ad libidum*, the mortality of significant numbers (40 – 95% depending on species) of undesirable saplings, and the lack of damage to stems > 4 inches in diameter of commercially valuable species. An unanticipated outcome was the selective avoidance of goats for bark of sugar maple trees, and thus the potential utility for goats in control of brush in the sugar bush of maple syrup producers.

B) Stocking rate – We evaluated stocking rates at 5 and 20 goats per $\frac{1}{4}$ acre paddock. Weight gains and sapling mortality were less at the lower stocking rate than the higher stocking rate. A herd of 20 goats had good effectiveness (weight gains and sapling mortality) and was logistically manageable. Higher stocking rates are possible and upper limits should be dictated by the ability of the herd manager to move goats in a timely fashion to avoid damage to desired tree species.

C) Feed supplement – the woody vegetation that develops in the partial shade of a mature, managed forest is usually dominated by species that remain because they are unpalatable to the large deer herds common in eastern forests. Thus, the dominate species are of poor nutritional quality even-though fresh weight biomass is often abundant. The maintenance of good goat health depends on a daily high-quality supplemental feed at approximately 2% of body weight for mature animals and 2.5 – 3% of body weight for animals less than 12 months of age. The supplemental feed can be a simple mixture of corn and soybean components or a total mixed ration. We found best growth when the ration included more than 16% crude protein and adequate levels of fiber and carbohydrates for energy.

D) Weight gains – Patterns of weight gain varied for juvenile and adult animals. Weight gains include the treatment period in the woods and a 4 to 6 week compensatory period in late August and September when goats

were on low-grade pasture with a daily supplement. Using a suitable daily supplement (see above), treatment juvenile weight gain was 84% of control juveniles or an average of 16.2 lbs treatment vs. 19.1 lbs control per animal. This pattern was comparable to year 1 but greater than in year 2. Weight gains among adults were 56% of control adults for the total mixed ration and 40% of controls for the home ration. For adults, the average weight gain per animal was 9.7 lbs on TMR pellets, 6.9 lbs on home-mix corn/soy and 17.4 lbs control. As noted below, weight gain differences were related to costs of feed for total mixed ration versus home ration. The weight gains reflect gains while the goats fed within mature forest (natural forage plus daily supplement) and also a compensatory period when goats were feed for up to 4 weeks in pasture with slightly higher rates of daily supplementation. Target weight gains for juveniles of 0.75 to 1.0 pounds per week seem to maintain goat health and permit the goats to respond favorable to a period of compensatory gain. Adult animals can lose small amounts of weight (up to 4 – 10% of body weight) while in the woods and readily recover the weight loss under compensatory feeding.

E) Sapling mortality – The mortality of woody understory, expressed as percent of original number of stems, varied considerably by species and by the procedures used to manage the herd. What most forest owners would consider as inadequate (less than 30% mortality of sapling numbers) occurred with low stocking rates of goats (5 per $\frac{1}{4}$ acre paddock) or with a daily supplement of feed having crude protein levels below 12%. The optimal sapling mortality occurs with mature goats receiving a total mixed supplement at 2% of body weight. This combination resulted in 90-100% mortality for striped maple, hemlock, and red maple and 50-90% mortality for hophornbeam and all but the smallest beech. Juvenile goats with a total mixed ration at 2.5% body weight provided the second best control of saplings with mortality levels of 100% for striped maple, 67% for red maple, and 25% for all but the smallest beech. Mature goats feed a simple home ration of corn and soy beans girdled (killed) 67% of hemlock, 57% of striped maple, and 38% of all but the smallest beech. In all treatments stems greater than 4 inches in diameter were not girdled. Also, there was no damage to sugar maple saplings at either the Arnot Forest or the one collaborator who had sugar

maple saplings in the paddocks. All seedlings, including sugar maple, are consumed by goats.

F) Management system- the management system used to work efficiently with goats in the woods is detailed extensively on the project web page at www.dnr.cornell.edu/ext/goatsinthewoods in a workbook. The web page includes a draft practitioner's manual that includes the "how-to" aspects of working with goats. As a synopsis, herds of approximately 20 goats were contained within an electronet fence charged by a battery powered fence charger. One to three 5 ft galvanized ground rods were used depending on soil moisture conditions. Paddocks for the project were ¼ acre though collaborators found 1 to 2 acre paddocks more time efficient. Goats were feed a daily supplement of 2-2.5% of body weight and provide fresh water. Fence lines were checked daily to assure integrity and charge. A minimum threshold of 3000 volts was used to evaluate sufficiency of electrical current to contain goats and exclude predators. There were no cases of predator problems during the three years of the project. Goats were moved to a new paddock when the overwhelming majority of green foliage was consumed. In an extremely dense understory, 20 adult goats would stay in a paddock for 3 to 4 days, while 20 juvenile goats would stay for 7 – 9 days. Every 7 to 10 days, at the time goats were moved, each animal was weighed by suspending it in a sling attached to a dial scale supported from a wooden tripod. The tripod had legs about 7 – 8' long and was portable in the woods.

G) Forest owner / maple producer profile – woodlot owners, regardless of their primary objective, were largely receptive to the use of goats once they knew that protocols existed to protect the health of the forest. Original assumptions that goats would be most useful for timber management objectives were relaxed and broadened given the interest expressed by prospective collaborators for using goats to improve visibility, restore brushy field, improve sugar bush access, and reclaim vineyards. Many forest and rural land owners saw goats as a preferred option to other cultural treatments such as hand clearing or herbicide applications. The land owner's primary barrier to adoption and use of this technology will be finding a goat producer willing to provide the service.

H) Goat producer profile – Most goat producers were interested in the project but skeptical of the financial details. Of the cooperators, the full time goat producers typically had significant difficulty arranging their schedules to provide time to tend the goats. Either the project goats weren't closely monitored resulting in damage to desired forest trees or the producer worked extra hours to allow for the added activities. Based on our observations and field day evaluations, there are two likely users of this technology from a livestock perspective. First, among participants at field days were several retired dairy farmers who missed livestock interactions. These people have sufficient knowledge of animal systems and business marketing that once trained on the unique traits of goat production could initiate entrepreneurial ventures. A subset of this group would be people with less livestock but more business interest who would need extra training in livestock husbandry. The second user are current goat producers, either full- or part-time. They should be cautious about over commitments if providing business services to woodlot owners, but will be able to use information this project developed regarding the management / production system. There is a high probability for adoption from this second group as most prospective collaborators were most interested in using their goats on their woodlot. Those producers / owners who provide vegetation management service to woodlot owners will especially want to study the details of their system relative to the assumptions set forth in the economic analysis.

I) Extension educators – both natural resource and livestock focused educators and agency personnel were supportive of this project. Their traditional audiences will view the project and its application from different perspectives. The livestock perspective emphasizes financial considerations, logistics, animal health, and subsequent marketing. The woodlot owner perspective will emphasize costs per acre, forest health, and efficiency of vegetation control.

## 7. ECONOMIC ANALYSIS

The prospect for goats as a profitable vegetation management tool is favorable under certain conditions. Goats can be viewed as one of several tools that a woodlot owner might select to control undesired vegetation. Of special comparison

is the potential role that goats play relative to herbicide applications. Commercial scale herbicide applications, for a relative context to the projections below, cost woodlot owners between $115 to $150 per acre on lots that are approximately 30 acres and larger. The actual charge to landowners will vary depending on may factors. Correctly applied herbicides can control better than 95% of the target vegetation. Relative to herbicides, goats have a less effective kill, greater logistical challenges, and slower application of treatment for large parcels. However, large parcels are a small subset of rural ownerships. Goats will find their greatest profit potential with audiences (i) who have parcels less than 75 acres and thus too small for a favorable economy of scale with herbicides or (ii) from woodlot owners, like maple producers or suburban owners, who wish to avoid herbicides for business or personal reasons.

The economic analysis for this project is based from the perspective of the cost per acre for a goat producer to provide a service to a woodlot owner. The profit potential for a goat producer would incorporate the cost per acre against the revenue per acre received for services, sale price of the animals, and reduction in costs that would be incurred on-farm. Significant changes in assumptions such as adult versus juvenile animals would affect subsequent sale and thus profits. Producers (described here as "service providers") should develop an enterprise budget that addresses their specific situation, but the following may provide some useful context.

The following sample economic analysis tables reflect the following assumptions:

- Fixed costs – include equipment such as an ATV, chain saw, fencing, battery, charger, ground rods, livestock panels, tarps, feed troughs, water buckets, and transportation of goats to the site. Averaged over a 5 year depreciation period, fixed costs were $1588 per summer.
- Variable costs – included feed at $0.15 / pound and hourly labor at minimum wage of $5.15. Total variable costs for the summer were $1154.
- Total costs = $2742 for 90 day activity
- Revenue - includes the sale of the goats and the service fee charged to the woodlot owner. Actual revenue depends on the scenario.

Summary tables of costs and revenues are provided below and a narrative description is provided here. With the above assumptions for a service provider using juvenile goats, treating 9 acres per season, with a selling price of $1.20 per

pound for an average goat of 58 pounds, the break-even point is reached when the landowner is charged $150 per acre. At the break even-point, all costs are covered. If the service fee charged the landowner increases to $200 per acre, the net revenue above costs is estimated at $451 for the season.

With the above assumptions for a service provider using mature goats, treating 20 acres per season, with a selling price of $1.20 per pound for an average goat of 100 pounds (but selling only 10 of 20 goats), the break-even point is reached when the landowner is charged between $75 and $100 per acre. At the break even-point, all costs are covered. If the service fee charged the landowner increases to $150 per acre, the net revenue above costs is estimated at $1,459 for the season. At a service fee of $200 per acre the net revenue above costs is estimate at $2,459

**Table 1. Summary of financial considerations for use of juvenile and adult goats in control of woody vegetation in mature hardwood forests.**

**Juvenile goats sold at average weight of 58 lbs and 5 year depreciation on fixed costs**

| Service Fee / Acre | # acres | Revenue from Service | Selling Price Per Pound | Selling Weight | Revenue from Animal Sale | Gross Profit | Costs / 5 years | Net Revenue |
|---|---|---|---|---|---|---|---|---|
| 50 | 9 | $450 | $1.20 | 58 | $1,392.00 | $1,842.00 | $2,741 | ($899) |
| 75 | 9 | $675 | $1.20 | 58 | $1,392.00 | $2,067.00 | $2,741 | ($674) |
| 100 | 9 | $900 | $1.20 | 58 | $1,392.00 | $2,292.00 | $2,741 | ($449) |
| 150 | 9 | $1,350 | $1.20 | 58 | $1,392.00 | $2,742.00 | $2,741 | $1 |
| 175 | 9 | $1,575 | $1.20 | 58 | $1,392.00 | $2,967.00 | $2,741 | $226 |
| 200 | 9 | $1,800 | $1.20 | 58 | $1,392.00 | $3,192.00 | $2,741 | $451 |
| 300 | 9 | $2,700 | $1.20 | 58 | $1,392.00 | $4,092.00 | $2,741 | $1,351 |

**20 Adults with half sold at average weight of 100 lbs.**

| Service Fee / Acre | # acres | Revenue from Service | Selling Price Per Pound | Selling Weight | Revenue from Animal Sale | Gross Profit | Costs / 5 years | Net Revenue |
|---|---|---|---|---|---|---|---|---|
| 50 | 20 | $1,000 | $1.20 | 100 | $1,200.00 | $2,200.00 | $2,741 | ($541) |
| 75 | 20 | $1,500 | $1.20 | 100 | $1,200.00 | $2,700.00 | $2,741 | ($41) |
| 100 | 20 | $2,000 | $1.20 | 100 | $1,200.00 | $3,200.00 | $2,741 | $459 |
| 150 | 20 | $3,000 | $1.20 | 100 | $1,200.00 | $4,200.00 | $2,741 | $1,459 |
| 175 | 20 | $3,500 | $1.20 | 100 | $1,200.00 | $4,700.00 | $2,741 | $1,959 |
| 200 | 20 | $4,000 | $1.20 | 100 | $1,200.00 | $5,200.00 | $2,741 | $2,459 |
| 300 | 20 | $6,000 | $1.20 | 100 | $1,200.00 | $7,200.00 | $2,741 | $4,459 |

Alternative economic situations – The analysis above is sensitive to the number of acres treated and the associated costs. For example, if the service provider uses

adult goats they perhaps all won't be sold. However with adult goats the service provider doubles the number of acres treated because adults move approximately twice as fast through the vegetation and have a higher level of efficiency. Also, from 2003 feed costs data, the home-mix was approximately one-half the price of the TMR pellet, a potential savings, but adults gained about 40% less weight and were about 40% less effective in controlling undesired woody stems.

A best recommendation from an economic perspective isn't strictly possible given the unique situation of each producer. However, the potential for enhanced profit would likely include elements of the following: herds that include a significant proportion of adults; careful measuring of feed to assure animal health without over feeding; and a marketing plan that targeted small woodlot owners or owners who couldn't or wouldn't be able to use herbicides.

## 8. PUBLICATIONS AND OUTREACH

Over the three years of the project the project gained significant publicity through state and regional publications. A major asset in publicity was the annual purchase of goats that required articles in trade journals. Oral presentations were given at numerous events, including more than a dozen field days, one national Tree Farm conference, during a field trip for the national conference of the Society of American Foresters, and for an assortment of state-level livestock and natural resource related events.

There are two primary publications that result from this project. One is the project web site that served initially as a repository of information about the project and its sponsors for those interested in being collaborators. The web site is now shifting in its role to focus on educational materials for people who are increasingly interested in how the project may serve their needs. The website URL is ~~**www.dnr.cornell.edu/ext/goatsinthewoods**~~ The web site includes an assortment of publications such as the "Are You a Candidate" fact sheet that helps goat producers and forest owners assess their potential to use goats. The site also links to the forestry extension web page and the small ruminant web page for added technical publications. The second primary publication of the project was developed to further assist in adoption of the technology. A workbook was developed for collaborator team members during 2002, refined in 2003 and is being revamped as a "practitioner's manual" currently. Copies of the 2003 Team and current draft of the Practitioner version are included with this report. The

final version of the manual will be formatted with pictures and diagrams to aid the user in assessing the potential for goats in the woods. The likely, but as yet uncommitted, producer of the manual is NRAES, the Cooperative Extension organization for "Natural Resources and Agricultural Engineering Services, based at Cornell University but serving the 12 NE states.

## 9. FARMER ADOPTION

Our primary tool to assess farmer adoption was through exit surveys collected following field days. These surveys were collected for most but not all field days. On one occasion we didn't have sufficient attendance to warrant a survey and on another occasion we forgot to hand the survey to the participants.

During the three years of the projects, we had approximately 433 adults and 100 university students attend formal field days that we delivered. Of the adults, approximately one-third were goat producers. Of the surveys that were returned about half of the respondents had livestock interests and the remainder had forestry or maple syrup interests. Approximately 10% of respondents with livestock interest indicated they might try something similar to the technologies we presented, with financial aspects being the most relevant question. Woodland owners had similar or slightly higher receptivity. A primary barrier will be further building the network of agency/educators who can connect goat producer service providers with woodlot or sugar bush owners. The web site and manual will aid in the resources that each group can draw from for assessing their potential interest.

## 10. AREAS NEEDING FURTHER STUDY

A) During the duration of the project we encountered people involved in various conservation efforts who sought tools that could be used to control invasive exotic plant species and native aggressive colonizing species such as dogwoods, honeysuckle, autumn olive, garlic mustard, and bayberry. Although we didn't specifically explore the use of goats in this capacity, anecdotal evidence from the exposure of goats to especially honeysuckle, dogwoods, and autumn olive suggest that goats could be highly effective. Other species, such as bayberry (Berberis spp.) were seemingly unpalatable to goats. Likely partners in goat control of invasive species include The Nature Conservancy, Natural Heritage Programs of state environmental agencies, US Fish and Wildlife Service, and land trusts.

B) As mentioned in section #9 above, the ability of woodlot owners / maple producers and goat producer service providers to connect remains imperfect. Once connected the relationships can develop fairly easily. This project has significantly raised awareness among Cooperative Extension personnel and complementary agency staff in SWCD and RC & D. Further the six teams (about 30 people) involved as research/extension collaborators provide a suite of peers that prospective users can contact for additional information. We anticipate that revisions to the web page, publication of the manual, and marketing of these resources to these public agency groups will provide them the capacity to further market the technology.