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Supporting Sustainable Management of Private Woodlands

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Low-Cost Fence Designs

– to Limit Deer Impacts in Woodlands and Sugarbushes

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The white-tailed deer (Odocoileus virginianus) can significantly influence the diversity, longevity and sustainability of rural woodlands, forests and maple syrup sugarbushes. As selective browsers (Figure 1), deer will eat some plants more readily than they eat other plants. Many of the tree species deer prefer to consume are valued by owners as sources of timber, maple syrup, or as food-producing trees for wildlife, such as oak and maple. Deer also eat many native wildflower and understory plants.

The effects of deer browsing on woodlands and sugarbushes can have long-lasting effects (called "legacy" effects) that persist for decades after deer impacts are reduced. In areas with a history of deer overabundance, the failure to establish and grow new, young trees is having a detrimental effect on woodlands and the potential to keep these areas healthy and diverse.

Under high deer impact, deer eat the plants that are used to assess if there is a problem. As deer impact increases, the evidence for deer impact decreases (Figure 2). To an untrained eye, a heavily browsed woods may appear, open, park-like and picturesque rather than degraded and impoverished. In woodlands, the evidence for the over-abundance of deer include one or more of these features:

- Park-like appearance in the woods (Figure 3)
- An understory dominated by invasive shrubs

Figure 1. Browse impact of deer on stump sprouts.

Figure 2. Small exclosures are simple and relatively inexpensive tools to assess the impacts that deer have on forest vegetation. By excluding deer, vegetation may be able to respond and illustrate the intensity of deer browsing. (Photo courtesy of Paul Curtis)

- An understory dominated by ferns (Figure 4)
- An understory dominated by non-palatable woody brush
- A browse line of the lower tree canopy
- Cropped or "Bonsai" tree seedlings (Figure 5)
- An absence or stunted wildflowers such as Trillium, Indian cucumber, or Jack-in-the-pulpit.

In most cases, recreational hunting is insufficient to control the impact that deer have on native vegetation. Depending on landscape pattern, deer population size, and food availability approximately 40% to 60% of a deer herd must die or be culled each year to stabilize the population. Reducing the population requires even greater mortality. As the hunter demographic becomes older and less effective, and land is less accessible for hunting, the management impact of recreational hunting is increasingly limited. In some cases recreational hunting may be able to help augment other deer management strategies and reduce the impacts of deer.

Figure 3. An open, park-like understory in this sugarbush is a combination of too much shade and too many deer.

Figure 4. Ferns often dominate in areas with high deer pressure, and can interfere with natural regeneration of desired trees.

Protection of isolated trees is possible with wire cages or tree tubes. Several tree tube designs are available (Figure 6). Tree tubes should be at least 5 ft tall and with ventilation ports to allow air circulation. Tree tubes need to be securely staked to the ground, and checked annually to ensure the tube is functional and the bottom in full contact with the soil (Figure 7). Tree cages made from 2" x 4" welded wire or poultry wire should be 5 ft tall and well staked. Some nut trees and conifers may do better in larger diameter cages than in tubes. Weed

Figure 5. Repeated deer browsing removes the buds and forces lateral buds to expand, resulting in a bonsai-like seedling with little prospect for desirable form.

Figure 6. Examples of four tube types, both cylindrical and flat designs, the latter being assembled into a cylinder. All are 5 ft tall. Not presence of air-ventilation holes to reduce accumulation of hot air.

Figure 7. A tree tube design illustrating ventilation holes to reduce accumulation of hot air.

Figure 8. Woven wire fence 8 ft tall and suspended on installed posts is a proven method of limiting deer access to forest regeneration. (photo courtesy of Dr. Gary Alt)

Figure 9. For large areas such as this regeneration cut, a fence is most cost effective, as shown on this 4 – 5 year old regeneration cut in Pennsylvania. With high deer pressure, the effectiveness of these fences can be dramatic. (photo courtesy of Dr. Gary Alt)

management around the tube or cage is necessary to improve seedling growth, and will limit habitat for rodents that might girdle the seedling.

For larger areas, fencing is a more efficient and cost-effective option than tubes or cages (Figure 8). Typical fencing designs include clearing an access trail, driving posts where needed, and the use of large machinery to transport 8 ft woven wire fence spools (Figure 9). Some newer designs use 8 ft plastic mesh fence that allows for the use of small and less expensive fence posts. No fence perfectly excludes deer, and all fences require inspection and some amount of maintenance. The most expensive fences, but most effective, are made of woven wire with driven fence posts. Installation costs are typically $2.50 to almost $4 or more per running foot.

Research by Cornell Cooperative Extension and Cornell University Department of Natural Resources staff is assessing the costs and efficacy of two fencing designs to prevent or limit deer impacts. The objective is to identify low cost options that adequately exclude deer until tree seedlings grow above the reach of deer. The two methods use either plastic mesh or high tensile wire as the fencing material. These designs are being tested in 0.5 to 2 acre areas that have been managed through thinning or harvesting to increase sunlight and accelerate the establishment and growth of woodland regeneration. In some cases, herbicides were used to control interfering understory plants (Figure 10). The fencing designs are also being tested in sugarbushes to protect young maples and promote regeneration and sugarbush sustainability.

As described below, the designs are affordable for private woodland owners, and continued research is evaluating the long-term effectiveness of the designs at excluding deer. Fences will need to be maintained until seedlings of desirable species are at least 5 feet tall. In the early years, vegetation inside the fence will look similar to vegetation outside the fence and offer little incentive for deer to test the fence. In later years, deer may recognize that the vegetation is actually "greener on the other side of the fence" and be more likely to challenge the fence.

The fence designs shown in this fact sheet are being tested using the AVID field monitoring protocol (www.AVIDdeer.com). After one growing season, seedlings inside the exclosures were significantly taller than seedlings outside the exclosure. If fences remain effective, then a significantly higher percentage of seedlings may grow beyond the susceptible browsing height in a shortened time frame. An appropriate number and height of seedlings is necessary to consider a woodland opening to have sufficient stocking, or seedling density. Depending on seedling height at the time of fencing, past deer pressure, soil quality, and amount of sunlight, seedlings may need 5 to 10 years of protection before they have grown beyond the typical height of deer browsing. This fact sheet will be updated as new data become available on the effectiveness of these fence designs.

The cost savings is through the use of low-value trees as living fence posts (Figure 11), and avoids the purchase and installation costs of fence posts. However, rather than attaching fencing directly to the tree, a batten strip made of pressure treated wood is attached to the tree with a nail and fender washer. At most one or two nails per tree are used. On fence corners the trees should be 7" – 8" dbh (diameter at breast height), but trees as small as 3" dbh will suffice on straight runs of the fence. As the tree grows it pushes against the batten strip, which pushes against the fender washer, which floats the nail (Figure 12). The design prevents the typical situation where the tree grows around the fence material. If after 5 to 10 years the seedlings may be at a safe height, and the fence can be removed.

Plastic Mesh Fencing

Plastic mesh fencing involves higher material costs but less time invested in labor for installation. Plastic mesh fencing is available on the Internet through numerous suppliers using a search for "poly mesh deer fence." Mesh size used in this project is approximately 2" x 2", but other sizes might be equally effective. Current designs started with a 10 ft x 330 ft roll of mesh fence on a cardboard spindle, cut in half with a chainsaw. The fence height was 5 ft (Figure13). Some vendors offer 7 ft fencing which is likely to be more effective at excluding deer by allowing for a lower apron at ground level and taller height, but with added costs of labor to install.

Materials

- Plastic mesh fence 5' to 7' high. Ten-foot long spools can be cut in half. Prices vary from $0.48 to $0.68/foot on the full-length spool.

Figure 10. Enclosed area treated with herbicides to control interfering vegetation.

Figure 11. Flagging on paper birch identified this tree as a "fence post" tree.

Figure 12. Batten strips can be custom fit as needed to tree shapes.

Figure 13. Plastic mesh fence with single wire strand and batten strip.

Figure 14. In-line tensioners used to tighten the 12 gauge wire.

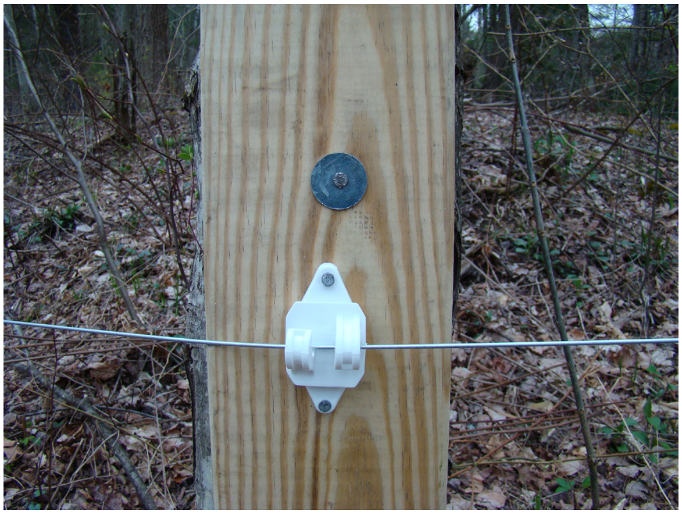

Figure 15. Pressure treated deck board (5/4 x 6) with fender washer, galvanized nail, and plastic clip for electric fence.

- 12 gauge high tensile wire, single strand
- Wire tensioner and splicing clips (Figure N)
- Batten strips of pressure treated lumber, approximately 10-inch pieces of 2x4 or 5/4 x 6 deck boards. One per tree.
- Plastic electric fence insulators (Figure O)
- Rust proof (e.g., galvanized) 3” to 3.5” nails
- Deck screws or galvanized joist hanger nails
- 1.25” to 1.5” fender washers
- Hog rings and hog ring pliers to secure mesh to wire
- Brightly colored synthetic baling twine

Plastic mesh fencing installation

1. Determine your perimeter and flag low-value trees to serve as living fence posts. Try to locate a tree every 40-50 feet (avoid spans greater than 60 feet). If possible, select trees to be on the “inside” of the fence. Avoid abrupt corners on the fence (Figure 16). Best results occur if trees are selected before any harvesting occurs, and those trees must be protected from damage or removal during the harvest.
2. To simplify access, clear significant brush from fence line. It may be less expensive to re-position the fence than to clear the brush.
3. Attach one plastic insulator to each 10” batten strip using deck screws or joist hanger nails. Pre-drill holes for fender washers and nails to limit splitting of the board. Attach batten strips to trees so that the insulator is approximately 54 to 58 inches above ground.
4. Thread 12 gauge wire through insulators, and tighten using wire tensioner and splicing clips.
5. Unroll and position fence to suspend from the wire.
6. Use hog rings on 18 – 24” intervals to attach the plastic mesh fence to the wire.
7. Gates are created by severing the fence vertically, and attaching an apron of fence that extends approximately 4 ft on either side of the opening.

8. If ground topography leaves gaps under fence, pile brush or slash to prevent deer from crawling under the fence. A continuous windrow of brush or slash on the outside edge of the fence will enhance the effectiveness of the fence, and obviate the need for baling twine in the next step.
9. Install baling twine approximately 30” offset from fence and 30” off ground. Height is important, but distance from fence can vary from 1 ft to 4 ft. Wrap twine around saplings, around wooden stakes, or use fiberglass rods with clips. (Figure 17)

The fence should be inspected two to three times per year, and after storms.

Figure 16. On abrupt corners, double batten boards may be necessary to protect the tree. Abrupt corners increase resistance when pulling wire around perimeter.

Total Cost: With labor estimated at $15/hour and materials the total project cost averages $0.59/running foot.

Figure 17. Baling twine attached around perimeter of fence.

A modification of this mesh design that is likely to be more effective includes the use of 7 ft mesh fence and an additional strand of wire approximately 12 inches off the ground. The vertical section of the fence is approximately 6 ft to 6.5 ft, allowing for an apron plus the low wire to restrict deer moving under the fence. The cost for materials would be marginally higher, but labor costs would be as much as double because of the extra effort to install another wire, handling a 7 ft vs. 5 ft spoon, and using a ladder to hog-ring the fence to the top wire. The 7ft and 5 ft designs have been co-located and will be compared for effectiveness through ongoing research.

High Tensile Fencing

High tensile fencing involves lower material costs but almost twice as much time and thus increased labor costs. It involves the use of standard 12 gauge high-tensile galvanized wire that is secured to trees that form the perimeter of the fenced area.

High tensile fencing materials

- 12 gauge high tensile galvanized wire: Available at farm stores for approximately $100 for 4,000 feet of wire, approximately $0.03 per foot
- 8 foot long pressure treated deck boards 1 ¼ inch thick x 5 ½ inch wide, or pressure treated 2x4s (approximately $3.67/board)
- Wire tensioners and splicing clips (and appropriate tools)
- Electric fence plastic insulators
- Deck screws or galvanized joist hanger nails
- Rust proof (e.g., galvanized) 3” to 3.5” nails
- 1.25” to 1.5” fender washers

Figure 18. Use of a deck board as a batten strip and 8 strands of high-tensile wire

High tensile fencing installation

1. Determine your perimeter and flag low-value trees to serve as living fence posts. Try to locate a tree every 40-50 feet (avoid spans greater than 60 feet). If possible, select trees to be on the “inside” of the fence. Avoid abrupt corners on the fence. Best results occur if trees are selected before any harvesting occurs, and those trees must be protected from damage or removal during the harvest.
2. To simplify access, clear significant brush from fence line. It may be less expensive to re-position the fence than to clear the brush.
3. Attach plastic insulator to batten strips using deck screws or joist hanger nails. Attach insulators from bottom of batten at approximately 10”, 20”, 30”, 40”, 54”, 68”, 82”, and 96”. (Figure 18)
4. Position batten strips at selected trees. Before nailing board to tree, thread the top wire in the uppermost insulator of each board.
5. Attach batten strip with a nail and fender washer near ground line and one additional nail and washer at any location along the batten that will secure the board.
6. Thread 12 gauge wire through insulators, and tighten using wire tensioner and splicing clips. Thread and tighten one wire at a time to avoid intertwining wires. Tightening the wire helps secure the boards to the tree.
7. If ground topography leaves gaps under fence, pile brush or slash to prevent deer from crawling under the fence. A continuous windrow of brush or slash on the outside edge of the fence will enhance the effectiveness of the fence, and obviate the need for baling twine in step #9.
8. Use trees that are sufficient in diameter and firmness at angled points in the fence because they will be under significant side strain. Figure 16)
9. Install baling twine approximately 30” offset from fence and 30” off ground. Height is important, but distance from fence can vary from 1 ft to 4 ft. Wrap twine around saplings, around wooden stakes, or use fiberglass rods with clips. (Figure 17)

The fence should be inspected two to three times per year, and after storms.

Total Cost: With labor estimated at $15/hour and materials the total project cost average was $0.51/running foot.

For additional information on woodland management go to:
www.ForestConnect.com

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