Factors Limiting Early Development of Riparian Hardwood Plantings In Page, Shenandoah, Warren and Rockingham Counties In Virginia (2010-2013)

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Contents

Abstract

The Virginia Department of Forestry (VDOF) is in partnership with the Farm Service Agency (FSA) and Natural Resources Conservation Service (NRCS) to provide plans for riparian planting done through the Conservation Reserve Enhancement Program (CREP). The plans local foresters provide include species selection and seedling placement to be sure the right tree is planted in association with the soils, aspect, soil moisture and slope of the site. The foresters also follow up with an inspection of the new riparian planting and a repeat inspection in two to three years after planting to ensure it is successful. A minimum seedling survival rate of 60 percent is expected for assurance that a future sustainable forest buffer has been established. All information regarding both inspections (one and two) are recorded on standard agency forms, Form 83 and Form 84, respectively. Although the inspection of the riparian plantings is being performed, unless replanting is required, the information collected is just filed.

A monitoring project has been undertaken to compile the information on the Form 84 sheets collected by foresters in select counties. The value in this project is to use the information on the forms to check on how the riparian plantings are developing after two to three years. The compiled data can also be used to improve maintenance of the plantings. The information recorded on the Form 84s underscores the influence of natural impacts and the effect maintenance can have on the success of planting.

Form 84s from Page, Warren, Rockingham and Shenandoah counties are utilized in this project. There are 42 forms reviewed and 30 trees inspected for each form. A summary of the findings provides the following information:

- **Survival** – 920 of 1,180 seedlings inspected survived through the second inspection period.
- **Average Survival** – 70 to 90 percent on the 42 sites is the average survival; only six of the 42 sites have less than the 60 percent minimal survival requirement.
- **Detrimental Influences** – Two sites with unacceptable survival rates of 20 percent and 24 percent have severe vole infestations. Although deer damage was noted at all but one of the 42 sites, deer damage alone was not severely detrimental to seedling survival levels. However, a combination of deer damage and the presence of invasive plant species resulted in below minimum survival levels at five sites. A site with fescue as the only influencing factor has a low 43 percent survival rate.
- **Positive Influences** – Sites with mowing and/or spraying to control vegetative competition have average survival rates of 80.5 percent. This is 10 percentage points higher than survival at sites without vegetative control.

The most significant take away message resulting from the compilation of the Form 84 data is the need for site management before and after planting. Planting seedlings in a field covered in fescue turf results in poor seedling survival. The presence of a heavy vole population severely reduces seedling survival rates. Also, if a site has one or more of the negative influences cited in the Form 84 data, it is recommended to delay planting until that influence can be eliminated through site preparation or wildlife management. The Form 84s filled out by local foresters have a wealth of information that can guide future riparian planting projects.

Introduction

There are thousands of hardwood seedlings planted in the Commonwealth of Virginia every year. The planting is primarily done by contracted planting crews, some by non-profit groups and also by private landowners. The cost incurred for the planting is the responsibility of the landowner, many of whom are enrolled in federal cost-share programs that will help defray the planting expense. The bigger picture is the relationship of planting of trees in riparian zones to water quality. The multiple benefits of having forest cover in a riparian zone encompass stream health, water quality, recreational activities, wildlife habitat on land and in the water, soil stabilization, streamside shade, and improved air quality just to name a few. The values realized are dependent on the success of the project.

A large amount of riparian planting is done with the support of the Conservation Reserve Enhancement Program administered by the Farm Services Agency (FSA) and the Natural Resources Conservation Service (NRCS). The Virginia Department of Forestry (VDOF) is in partnership with FSA and NRCS to provide a plan, species selection and the inspection of the riparian plantings to ensure that the planting is done properly. A further assurance that the planting is successful is an inspection after one to three years by a local VDOF forester to check

that there is at least 60 percent seedling survival. With 60 percent survival, it is expected that a future sustainable forest has been established.

Although the inspection of the riparian plantings is being performed, unless a replanting is required, the information collected is just filed. A monitoring project has been undertaken to compile the information on the Form 84 sheets collected by foresters in select counties. The value in this project is to use the information on the forms to check on how the riparian plantings are developing after two to three years. The compiled data can also be used to improve maintenance of the plantings.

Form 84s from Page, Warren, Rockingham and Shenandoah counties are utilized in this monitoring project. These four counties are within the Potomac/Shenandoah watershed and connected to the Chesapeake Bay watershed through the Potomac River. The information recorded on the Form 84s underscores the influence of natural impacts and the effect maintenance or lack of maintenance can have on the success of the planting. The findings of this project are presented in the order that the information is collected on the Form 84. There were 42 forms reviewed and 30 trees inspected for each form. The majority of the sites reviewed are in Rockingham County (20) with the next largest share coming from Shenandoah County (16). The remaining six sites are divided between Warren and Page counties.

In the decision-making process for riparian plantings, particularly Conservation Reserve Enhancement Program cost-share projects, the role of a forester is to help plan the planting. The selection of species falls within the forester's role. Field conditions are considered at each site -- the aspect of the land, the topography, current land use, soil moisture, proximity to water, as well as potential wildlife issues, presence of invasive species, and other site characteristics that will influence the success of the planting project.

For the 42 sites considered in this Form 84 summary, there were 28 different species inventoried. Some sites had as many as 14 different species and others as few as two. More species may have been planted but did not survive and thus cannot be included in this report. The list of species surviving at the 42 sites is available in **Table 1**. The total number of each species used over all the sites is also presented in the same table. Both bottomland species and upland species are included in the list. Bottomland species are best suited for low areas where the water table is closer to the surface, and also where the stream overflows into the floodplain. When planted in soil with a high moisture content (bottomland), the soil pores are filled with water leaving less room for oxygen around the roots. Riparian species will survive under these conditions because they have the ability to survive with less oxygen in the root zone than most upland trees require. The upland species are best suited for areas of the site with a slightly higher elevation, such as the upper edge of the floodplain or on the side of a slope. Sometimes when a seedling is planted in a less than ideal location, the seedling will acclimate and survive. However, a poorly located seedling may not reach its potential in terms of height, seed/fruit production, and it may have a shorter life span. The right tree in the right location is key to the success of riparian projects.

Results

Survival

The success of the riparian plantings is immediately evident when, out of 1,180 trees inspected, 260 were dead and 920 survived (81 percent). Just looking at the average survival is somewhat misleading because on an individual project level survival is in a range of 20 percent to 100 percent. There were two sites that were extremely low – 20 and 24 percent. The specific reasons for these very low survival rates will be discussed later in this report. Survival at a majority of the sites was in a range of 70 percent to 90 percent. Overall survival on a site basis is presented in **Figures 1 and 2**.

Table 1. List of species recorded on Form 84s from the 42 sites with a designation of normal site preference. The number of surviving seedlings of each species is also included here.

Species (Common name)	Number Surviving	Bottomland/Upland
Bald Cypress	18	Bottomland
River Birch	8	Bottomland
Common Apple	13	Upland
Persimmon	24	Bottomland
Black Oak	41	Upland
White Oak	92	Upland
Black Gum	19	Bottomland
Hickory	6	Upland
Chestnut Oak	92	Bottomland/Upland
Northern Red Oak	216	Upland
Ash sp.	38	Bottomland
Hazelnut	15	Bottomland/Upland
Hackberry	3	Bottomland
Red Maple	30	Bottomland
Dogwood sp.	25	Bottomland/Upland
Willow Oak	18	Bottomland/Upland
Black Walnut	20	Bottomland/Upland
Pin Oak	26	Bottomland
Yellow Poplar	20	Upland
Southern Red Oak	12	Upland
Sassafras	7	Upland
Eastern White Pine	2	Upland
Red Bud	7	Bottomland/Upland
Black Cherry	4	Bottomland/Upland
Saw Tooth Oak	34	Upland
Bur Oak	7	Upland
Unidentified species	24	

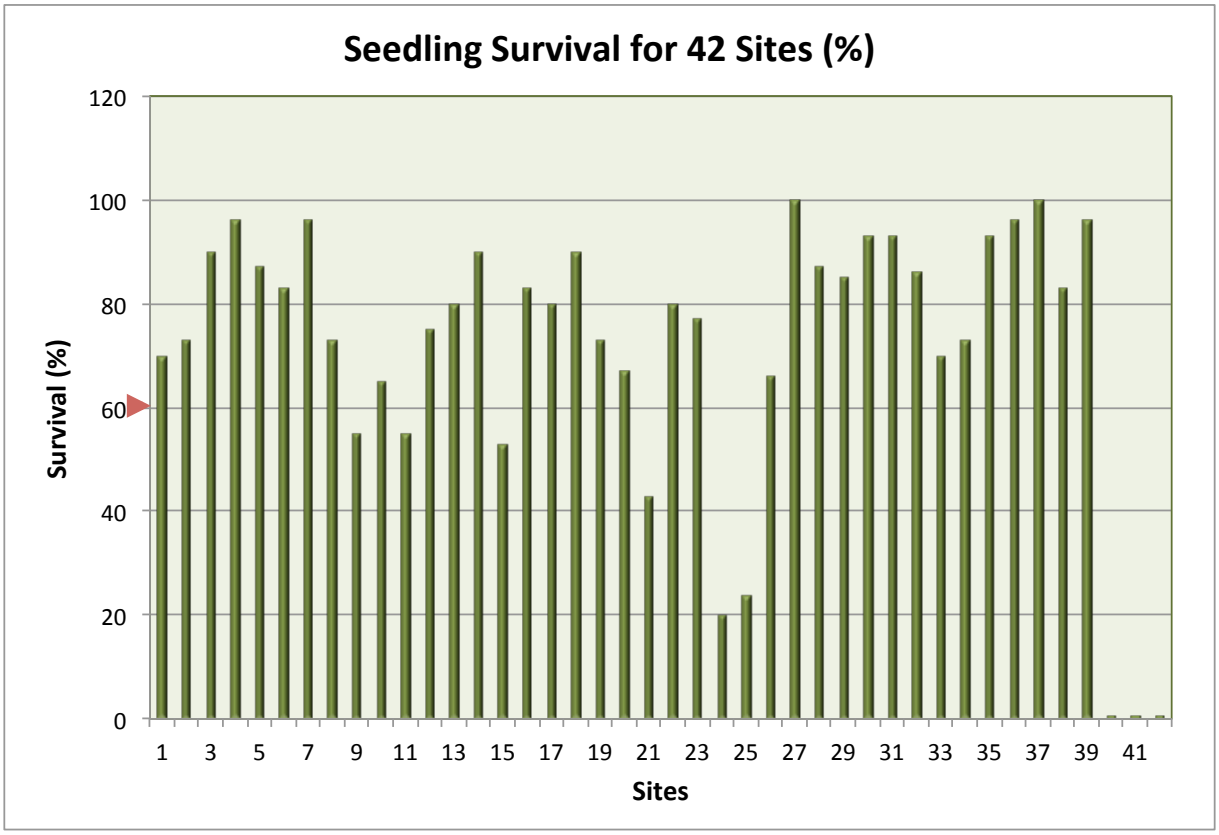

Figure 1. Percent survival for each of 42 sites. Arrow indicates required level of survival.

Percent Survival	Number of Sites in Percentile Range											
	1	2	3	4	5	6	7	8	9	10	11	12
20	▲	▲										
30												
40	▲											
50	▲	▲	▲									
60	▲	▲	▲									
70	▲	▲	▲	▲	▲	▲	▲	▲				
80	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲
90	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	
100	▲	▲										

Figure 2. Display of seedling survival percentile ranges and number of sites in each range.

Invasive Plant Species

Farmers have been battling weeds in their crops for centuries. Although most weeds are just a plant out of its expected location, invasive weeds present a different situation. By definition, an

invasive weed is an introduced species, with aggressive tendencies and has no natural enemies to keep its growth and spread in check. Invasive weeds are as detrimental to a young tree planting as they are to any other newly planted crop. Some invasive species have been introduced and used for erosion control, as ground covers, as forage material or garden plants. Kudzu, crown vetch, multiflora rose, Johnson grass and purple loosestrife are some of many that fall into these categories. Fescue is commonly used as a pasture grass and in lawns. It is a special category of invasive that has what is termed an allelopathic characteristic. This means it releases a chemical into the soil that inhibits growth of many native species. Because of this tendency, it is able to colonize areas quickly without competition from other plants. This is the case for many planting sites that are taking place on old pastures and fields. The fescue removes soil moisture and minerals from the soil leaving poor soil and water conditions for young seedlings.

Many of the sites reviewed on the Form 84s list heavy fescue as a problem. If a planting site does not receive site prep, such as mowing, herbicide application, disking or scalping, the young seedlings start out in disadvantaged conditions. Out of the 42 sites reviewed, 20 had invasive species. Fescue was by far the most often mentioned invasive. There were 11 other invasive plants listed on the forms. **Table 2** has a list of the invasive plants spread over the sites reviewed and the rate of occurrence.

Table 2. Invasive species and number of sites represented as impacted.

Species (Common names)	Number of Sites Where the Species Occurred								
Fescue	-	-	-	-	-	-	-	-	8
Japanese Honeysuckle	-	-	-	-					4
Canada thistle	-	-	-	-					4
Tree of heaven	-	-	-						3
Multiflora rose	-	-							2
Autumn olive	-								1
Burrdock	-								1
Crown vetch	-								1
Horse nettle	-								1
Japanese Stilt Grass	-								1
Orchard grass	-								1
Privet	-								1
Total 12 species	Multiple species at some sites, none at others.								20 sites

Wildlife Damage

As the edges of towns and suburbs sprawl out closer to active agriculture and forest areas, the amount of wildlife habitat is shrinking. Corridors between suitable habitats are becoming more fragmented isolating wildlife populations into small islands of habitat. To find food, the wildlife are venturing into croplands and yards. This issue will not be discussed in depth in this report. It is necessary, however, to discuss the impacts changing land uses and wildlife are having on newly planted tree seedlings.

Deer really are a major factor in the survival and health of riparian plantings. In the Form 84 reviews, 80 percent of the tracts (34 out of 42) had deer browse issues. We did not have seedling

heights at the time of planting, so there is no way to compare growth progress. The seedlings are described as undersized for their age, with browsing confining the height of the seedlings to the height of the tree shelter in which they are contained (primarily four feet). This type of browsing pressure can weaken the seedlings so much that they die or their branching structure is very poor in the future. Sites with more sycamore, sawtooth oak and other species not preferred by deer have fewer issues with browsing.

Another wildlife pest that has done damage to new riparian plantings is the vole. Only three sites were reported to have vole damage. However, the sites that had this issue were considerably damaged. At one site, 26 percent of the seedlings were damaged, and the seedling survival was at a low 24 percent. In a similar situation, there is vole damage to 13 percent of the seedlings and survival for the whole tract was 20 percent. A combination of voles, deer browse and heavy fescue cover devastated this site. The only other site with reported vole damage had 10 percent of the seedlings damaged and the overall survival was 66 percent. Voles generally move into sites in the fall and winter. They use dense grass debris as cover for movement, burrow into the area of the seedling roots and gnaw on the stem at ground level (**Figures 3 and 4**). The vascular system of the seedling is compromised. Without the transport of water and food, the seedling dies.

Figures 3 and 4. Vole-damaged seedling and a field with prime vole habitat.

Regeneration

The natural land cover in Virginia, as with most of the Mid-Atlantic region, was heavy forest cover before colonization. With settlement, agricultural development and foreign trade, Virginia forests were cut for timber, building and other domestic activities. Forest cover in Virginia is at approximately 55percent according to recent US Forest Service, Forest Inventory Analysis (FIA). With the historical background of the region, it is expected that a field left untilled and unplanted will eventually revert back to forest cover through natural regeneration. Regeneration starts with seed from nearby wooded sites. The size and weight of the seed as well as adaptive structural features influence the mode of dispersal. Depending on the dispersal mode, the seed blows into the site; it can also be carried by flowing water and animals. Seed can stick to

equipment, footwear, animal fur and feathers or be dropped in animal scat. Therefore, there is a lot of opportunity for regeneration to take place. At the sites being reported here, there is some natural regeneration taking place. There were emerging seedlings inventoried at 17 of the 42 sites (40 percent). Note the species and the actual numbers of stems regenerating among the planted seedlings on the new riparian sites (**Table 3**). We do know that the outside influences of wildlife, invasive species, occasional mowing and lack of seed source does keep natural regeneration to a minimum.

Table 3. Regeneration taking place at new riparian sites.

Species	Number of Stems on Each Numbered Site																	Total
	2	3	5	7	17	18	19	20	24	29	31	32	33	35	38	40	42	
Cedar	2			2							1					3		8
Black Walnut		1			1	4	1							1				8
Black Cherry			1															1
Silver Maple								3										3
Mulberry								1		1			3					4
Red Maple								1										1
Black Locust									1	1	1							3
Crab Apple												5						5
Black Gum													15					15
Green Ash													2					2
Yellow Poplar															1			1
Box Elder																	1	1
Total	2	1	1	2	1	4	1	5	1	2	1	5	20	1	1	3	1	52

Note: Site 33 has well above the site average of 1.2 stems from natural regeneration.

Site 33 has the most stems of natural regeneration. A look at the specific information for this site has a couple of indicators of why this is the case. The site is not being mowed and no deer browse was recorded at this site. The planted seedling survival is at 70 percent. There are several invasive species present at the site, but this is not negatively influencing seedling regeneration. Natural regeneration at some sites can make up for seedling mortality by increasing the number of viable stems per acre.

Lessons Learned

Although riparian forest buffer planting has been taking place in the Commonwealth of Virginia for a many years, each planting is unique. The approach to these projects has an established pattern of site evaluation, species selection, species location, number of trees per acre and method of planting. But there is enough flexibility that the cost can vary from site to site. One certainty is that it is a costly and complex task. Site preparation gets the seedlings off to a good start. Site prep can involve scalping the sod off rows where the seedlings will be planted. Herbicide can also be applied in the rows ($30 to $60 per acre) where seedlings are planted. Mowing or disking the whole site can cost from $35 to $150 per acre. Prescribed burning is another option ($80 to $120 per acre) for site preparation. To plant 110 hardwoods per acre and use tree shelters to protect the seedlings means a price tag of about $500 to $750 per acre. To protect this investment requires thought about maintenance for the first few years.

From the summary of information from the Form 84s, it can be determined that most sites will do better if there is some maintenance. Some prominent influences on seedling survival were:

- Fescue grass and other weed competition
- Invasive species
- Deer browse
- Vole damage

Looking at each of the influences in **Table 4**, the impact of mowing has a positive effect on seedling survival. Those sites that are mowed have a survival rate that is 10 percentage points higher. This is a significant increase. The effect of having invasive plant species within the planting site has a negative 10 percent influence on the rate of seedling survival. Surprisingly, deer browse has only a 7 percent negative influence on seedling survival. Often when the seedlings are browsed, the growth is stunted but the seedlings don't die in the first couple of years. However, vole damage has the most severe impact on seedling survival. For sites with vole infestations, survival was a low 33.3 percent in comparison to 80.8 percent seedling survival for sites without voles.

Table 4. Major influences on seedling survival.

Influence	Survival with	Survival without
Mowing/Spraying	80.5%	70%
Invasive Species	72%	81.5%
Deer Browse	70%	77%
Vole Damage	33.3%	80.8%

Each of the riparian planting sites is similar yet unique. Out of the 42 sites reviewed, 30 had fencing to keep livestock out of the planting and out of the nearby water source. Thirty seedlings were evaluated at each site. For these sites, there were only four foresters who did the reviews, which keeps the variability in recording methods and measurements to a minimum. Information we don't have is site specific, such as the aspect, topography, soil characteristics and the planting crew. Since we are looking at only four counties in the same region of the state, some assumptions about the soil, topography and who did the planting can be made. Although the distribution of the sites in each county is not equal, we can still look at survival by county. This eliminates variables, such as the planting crew, and minimizes the variability in soils. **Figure 6**. displays seedling survival by county.

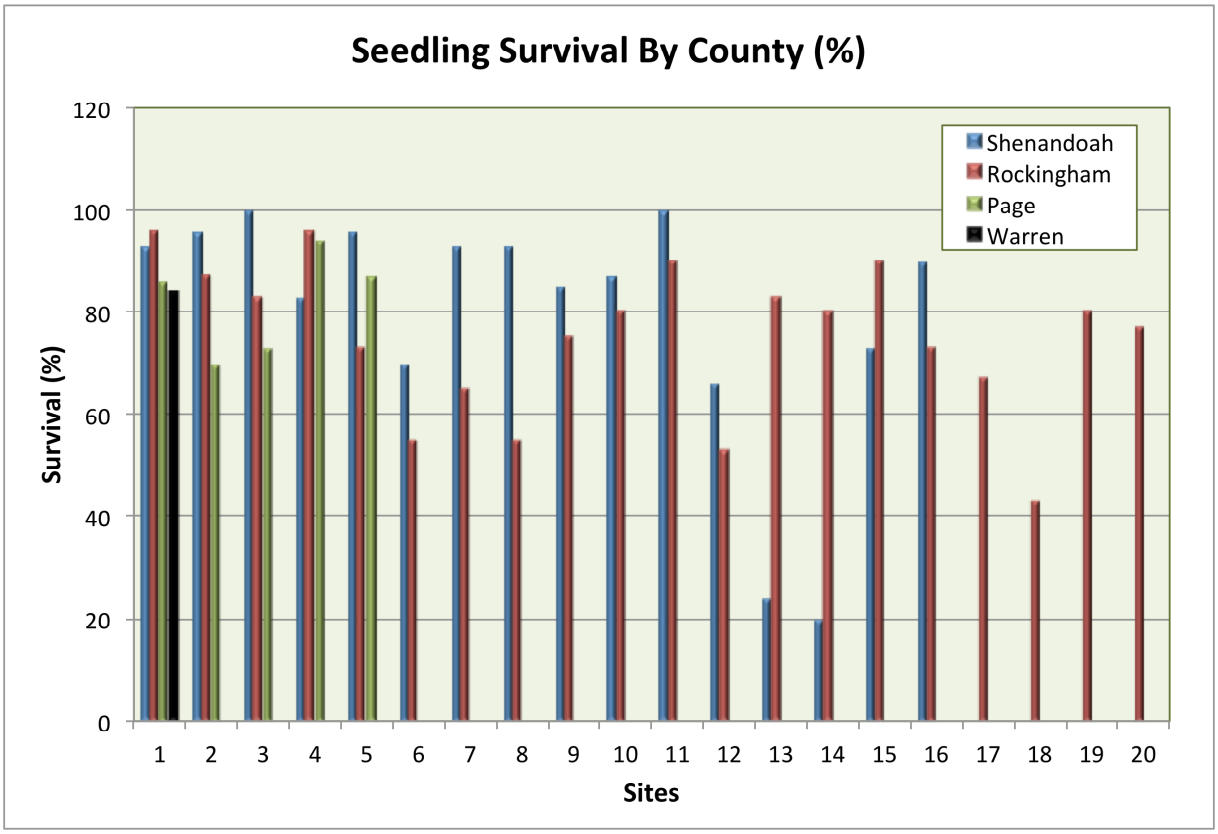

Figure 6. As mentioned in the beginning of the report, Rockingham County contributed the most sites (20); Shenandoah contributed 16; Page had 5, and Warren 1 site. In the graphic above, it can be noted that both the two highest survival rates came from Shenandoah (100 percent each) and the two lowest survival rates also came from Shenandoah county (20 percent and 24 percent). Four additional sites under the required 60 percent survival rate are from Rockingham County. Conclusive information that can be drawn from the data is a comparison of the characteristics of those sites with the highest scores and those with the lowest scores.

Table 5. Highest and lowest seedling survival rates with influencing factors.

Percent Survival	100	100	96	96	96		20	24	43	53	55	55
Invasive Plants	0	0	0	0	1 stem privet		Fescue	Fescue	Fescue	Orchard grass, horse nettle, thistle	0	0
% Deer Browse	10	13	6	30	20		16	16	0	26	20	10
% Vole Damage	0	0	0	0	0		13	26	0	0	0	0

Interpretation of the influencing factors offers the impression that the presence of fescue and a suite of other invasives is very detrimental to survival of young seedlings. Voles are the other most remarkable negative influencing factor on the plantings. Those planting sites with the highest survival rates did not have the influence of either invasive plant competition or any vole damage. All of the sites with the highest rates of survival had some deer browse as did those sites

with the lowest survival rates. The two sites with the very lowest survival rates (20 percent and 24 percent) had a combination of fescue competition, deer browse as well as heavy vole damage. Out of both groups with high and low survival rates, one of the sites with 100 percent survival and a site with 43 percent did receive mowing as a maintenance measure. Mowing in this suite of sites was not a primary factor influencing seedling survival.

Conclusions

The facts provided by the Form 84 inventories indicate that there is a high average rate of seedling survival for riparian plantings in the counties considered. Time spent in planning the plantings is a good investment in future riparian forest development. Some recommendations that can be drawn from this particular project are:

- The most severe detriment to riparian project success is vole infestations. Therefore, the maintenance of riparian plantings to eliminate vole habitat is worthwhile. The proper seating of tree shelters into the soil, the use of repellents, and spraying or mowing grass around shelters will help keep voles out of the planting site.
- Although deer browse had only a slight effect on seedling survival, it did reduce the vigor and structural development of the seedlings. Deer population control will allow seedlings to reach canopy closure earlier and will also produce trees with structural integrity. Deer browse results in poor branching patterns and very thick and shaggy canopy structure.
- The removal of fescue before planting will increase seedling survival rates. Spraying or scalping strip rows to be planted makes planting more efficient. It will also remove the fescue competition and vole habitat.
- Inspecting riparian plantings regularly and using adaptive management practices will increase riparian project success.

Form 84 project site reviews are time consuming, but they provide valuable information about project site conditions. They help pinpoint management needs on a site by site basis. These reviews are well worth the time.

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