**Grant agreement #:** 09-023W

**Grant Title:**

Response of flowering dogwood (*Cornus florida*) to dogwood anthracnose and fire in southern Illinois

**Grantee:**

The Board of Trustees of Southern Illinois University, Dr. Prudence Rice, Office of Research Development, MC4709 Woody Hall C216, Carbondale, IL 62901 Tel: (618) 453-4540

**Time Frame of Report:** July 1, 2008 – June 30, 2009

**Grantee Representatives Completing Report:**

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**Project objective:**

1. Establish the response of flowering dogwood in response to anthracnose and fire in southern Illinois.

Recent research by the PIs has documented a dramatic decline in dogwood density, attributed to dogwood anthracnose, in oak-hickory forest types in southern Illinois. The proposed research will resample fifty-five long-term vegetation plots in southern Illinois that were established and burned in the early 1990s. We hypothesize that because some of the proposed sampling area was burned prior to becoming infected with dogwood anthracnose, that the burned portion of the sampling area will have greater dogwood density and lower severity of dogwood anthracnose than the unburned portion.

**Project description:**

Historically, flowering dogwood (*Cornus florida*) was one of the most common and charismatic understory species in eastern forests. Currently however, dogwood populations are threatened by dogwood anthracnose, an exotic disease that has decimated dogwood populations across the eastern US. Loss of dogwood from eastern forests has reduced ecosystem health and stability by disrupting nutrient cycling and decreasing mast production for wildlife. It has also been linked to decreased invertebrate species diversity and reduced survival of bird hatchlings.

Recent research by PI – Holzmueller in southern Appalachia has indicated that areas infected with dogwood anthracnose that were burned prior to infection have greater dogwood density compared to unburned infected areas, however, this phenomenon has not been reported elsewhere. We resampled fifty-five long-term plots that were established in 1991 and prescribed burned in 1992 and1993 to establish the response of flowering dogwood to anthracnose and fire in southern Illinois. Data collected from this study was used to develop management guidelines that will maintain dogwood as a component in southern Illinois forests.

**Summary of Project accomplishments:**

**Introduction**

Historically, flowering dogwood (*Cornus florida*) was one of the most common understory species in eastern deciduous forests. The species is currently threatened by an exotic fungus (*Discula destructiva*) that causes the disease dogwood anthracnose (Holzmueller et al. 2006). Dogwood is an important food source for over 50 species of wildlife and loss of this species could significantly affect the wildlife carrying capacity of oak-hickory forests (Rossell et al. 2001). Although disease severity is affected by a number of factors including aspect, elevation, light availability, moisture, and nutrient availability, few management options exist to control the impacts of dogwood anthracnose in oak-hickory forests (Holzmueller et al. 2006). However, recent research by Holzmueller et al. (2008) reported greater dogwood density in areas that had burned prior to infection with dogwood anthracnose compared to areas that had not burned in southern Appalachia. In addition, the authors recommended reinitiating the historic fire regime of 10-15 years in order to perpetuate dogwood as a component of oak-hickory forests.

**Materials and Methods**

Dogwood anthracnose was first confirmed in Illinois in 1995 (Schwegman 1998). We conducted our study at LaRue Pine Hills/Otter Pond Research Natural Area (LPH/OP RNA) which is part of the Shawnee National Forest, Union County, Illinois to further investigate if fire could be used as a tool to protect forests from the impacts of dogwood anthracnose. We resampled fifty-five 0.04 ha permanent study plots that were established in early spring 1991 and prescribed burned later on March 25, 1991 and again on March 20, 1993. Burn intensity for both burns was classified as low (Robertson 1994). In addition to sampling before the first burn, plots were resampled in the winter following each burn in 1992 and 1994, and in the summer of 2008. Overstory trees (≥ 6.6 cm dbh) were tallied and recorded by species in each 0.04 ha circular plot. Saplings (1 < 6.6 cm dbh) were tallied and recorded by species in a 0.004 ha circular plot within each 0.04 ha circular plot.

**Results and Discusion**

Overall, total dogwood density increased 4% in 2008 compared to 1994 post-burn levels. This increase is attributed to increased dogwood density in the understory (1994 post-burn: 73 stem $ha^{-1}$ versus 2008 post-burn: 102 stems $ha^{-1}$; Table 1). In a companion study of unburned forest plots at LPH/OP RNA, Suchecki and Gibson (2008) reported a 68% decrease in dogwood density from 1994 to 2004. A significant loss of dogwood density was also observed from 1980 to 2000 in unburned areas at the nearby Trail of Tears State Forest (<10 km from LPH/OP RNA) (Ozier et al. 2006). Although signs of anthracnose were observed on all trees within the study area, the results of this project indicate that prescribed burning reduces the impacts of dogwood anthracnose when compared to unburned areas in nearby oak-hickory forests.

While prescribed burning appeared to maintain dogwood density at LPH/OP RNA, dogwood density decreased by 35% between the 1991 pre-burn and 1994 post-burn measurements. Dogwood will readily resprout following fire, but burning too frequently may decrease dogwood density (Arthur et al. 1998), and, reduce the effectiveness of fire to control the impacts of dogwood anthracnose (Holzmueller et al. 2008). Oftentimes however, multiple burns are necessary to kill larger, relatively thin-barked less desirable species, such as sugar maple (*Acer saccharum*) and American beech (*Fagus grandifolia*). Burning may need to be combined with mechanical understory removal of these species to reduce competition for light and nutrients in order to increase dogwood survival from anthracnose (Pierce et al. 2008).

Maintaining dogwood as a component of eastern deciduous forests is important because of the key role the species plays in nutrient cycling and mast production for wildlife (Rossell et al. 2001, Jenkins et al. 2007). Loss of dogwood could potentially limit the wildlife carrying capacity of these forests if the species is replaced with less desirable wildlife species like sugar maple or American beech. If dogwood is eventually lost from these forests despite burning, this study also indicates that prescribed burning may be used as a tool to restore ecosystem function by favoring soft mast producing species such as paw paw (*Asimina triloba*), sassafras (*Sassafras albidum*), spicebush (*Lindera benzoin*), and black gum (*Nyssa sylvatica*) (Tables 1 and 2). From 1991 to 2008, total paw paw density increased 316%, sassafras density increased 494%, and blackgum density increased 61%. Presence of spicebush was not reported in 1991, but it was observed in 2008 (176 stems $ha^{-1}$). Increased abundance of soft mast species may sustain wildlife species that might otherwise be lost with the loss of dogwood. In addition, prescribed burning inhibited development of a dense sugar maple and beech understory (Table 1), which inhibits dogwood and is often common in the absence of fire (Aldrich et al. 2003, Ozier et al. 2006, Pierce et al. 2008).

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Table 1. Pre-burn and post-burn mean (± 1 SE) density (stems $ha^{-1}$) of select understory (1 < 6.6 cm dbh) species over a 17 year period at LaRue Pine Hills/Otter Pond Research Natural Area. The area was burned on March 25, 1991 and March 30, 1993.

| Species | 1991 Pre-burn Mean ± 1 SE | 1992 Post-burn Mean ± 1 SE | 1994 Post-burn Mean ± 1 SE | 2008 Post-burn Mean ± 1 SE |
|---|---|---|---|---|
| *Acer rubrum* | 0 ± 0 | 0 ± 0 | 0 ± 0 | 14 ± 14 |
| *Acer saccharum* | 114 ± 24 | 55 ± 19 | 36 ± 16 | 88 ± 41 |
| *Amelanchier arborea* | 23 ± 12 | 18 ± 11 | 14 ± 10 | 28 ± 16 |
| *Asimina triloba* | 318 ± 185 | 77 ± 31 | 50 ± 25 | 1370 ± 340 |
| *Cercis canadensis* | 0 ± 0 | 0 ± 0 | 0 ± 0 | 51 ± 34 |
| *Cornus florida* | 127 ± 34 | 91 ± 28 | 73 ± 23 | 102 ± 35 |
| *Diospyros virginiana* | 0 ± 0 | 0 ± 0 | 0 ± 0 | 5 ± 5 |
| *Fagus grandifolia* | 0 ± 0 | 0 ± 0 | 0 ± 0 | 9 ± 9 |
| *Fraxinus species* | 5 ± 5 | 0 ± 0 | 0 ± 0 | 14 ± 8 |
| *Lindera benzoin* | 0 ± 0 | 14 ± 10 | 0 ± 0 | 176 ± 78 |
| *Liriodendron tulipifera* | 0 ± 0 | 0 ± 0 | 0 ± 0 | 19 ± 19 |
| *Morus rubra* | 0 ± 0 | 5 ± 5 | 0 ± 0 | 28 ± 16 |
| *Nyssa sylvatica* | 23 ± 15 | 0 ± 0 | 0 ± 0 | 46 ± 32 |
| *Ostrya virginiana* | 5 ± 5 | 0 ± 0 | 0 ± 0 | 65 ± 32 |
| *Pinus echinata* | 0 ± 0 | 0 ± 0 | 0 ± 0 | 23 ± 19 |
| *Quercus alba* | 14 ± 10 | 0 ± 0 | 5 ± 5 | 5 ± 5 |
| *Quercus marilandica* | 14 ± 14 | 0 ± 0 | 0 ± 0 | 0 ± 0 |
| *Quercus muehlenbergii* | 0 ± 0 | 5 ± 5 | 5 ± 5 | 9 ± 6 |
| *Quercus rubra* | 18 ± 6 | 5 ± 5 | 5 ± 5 | 5 ± 5 |
| *Quercus velutina* | 0 ± 0 | 0 ± 0 | 0 ± 0 | 125 ± 81 |
| *Sassafras albidum* | 45 ± 18 | 5 ± 5 | 5 ± 5 | 574 ± 139 |
| *Tilia americana* | 5 ± 5 | 9 ± 6 | 5 ± 5 | 9 ± 6 |
| *Ulmus* species | 14 ± 11 | 0 ± 0 | 5 ± 5 | 0 ± 0 |
| *Vaccinium arboreum* | 55 ± 34 | 0 ± 0 | 0 ± 0 | 74 ± 65 |
| *Vitis* species | 9 ± 6 | 0 ± 0 | 0 ± 0 | 46 ± 20 |

Table 2. Pre-burn and post-burn mean (± 1 SE) density (stems ha$^{-1}$) of select overstory (≥ 6.6 cm dbh) species over a 17 year period at LaRue Pine Hills/Otter Pond Research Natural Area. The area was burned on March 25, 1991 and March 30, 1993.

| Species | 1991 Pre-burn Mean ± 1 SE | 1992 Post-burn Mean ± 1 SE | 1994 Post-burn Mean ± 1 SE | 2008 Post-burn Mean ± 1 SE |
|---|---|---|---|---|
| *Acer rubrum* | 1 ± 1 | 1 ± 1 | 2 ± 1 | 3 ± 2 |
| *Acer saccharum* | 125 ± 17 | 126 ± 18 | 112 ± 17 | 99 ± 15 |
| *Amelanchier arborea* | 6 ± 2 | 5 ± 2 | 5 ± 2 | 6 ± 3 |
| *Asimina triloba* | 16 ± 6 | 14 ± 5 | 10 ± 4 | 11 ± 4 |
| *Cercis canadensis* | 7 ± 3 | 6 ± 3 | 5 ± 3 | 0 ± 0 |
| *Cornus florida* | 70 ± 12 | 68 ± 12 | 55 ± 12 | 31 ± 8 |
| *Fagus grandifolia* | 1 ± 1 | 1 ± 1 | 1 ± 1 | 1 ± 1 |
| *Fraxinus species* | 17 ± 3 | 15 ± 3 | 13 ± 2 | 10 ± 1 |
| *Juniperus virginiana* | 4 ± 2 | 4 ± 2 | 4 ± 2 | 2 ± 1 |
| *Liquidambar styraciflua* | 4 ± 3 | 4 ± 3 | 4 ± 3 | 3 ± 2 |
| *Liriodendron tulipifera* | 11 ± 4 | 10 ± 4 | 10 ± 4 | 12 ± 5 |
| *Morus rubra* | 1 ± 1 | 1 ± 1 | 0 ± 0 | 5 ± 4 |
| *Nyssa sylvatica* | 10 ± 3 | 7 ± 2 | 7 ± 2 | 7 ± 2 |
| *Ostrya virginiana* | 5 ± 2 | 5 ± 2 | 4 ± 1 | 5 ± 2 |
| *Quercus alba* | 46 ± 11 | 45 ± 10 | 41 ± 10 | 34 ± 9 |
| *Quercus marilandica* | 30 ± 26 | 29 ± 25 | 28 ± 25 | 21 ± 20 |
| *Quercus muehlenbergii* | 14 ± 5 | 13 ± 4 | 12 ± 4 | 11 ± 3 |
| *Quercus rubra* | 60 ± 7 | 52 ± 6 | 25 ± 6 | 18 ± 2 |
| *Quercus stellata* | 7 ± 4 | 6 ± 4 | 6 ± 4 | 6 ± 3 |
| *Quercus velutina* | 18 ± 5 | 24 ± 7 | 18 ± 5 | 33 ± 9 |
| *Sassafras albidum* | 59 ± 10 | 48 ± 8 | 35 ± 7 | 42 ± 9 |
| *Tilia americana* | 5 ± 4 | 5 ± 3 | 5 ± 3 | 2 ± 2 |
| *Ulmus* species | 17 ± 2 | 13 ± 2 | 13 ± 1 | 8 ± 1 |

**Project photos**

**Total Project Expenditures:**

| Item | Amount |
|---|---|
| Salaries/Wages | $1818.17 |
| Indirect Costs | $181.82 |
| Total | 1999.99 |