FINAL REPORT
Forest Service Grant no GR-2-97-009

Period covered by this report: September 19, 1997 through November 15, 2001

NOTE: Please review the following information and revise complete as necessary.

Issued to: South Dakota State University
Address: Hort., Forestry, Landscape & Parks Dept., Box 2140A, NPB 201, Brookings. SD 57007-0996

Congressional District Number: At large

Project Name: The Influence of Urban Fringe Forests on the Development of Urban Communities

Contact Person/Principal Investigator

Name: John Ball
Mailing Address: Same at above
Phone Number: (605) 688-4737
Fax Number: (605) 688-4713
E-Mail Address: john_ball@sdstate.edu

Your Organization's internet home page address:

Date of Award: September 19, 1997

Grant Modifications: Mod. 1: No-cost time extension from September 30, 1999 to September 30, 2000
Mod. 2: No-cost time extension from September 30, 2000 to September 30, 2001
Mod. 3: No-cost time extension from September 30, 2001 to November 15, 2001

Date of Expiration: November 15, 2001

Funding: Federal Share: $21,700 plus **Grantee Share:** $21,700 = **Total Project:** $43,400

FS Grant Manager: Susan Ford
Address: USDA Forest Service, State & Private Forestry, P.O.Box 25127, Lakewood, CO 80225
Phone Number: (303) 275-5742
Fax Number: (303) 275-5754

Please provide an abstract on your project and its results. This abstract will be posted on the NUCFAC internet site (approximately 200 words or less).

While forests are being converted to urban development, many fringe forests still surround metropolitan regions and remnant forest islands embedded within these regions as parks or scattered forests in residential developments. Though forests are prized for building sites, they lose biological integrity through the stresses imposed by the development process. Eventually, a forest is fragmented to the point it no longer functions as a forest and becomes more a collection of trees. This project documented the influence that forests have had on suburban and exurb expansion as well as investigated the influence urban development has on forest composition

and structure. Forests are highly desired building locations, however, not all forests are equally preferred for development. Savanna-like stands — those with a basal area between 35 and 40 ft^2/acre (8 and 9 m^2/ha) — or approximately 65 trees per acre (26 trees per hectare) that are 10 inch (25.4 cm) diameter and 25 to 45 feet (7.6 to 13.7 in) tall are the forests most preferred for development. This development activity has a significant impact, even when mature trees are conserved during the process. The conversion of the site from forests to urban results in soil changes including increases in pH, soluble salts, phosphorous, and potassium and a decrease in organic matter content. The remnant trees — those remaining after the stands were converted to housing — may appear healthy, however, due to the fragmentation of the stand, their vitality indicate a decline. Surprisingly, canopy cover, a common measure of urban forest health, may actually increase with development as many remnant trees though in decline survive for decades and natural forest disturbances such as fire are reduced allowing trees including exotics to become established. In addition, despite the cover, homeowners continue to plant trees in these forested developments. Efforts in tree conservation must focus on forest conservation and attempt to maintain intact forests islands at least 0.6 acres in size and with an area to perimeter ratio of 0.5 or greater.

Project objectives:

The objectives of this project are to document the influence the forests surrounding metropolitan areas have had on suburban and exurb development patterns since the end of the Second World War. The project will also examine the impact these development patterns have had on the remnant forests that have been incorporated into and fragmented by urban development.

Objectives met successfully to-date:

Aerial photographs of the region were collected from 1950 to the present (2000) to provide a 50-year series of changes in forest cover in and surrounding the metropolitan area. Changes in city boundaries from 1950 to the present as well as zoning changes were also collected. Topographic and soils data were also been collected. These were digitized and incorporated as layers on the base map. The fragmentation of the forest has been extensive as the city rapidly expanded into the adjacent forests to the west. There have also been numerous forest islands formed as development progressed from widely scattered homes to more high-density residential housing. Changes in forest patch size, area to perimeter ratio and other variables have been analyzed to determine minimal acceptable areas and shapes that will allow the forest to be sustainable. More than 200, 52.7-foot (16 m) radius plots were established to examine remnant trees and environmental changes.

Objectives not yet met:

We need to complete the planning guide for communities to use to better manage their forest islands. This will be completed as soon as the Master thesis is accepted by the graduate committee.

List the major research or policy findings of your project.

1. That urban sprawl does not always result in a decrease in canopy cover. When suburban development expands onto agricultural land there is an increase in canopy cover. Equally true, the development of existing forests does not necessarily result in a reduction of canopy cover. Due to the absence of natural forest disturbances — principally fire — there can be an increase in tree recruitment, establishment and survival in unmown areas. In addition, despite the existing forest canopy, homeowners often supplement this cover by planting new trees.
2. While forest canopy cover may not decrease, and possibly increase, this does not necessarily mean that the remnant forest is healthy. Canopy cover in itself is not an indictor of urban forest health. While cover and number of trees may increase — often due to the reducing in natural forest disturbances such as fire - the composition and structure of the remnant forest may be significantly altered. Two key determinates of the biological integrity of these remnant forest islands is the area and the area to perimeter ratio. Islands are too small, less than 0.6 acres, or a ratio less than 0.5 are invaded by exotic species, trees, shrubs and

herbaceous plants, and these significantly reduce the recruitment and establishment of native species.

3. Remnant trees now existing as isolated trees in lawn areas may appear healthy but the changes in their environment, in particular soil and microclimate, results in a decrease in tree vitality and an increase in vulnerability to abiotic and biotic stresses. The primary changes were the elimination of the shrub layer and a conversion of the herbaceous layer from domination by *Achillea* spp., *Campanula* spp. and other natives to *Fecstuca* spp, *Poa* spp. and *Lolium* spp., the typical fescue/Kentucky bluegrass/ ryegrass lawn. Within these areas converted to lawn, the soil differences from adjacent undisturbed stands include an increase in pH from approximately 6.3 to 7.8, along with a increase in soluble salt from 0.2 to 1.5 mmho/cm. Phosphorus and potassium also were significantly leveled on sites converted to development, sometimes as high as 100 and 700 respectively while the forested sites were closer to 4 and 300 ppm. The only decrease was soil organic matter. This dropped from approximately 5% to less than 2% between undisturbed and developed sites. While trees can be "saved" in development, the longevity is in question unless other environmental factors — soil and shrub/groundcover vegetation — are considered as well.
4. Development closely followed forested land. Stands with a basal area of between 35 and 40 ft²/acre and were composed of trees about 10 inches in diameter were highly desired for development.

If not apparent in the above, or if your project did not involve research, how did this project increase the knowledge we have about urban forestry? How did (will) the public benefit?

Most of the problems urban foresters and planners face is how to incorporate urban development into existing forestlands yet still maintain the remnant forest cover. The answer is not simply maintaining large forest area intact, though this would be beneficial, but instead what shapes should be maintained and the importance of not converting the ground layer to a mown lawn. The project will provide guidelines to zoning boards, developers and individual homeowners can use to maintain remnant forests in urban areas.

What recommendations might you make for community foresters or others who might benefit from your project?

1. While trees can be saved, it is better to save forests. Try not to focus on the size of the forest — at least above an acre - as much as the area to perimeter ratio of the stand. The less edge a forest island has, the less susceptible it is to invasion of exotic species and the more likely
2. The health of remnant forests is more influenced by cultural then environmental factors. Decisions made by developers on what stands to develop and which trees remain — as well as their commitment and care to protect trees — along with the public policy decisions such as dictating minimal lot size play a major role in determining the health and integrity of remnant trees.

Attach copies of reports, publications, or videos. If your work has been published (journals, popular press, etc.), provide where they have been published or reported and how copies can be obtained.

The majority of information for this project is being incorporated as part of a Master's thesis in geography. This information will be submitted to the *Journal of Forestry* and *Landscape Journal* after the thesis has been defended this spring. The information regarding forest island size was published in the Ball, J. 2001. Management needs of the remnant and emergent urban forests in the United States, 118 — 125, In Haiyan, Y (ed.) *Research on International Social Forestry*. Chinese Academy of Forestry, Beijing, P.R. China.

How will your results be disseminated to the public?

The results will be disseminated through a report to the local planning district. They are extremely

interested in any guidelines we may be able to provide them. At the present time they believe their present building requirements are inadequate to maintain the original character of the sites. A number of developments completed in the 1960s, 1970s and 1980s have lost the majority of their remnant forest cover despite strict regulations that were developed to "save" the trees. The local paper, the *Rapid City Journal*, has been covering issues surrounding urban sprawl in the Black Hills very intensely during the past year. An extension bulletin is being planned to help communities deal with the issue of conserving natural forests. These will be sent to the Council when completed.

List the active partners (key individuals or organizations) involved in the project to-date:

The local partners include the South Dakota Division of Resource Conservation and Forestry, the Forestry Department of the City of Rapid City, the Planning Department of the City of Rapid City, and the local Master Gardeners (Pennington County Cooperative Extension Service).

Photo of Illustration: If possible, please provide a photo or illustration for our use that summarizes or represents the project. Indicate how this illustration should be credited.

If a no-cost extension has been requested for this project, why is (was) it needed?

We did request a no-cost extension to September 30, 1999 so that we may complete the data collection and analysis of the trees. This was identified in our original application. Due to some personnel changes, one of the co-investigators left the university, we are not able to complete the project by the above date and requested a no-cost extension until September 2001 so that a graduate student could develop the project into a thesis.

Flow would you evaluate the grant process? What changes, if any would you recommend?

The process is excellent and any questions were promptly addressed by Suzy or Cheri. The only suggest would be to have the funding available earlier in the year of the award. If the funds do not become available until fall and entire field season is lost.

Comments considered of importance but not covered above:

I would like to thank the Council and in particular Suzy del Villar, for their allowing for the time extensions.

This report was prepared by:
Name: John Ball
Title: Professor of forestry, South Dakota State University
Phone Number: (605) 688-4737
Date: February 15, 2002