USDA-FOREST SERVICE'S APPALACHIAN OAK PROGRAM[1]

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INTRODUCTION

As the USDA-Forest Service moves forward into the 21st century, the agency is operating under a new natural resource agenda recently outlined by Chief Mike Dombeck. The primary thrust of the new agenda is restoring and maintaining forest health to provide for sustainability of ecosystems to meet the long term needs of the American public. To support this agenda, the Region 8 Genetic Resource Management Program will initiate an artificial regeneration program for northern red oak and white oak in the Southern Appalachian Mountains.

One of the major issues recently identified in the Southern Appalachian Assessment is the loss of oaks from the Southern Appalachian ecosystems and the gene conservation questions associated with this loss. Oaks are being lost and natural oak regeneration is not adequate in the following situations.

High-Quality Cove Hardwood Sites

In this situation, it is extremely rare to find any advanced oak regeneration on the forest floor when sites are logged or when stands succumb to natural disaster. These are very productive sites and the competition from shade tolerant species or faster growing intolerant species overwhelms slow growing oak regeneration. Generally the oaks in the cove hardwood sites are old and very large which contributes to low levels of stump sprouts. Disturbance on the cove sites generally results in fast growing fully stocked stands of yellow-poplar (Loftis 1993).

Gypsy Moth Impacted Sites

The gypsy moth is having a major impact on existing oak forests (Gottschalk 1989). Oak-dominated forests are subject to nearly complete destruction by the gypsy moth. The moth is not selective as to site quality. Oaks on the poorest sites, as well as the high-quality sites, are impacted. This is especially destructive even on the lower quality sites as it nearly eliminates all regeneration potential of oaks. Repeated defoliation of the trees weakens them so much that stump sprouting is reduced or totally absent. In addition, the defoliation reduces the stored food reserves and weakens the acorns to the point that they will not germinate or do not have vigor enough to survive. It is predicted that the gypsy moth will continue to increase and spread over the Southern Appalachians in the next 30 to 50 years.

Oak Decline Complex

The oak decline complex results from insects and disease impacts being magnified in low vigor over-aged stands of susceptible oaks. Oak decline increases have recently been attributed to the significant regional droughts of the 1980's (Oak and others 1989). Whatever the cause, the resulting stands grow very slowly, produce very little mast for wildlife and are being replaced by other species of lower economic and wildlife habitat values.

Because of the economic importance and the importance of the oak species for wildlife habitat, biologic diversity, and ecosystem sustainability, we project that there will be a significant need for artificial oak regeneration in the future. This need will involve high and low quality sites. For example, there is one contiguous 200,000-acre block in the Lee Ranger District on the George Washington National Forest where virtually every oak tree and seedling was killed by the gypsy moth. This occurred on both high and low quality sites and has a tremendous impact on wildlife and other resources. Since there is no natural regeneration potential available, the only alternative, if we are to restore oak forests in these situations, will be planting the oak species that we want. Many of these same impacts have been identified in the Ozarks. If the Southern Appalachian initiative is successful, a similar program will be developed for the Ozarks.

A 1992 symposium on oak regeneration documented the past failures of both natural and artificial oak regeneration attempts (Loftis and McGee 1993). There are very few success stories. In most cases of artificial regeneration, initial survival is good, however, subsequent growth of the seedlings is extremely slow and they are lost to deer browse, dieback, and competing vegetation. There are many practical problems to overcome in order for artificial regeneration to be successful.

CURRENT NEEDS

Before any significant intermediate or large-scale artificial regeneration program can be initiated with the oaks, there are some basic issues which must be addressed for practical reasons. First, adequate sources of seed of known source of origin that are adapted to the regenerated sites must be secured. A consistent planned regeneration program will be extremely difficult to develop without more uniform consistent sources and supplies of seed. In some instances, the period between acceptable seed crops in natural stands may be several years in any particular geographic area. This leads to the movement of seedlings to areas in which they may not be adapted to the environment. It may also lead to the planting of species that are ecologically inappropriate simply because they are the

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only hardwood seedlings available in a particular year. In either case, it is extremely important that we be able to develop and manage the source of hardwood seed if we expect a hardwood planting program to be successful.

Second, we must develop the knowledge of seed zones or seed provenances for the oaks. If we have knowledge of provenances and geographic sources, the seed and seedlings can be moved with greater confidence of long term performance. Seed orchards can also be developed to cover the hardwood areas without excessive overlap or gaps.

HOW WE WILL PROCEED

Our current plans are reasonably straight forward and simple. We will arbitrarily divide the Southern Appalachian hardwood region into geographic sources and select parent trees in each geographic source area. Both northern red oak and white oak will be included. We will make open pollinated collections of acorns from timber quality trees and grow seedlings from each family. The resulting seedlings will be graded at the nursery for specific characteristics and will be outplanted into seedling seed orchards. When we accumulate enough families in the seedling orchards and they begin to produce seed in reasonable quantities, we will have a source of seed with which provenance studies can be initiated. Please be aware that this is a long-term undertaking and we do not expect results over night. Keep in mind the ancient proverb that the longest journey begins with the first step.

Present plans are to divide the Southern Appalachian hardwood region into three areas based on latitude. In the small number of geographic provenance studies that have been completed, latitude has surfaced as a significant variable (Kriebel and others 1988). Our latitude lines will follow the State lines of Kentucky and Virginia for the northern source. Due to the wide east-west range of the Daniel Boone, Jefferson, and George Washington National Forests, this northern zone will be subdivided into an east zone and a west zone in southwestern Virginia. The Clinch Ranger District in far southwest Virginia will go with the Daniel Boone National Forest.

The central zone will include the national forests in east Tennessee and western North Carolina. Due to the narrow east-west orientation, this zone will not be subdivided.

The southern zone will include the national forests from the Bankhead in the west to the Uwharrie in the east and all of the Chattahoochee-Oconee National Forests in Georgia. The Bankhead and Uwharrie will be handled as seperate geographic sources.

Elevation may be an important factor with the oaks (McGee 1973). The amount of real information is very scarce. We will take elevation into account by selecting trees from across the elevations that are most important to us. Our selections will be grouped so that in effect, it will be possible to test for the effects of elevation between sources in the outplantings. Consultations are underway with research geneticists at the Southern Research Station at Saucier, MS, and with Dr. Scott Schlarbaum of the University of Tennessee on the optimum sampling procedures that will allow us to meet our long-term goals for this effort.

Selection criteria will also be straight forward and simple. For a tree to qualify, it must be of timber quality and it must have a collectible acorn crop on the tree at the time of selection. We know from several sources (Beck 1993, Cecich 1993) that acorn production is genetically controlled and since mast production for wildlife is a major goal, this is an important criterion.

The seedlings will be grown under the nursery protocol developed by Dr. Paul Kormanik (Kormanik and Sung 1993, Kormanik and others 1993). At time of lifting, seedlings will be graded for size and number of first-order lateral roots. Seedlings not meeting the FOLR criteria will be culled. If, as we have observed in the past, a family produces an inherently high number of the seedlings that do not meet the FOLR criteria, the family may be eliminated altogether at the nursery production stage. At the seedling seed orchard, seedlings will be planted at a relatively close spacing, and non-performing seedlings will be eliminated as the planting develops. The orchard will be managed to produce seed at an early age and when enough families begin production, genetic provenance tests will be initiated. Seed, as available, will be used for reforestation plantings.

THE BASIS FOR THIS INITIATIVE

Many of you are probably familiar with the current research literature and actual field performance of planted northern red oak and white oak. You are probably asking why we think this initiative will work. We think this will work because there is an example of a producing seedling orchard and some established plantations of red oak and white oak that show excellent performance.

First, Region 8 has a producing northern red oak seedling seed orchard located on the Watauga Ranger District of the Cherokee National Forest. This orchard was originally established as a progeny test by the TVA in 1973. It was converted into a seed orchard by the Forest Service in 1987. It has been producing variable quantities of seed since 1991. The Forest Service also has a small number of white oak selections grafted into the Beech Creek Genetic Resource Management Area at Murphy, NC. The white oaks are about the same age as the red oaks and have produced several crops of acorns. These variable quantities of seed from known parent trees have been enough to generate considerable interest and research on orchard management, seed production, insect damage, seed quality, nursery seedling culture, and outplanting performance (Schlarbaum and others 1998). The research findings, while not conclusive in all cases, give us hope that an artifical regeneration program with northern red oak and white oak is currently feasible.

With seed produced in the two orchards we have been able to supply Dr. Paul Kormanik of the Southern Research Station and Dr. Scott Schlarbaum of the University of Tennessee with seed for research projects. From this we have established several outplantings of high-quality graded oak seedlings. In 1994, seventeen northern red oak plantations were planted with seedlings in which family identities have been maintained. Some of the plantations have been lost due to combinations of drought, poor site selecton, insect damage, fire, and deer browse. However, of the plantations that remain, several are performing beyond our expectations for survival and growth. These plantations will yield much valuable data in future years. We now have several existing plantations in which seedlings are showing the ability to survive well and initiate height growth. As with other artifically regenerated species, either pine or hardwood, additional release is necessary, however, these plantations are better than any other oak plantings that have been attempted on the national forests.

In the winter of 1998 in collaboration with Kormanik, we established the first white oak field planting with family identified, graded seedlings on the Brasstown Ranger District. This planting was established with 25 open pollinated families with 5 tree row plots replicated 8 times. Seedlings were graded based on height, caliper, and meeting the minimum number of first-order lateral roots. So far, survival looks promising. Early examination indicates very high survival and an excellent first flush of growth. So far the deer have entirely avoided the white oak seedlings. This plantation has the potential to provide us with much more specific performance information as each seedling was individually measured, lateral roots counted and recorded prior to planting and each seedling will be followed as an individual thoughout its development.

WHAT WE HAVE LEARNED SO FAR

Comparison of the orchard types has been very rewarding. Seedling seed orchards are the way to go. The oaks are very difficult to graft due to rootstock compatibility problems. When the grafts are successful, the resulting trees do not grow and develop as rapidly as the seedlings. The acorn bearing surfaces on the trees in the seedling orchard are several times larger than for the grafted trees at similar age. In the seedling orchard, acorn production is strongly genetically controlled. Some trees bear crops or have potential every year and others have never produced anything.

We have also learned that the oaks seem to be as plagued by insect problems as the pine orchards. Chemical control of insects will be necessary if oak orchards are to produce on a consistent basis.

Seed size is important and very variable in the orchards. There seems to be a much wider range of seed sizes and the small ones can be eliminated by mechanical screening prior to planting.

Many species of wildlife become problems in oak orchards. When the acorns start to fall, the deer, turkey, bear, and squirrels show up, sometimes in massive numbers. They can fully destroy a crop in a short period of time.

Proper acorn handling is critical to success (Bonner and Vozzo 1987). It appears that white oak acorns are considerably more sensitive than red oak acorns to storage and handling practices.

To obtain high-quality seedlings, the nursery protocol developed by Paul Kormanik produces very high-quality seedlings. The protocol provides for balanced seedling nutrition, irrigation schedules determined by measurement of soil moisture, seedlings grown at a low density, and small applications of nitrogen based on the growth of the seedlings and target seedling sizes. Seedlings are graded on the development of a minimum number of first-order lateral roots. Based on the observations in the nursery in 1995, there appears to be significant differences in families in first-order lateral root production.

Even with the best quality seedlings, good site preparation, excellent storage and handling practices, these seedlings will still require release from the competing vegetation, primarily yellow-poplar.

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