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PLANTING TRIALS WITH AMERICAN CHESTNUT

IN SOUTHERN APPALACHIAN FORESTS

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INTRODUCTION

We are really just getting started in our studies with American chestnut in the Forest Service. I don't have as many results to show as the folks at Penn State. I do first want to give some credit to the people who have really done most of the work in this study – particularly Chuck Rhodes, who was at the University of Kentucky at the time we started this and is now with the Forest Service out in Colorado and Jeff Lewis, who is a silviculturist in the Morgan Ranger District of the Daniel Boone National Forest.

I am going to start off with this profound statement, '*planted chestnut is only going to make it if it beats its competition*.' The name of the game in forest regeneration is beating the competition. There are a couple ways to beat the competition. One way, from a silvicultural standpoint, at least, is that you can control the competition. We have all been exposed to weed eaters and herbicides and probably other techniques we can use. I wonder if in some cases, at least on a broad scale, whether an approach that relies strictly on control of competition is logistically and economically feasible. It may be, it may not be, I don't know the answer to that. This may just be a question of how much value we put into restoring chestnut. There may be other ways, other approaches, that we can take that might allow us to use less competition control and perhaps avoid some of the difficulties and expense with trying to reintroduce American chestnut on say a 100,000-acre piece of ground.

WHAT DO WE KNOW ABOUT CHESTNUT?

Well, we know something about its distribution. I was asked to talk specifically about the southern Appalachians. We know about where chestnut grew, and we also know that a variety of species now occupy the space once occupied by chestnut. But its function has probably not been entirely replaced in these ecosystems in the southern Appalachians, or elsewhere. Why haven't those functions been replaced? It was the most numerous, most abundant tree in the southern Appalachians. As an individual species, it was the most numerous. It was an important food source for many animals. One thing learned recently is that it was extremely important as long-term durable coarse woody debris in both terrestrial and aquatic systems. That's something that's disappearing now, and I think some people are concerned that we don't have a good replacement. And of course it was commercially valuable and had great utility. So these are some of the reasons why we want to regenerate chestnut and restore it.

We also know that chestnut was a large tree. We know that it grew over a broad range of sites and soils. It certainly grew on mesic sites, where it reached its greatest development, but it also grew and was actually more dominant on sub-xeric to even xeric sites. It grew over a broad elevational range, as well, in the southern Appalachians. We know that its wood was durable and extensively used. It regenerates well from stool shoots and from seeds, which are borne regularly in abundance. The rate of growth is very rapid, being greater than any other hardwood in the region.

* transcribed from the verbal presentation by Jennifer DeCecco and edited by JE Carlson and KC Steiner

Unfortunately, as has been already pointed out at this meeting, by the time we began to get systematic scientific investigations going in the eastern United States, the chestnut was on its way out. Figure 1, as an example, is a picture taken in 1905. This photo was taken on Bent Creek, and this guy was studying what was replacing chestnut. This picture was taken probably just a few hundred yards from the North Carolina Arboretum. We really never did learn much about the silvical or ecological characteristics of American chestnut before its decline.

Figure 1. Early study on American chestnut regeneration, Bent Creek, 1905.

WHAT DO WE NEED TO KNOW?

The work of Ayers and Ashe (1905) restates what we discussed earlier – chestnut grew very rapidly. What they observed as they traversed the woods is that yellow-poplar also grew very rapidly. And I particularly like their description of yellow-poplar and chestnut 'freely seeding' into openings created after cutting (Figure 2). The young poplars often vastly outnumbered the chestnuts, but the chestnut grew faster and overtopped the poplar and suppressed it, which is an interesting observation.

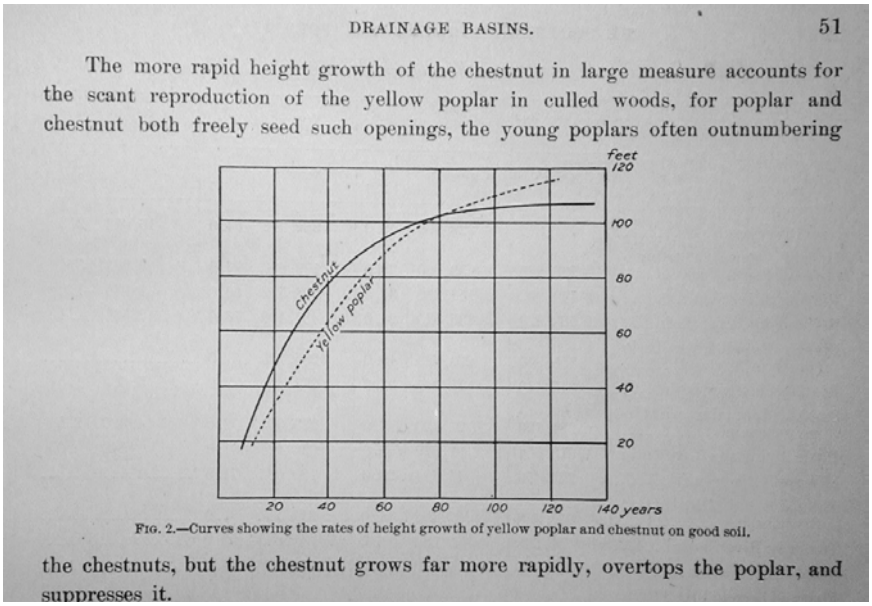

Figure 2. Yellow-poplar and American chestnut competition (Ayers and Ashe 1905).

But Ayers and Ashe were not the only people around during the period before chestnut began to decline. Another very keen observer was E. H. Frothingham. He came through the Asheville area in the early part of the century, actually about 1914-1915, as the national forests were being set up pursuant to the Weeks Act. Frothingham also later became the first director of what is now the Southern Research Station. He was also Director of the Appalachian Forest Experiment Station for the U.S. Forest Service from 1921 to 1934. He did a report (Frothingham 1917) on the cut-over areas of the southern Appalachians, from North Carolina to West Virginia. It was a very complete report. It was a thorough observational study, looking at many different cuts and what was becoming reestablished in those cuts.

But while Ayers and Ashe seemed to suggest that new seedlings were a viable source of regeneration in forest openings, that was not what Frothingham routinely observed. In fact, in only one case in all of his observations did he indicate that he thought that the source of successful regeneration was coming from seedlings. It was almost always from sprouts. There are some contemporary scientists (e.g., Billo, Paillet, McNab) who have painted a similar picture of the natural regeneration ecology of chestnut, indicating that it might not freely regenerate from new seedlings, at least over all sites.

Frothingham (1917) also stated that: "Observational studies of cut-over areas have the great disadvantage of missing the most important stages in the reproduction on cut-over areas, and especially the conditions prevailing immediately before and after the year of cutting."

This was a criticism he made of his own study and other observational studies. In observational studies you come in after the fact and maybe look at a time series of different cuts on different sites. This approach misses some of the most important information about factors that ultimately influence species composition. And over the last 40 years we have come to realize that one of the most important things that we need to know about species is their characteristic regeneration strategy – what is the source of successful reproduction? Reproduction comes from a finite number of sources: from new seedlings established after disturbance, from advance reproduction that persists through disturbance, and from sprouts from stumps or roots that also persist through disturbance.

WHAT DO WE KNOW ABOUT CHESTNUT REGENERATION?

We really don't know for sure where successful natural regeneration of American chestnut came from. Although we know that sprouts were successful, we don't necessarily know that seedlings were often successful. Can chestnut become established after disturbance and grow rapidly enough to compete successfully or does it have to persist through disturbance as advance reproduction, like the oaks and hickories and most other species that we have in the southern Appalachians? Perhaps it is like the oaks, which don't grow rapidly from small advanced reproduction as black cherry does, just as an example. Like the oaks, it might require a larger root system to sustain rapid height growth and to compete successfully. If it does require a large root system, what kind of light regime is needed to create or develop that large root system, and how long does it take for it to develop under those conditions?

I think the last question is extremely important. Does it behave consistently; is its regeneration strategy the same everywhere? Is it the same on xeric sites as it is on mesic sites? Is regeneration the same in Massachusetts as it is in the southern Appalachians? I don't think we really know the answers to these questions. It could well be that we'll find multiple strategies necessary in order to regenerate chestnut.

PRELIMINARY FINDINGS

In our initial study, which is only a couple of years old now, we decided to look at regeneration as well as we could with the limited plant material that we had. We are looking at the most fundamental of these questions, I think, which is where does successful regeneration come from if we are going to plant it? So we decided we would plant American chestnut seedlings in a very open situation, in a clearcut or a very low residual basal area oak shelterwood or that we would plant under an oak canopy and treat it in such a way that we would have a modest increase in light to be released several years later by an overstory removal. Those were the two basic treatments (open setting vs. under a canopy), and again, we were limited by the amount of chestnut plant material we had. The other thing we wanted to do in this study was to compare these strategies, planting in the open versus planting under a modified stand structure. But also we planted on both moist sites where yellow-poplar is a competitor and on drier sites where it is

not. As Phelps pointed out, yellow-poplar can be a fairly severe competitor. In the Southern Appalachians, it's maybe a little different than in Pennsylvania. But that is the nature of the study. At this point, all of the plantings are in eastern Kentucky, two of them are on National forest land, one at a college, one on a state forest, and the other on a school forest.

Figure 3. Open shelterwood planting site (20 ft^2 residual basal area).

We are in the process of completing the necessary paperwork to actually put a study on the Bent Creek Experimental Forest. It's been a long time coming, but we'll put in that study in the next year or two. But in the current location of the study the treatment was a very open stand condition, in this case a low residual basal area shelterwood (Figure 3). We chose this particular treatment because this is consistent with the forest plan on National Forest Land. We would not necessarily have been allowed to clearcut on National Forest Land. We created very open conditions with this shelterwood cut, creating an open shelterwood with 20 ft^2 of residual basal area. This was also a midstory removal, where we took out perhaps 20%-30% of the basal area from below, using herbicide injections for that. Again we did those treatments on some north facing slopes, mesic sites, where yellow-poplar was a competitor, as well as on south-facing slopes, where yellow-poplar was not a competitor.

In summary, we have an open shelterwood cut on a xeric site (Figure 4), an open shelterwood cut on a mesic site (Figure 5), a midstory removal on a xeric site (Figure 6), and a midstory removal on a mesic site (Figure 7).

Figure 4. Open shelterwood cut on xeric site.

Figure 5. Open shelterwood cut on mesic site.

Figure 6. Midstory removal on xeric site.

Figure 7. Midstory removal on mesic site.

EARLY CONCLUSIONS

So far we don't see any differences in survival among the sites and treatments (Figure 8). Chestnut planted in the open grows faster than those planted under more shaded conditions (Figure 9). But all of the seedlings have grown. It will be another 3-4 years probably before we are really able to definitely assess the competitive status of chestnut planted in the open.

This story is not complete yet. You can see the chestnut seedling in the open shelterwood site in Figure 5. But on the other hand, there is also yellow-poplar. We don't know whether that chestnut can actually compete with yellow-poplar, the primary competitor, without supplemental competition control. We certainly found that oaks cannot do so. So that is really the story we are looking at here, especially in the southern Appalachians – whether or not the planted chestnut can keep up with some of the competition, notably on the higher quality sites. And especially whether it can keep up with yellow-poplar on the really mesic sites. It's going to be quite awhile before we are able to assess the competitive status of chestnut that was planted under a modified canopy and then subsequently released. That is probably about a decade away.

So we do not know how much competition control is going to be necessary to establish chestnut under various conditions. But, I guess I do question from a logistical and economic point of view whether or not we can effectively reintroduce chestnut on a very, very large scale and control competition as intensively as may need to be done, particularly on mesic sites. It's entirely possible that we may end up looking at different planting strategies, one for one more xeric sites and a different strategy for mesic sites. I don't think we know this yet, and only time will tell, at least in the southern Appalachians.

Finally, I would also like to pose a question that might spur some additional research. If we find that we need to adopt multiple strategies or if we simply find that planting under a modified canopy might be a

viable strategy, do we need to look at how we produce seedlings that are well adapted to the environments in which they are being planted? This work should really operate in tandem. I am not sure that we are going to get perfect answers, as we are limited in terms of the plant material that we have to work with. But it could well be that we might want to modify the way that we produce seedlings if we are going to be planting them in more shaded environments.

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