

The Role of Seed Orchards in Climate Change



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People are becoming more concerned about the implications of climate change. Some scientists are telling us that historical species migration rates are much slower than what will be required as per some climate change model predictions. With this in mind people are suggesting we need to assist species migrations by setting up a network of **seed orchards**. These seed orchards could be plantations of:

1. species not currently in an area, or
2. southern provenances of existing species

Why do this?

They could serve as test plantations to see what might do well but this requires very specific documentation of what plant material is used and also requires long term monitoring to be able to judge its performance. They could serve as gene pool reserves to help buffer against the loss of the genetic material at its origin (due to climate change, insects, diseases or human settlement impacts). And they might serve as actual seed orchards to help regenerate future forests. This is if they manage to survive and produce seed in a climate that is not only different than their origin but also subject to the extremes that are projected to occur along the way – the change period between what we have and what it will settle out to be(??).

Planning and Implementation:

Once you've set your objectives, there is great complexity in the implementation (including planning and raising funds), that is, in getting any new plantation well established and maintained. Simply moving trees north is a crude plan. Adaptation to Climate is only one aspect of a species ability to thrive and reproduce. Other aspects must be considered including what sites you are moving material to:

1. soils – pH, texture, depth and drainage
2. elevation effects – uplands vs valleys at the same latitude can have very different local climates.
3. water body effects, i.e. our Great Lakes
4. interactions with other species – from soil microorganisms (beneficial and harmful fungi) to insects (pollinators and pests), birds, mammals and competing plants. Some things we introduce might turn out to be, or bring with them, **INVASIVE** species and cause disruption to current systems, e.g. buckthorn, garlic mustard, Norway maple, emerald ash borer, etc

Then there is the question of what genetic material you are moving north. What are the genetic principles that will guide selection of species, seed sources and parent trees.

1. Species Diversity including identification and hybridization
Which species do you select, recognizing that at the species level there is genetic adaptation to broad climate and site types? White pine won't do well in a swamp even if the climate is suitable. Then there are natural hybrids - soft maples, oaks, Amelanchiers, willows, hawthorns etc are confounding people – even the botanists sometimes. In these cases if you see something of interest – if it's growing well and reproducing – then describe it **WELL**, document it and choose a similar site for your seed orchard planting.

2. Seed sources and candidate parent tree or genetic quality
One of biggest defenses against threats – current and future - is genetic diversity. The opposite idea is to try to guess which tree we think will survive future conditions and clone it. Maintaining diversity gives us options especially in a very uncertain future. To help ensure genetic diversity within a species see the attached Seed Collection Guidelines which we give to seed collectors trained under FGCA's Ontario's Natural Selections seed source certification program.

Ontario's Natural Selections

Seed Collection Guidelines

Seed collectors have a tremendous influence on the capacity of reforested ecosystems to provide ecological, social and economic benefits for many generations.

1. Identify & maintain seed lots by location

- ◆ Seed Zone level is the bare minimum (OMNR 1996)
- ◆ A County or Township level gives you more flexibility, particularly in poor seed years, to match the seedlot to potential planting sites, possibly beyond a seed zone border.
!! – climate change implications demand a much more exact location be documented, so that performance can be judged and tracked back to the source, to either repeat the use of that seedlot, or not!
- ◆ To ensure planting stock is adapted to site conditions
- ◆ To avoid introducing mal-adapted stock which may contaminate adjacent stands

2. Collect seed from high quality stands - healthy, vigorous trees of good form

- ◆ To avoid poor genetic quality from stands which are too small or have been subjected to high grading. (High Grading = best trees removed, often resulting in a poor quality residual stand.)

3. Collect from stands with a large number of trees; depends on species:

(> 100 trees of seed bearing age for white pine; >5 for a species that is naturally more rare)

- ◆ To ensure collection from a broad genetic base.
- ◆ To reduce risk of collecting inbred seed.
- ◆ To increase the number of seeds per cone by reducing chances that 'selfing' has occurred.

4. Collect from a variety of trees distributed throughout the stand (15 to 20 trees):

- ◆ To avoid collecting seed of closely related trees.
- ◆ To collect a representative sample of the genetic diversity of the stand.

5. Collect seed in a good seed year:

- ◆ To ensure a large number of parents have contributed to the seed crop.
- ◆ To obtain more and higher quality seeds per cone

6. If you collect from plantations ...

- ◆ Collect from plantations of adapted and known seed source or,
- ◆ Collect from plantations of proven performance - mature and healthy, not maladapted.

7. If collecting from species susceptible to a specific disease or insect ...

- ◆ Collect from healthy trees or those that have recovered from attack. This will increase probability that some seedlings will be resistant.

8. Use handling and storage practices that maximize seed survival

- ◆ Consult seed manuals
- ◆ To avoid introducing artificial selection pressure which may reduce adapted genetic diversity (e.g. seed that survives high temperatures in an overfilled bag may not be the seed that best survives a tree planting situation).

Documentation, Monitoring and Reporting

It could well be that the people who establish these orchards will not be around to monitor them and judge their performance. Therefore it is very important to set up a system to Document, Monitor and Report – so that people in the future can truly benefit from these efforts.

The MNR has been working with many partners to develop a 'Stewardship Tracking System' a newly developed online mapping tool to track project information. This may be a solution for the seed orchard efforts:

” This tool enables conservation organizations in southern Ontario to enter the location and other information (e.g., species planted, seed zone origin of planting stock, etc.) about their tree planting projects. The STS will enable OMNR and their partners to collectively track and report the success of projects. Over time the STS will enable MNR and organizations conducting tree planting programs to learn about the factors that contribute to successful projects”.

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