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Newsletter of the FFESC project 2009-006: Red Alder Adaptation Strategy

Issue 2, September 2010

Introduction

This is the second issue of a newsletter for the FFESC Red Alder Adaptation Strategy project group. The purpose of this newsletter is to facilitate communication between various research teams within the project, with client groups and with other FFESC project teams. The intent is produce new issues on a semi-annual basis, with updates on progress and significant findings from each of the project teams.

Management of Red Alder – Why Not Now?

Craig Farnden, PhD RPF

Over the past few decades, there has been increasing interest in actively managing red alder in British Columbia as part of the coastal forest landscape. Beyond its recognized contributions to healthy and diverse ecosystems and cultural values, red alder is now recognized as having significant timber values. For example, on private holdings in Washington and Oregon States, land owners are experiencing financial returns for red alder on selected sites that exceed those for conifer species including Douglas-fir. Despite the known benefits, enthusiasm for actively managing alder in British Columbia has been slow to develop beyond a small number of organizations such as Northwest (Weyerhaeuser) Hardwoods. If we wish to develop a vibrant and sustainable segment of our forest economy that is based on hardwoods, it is prudent to identify some of the impediments that might exist that could be inhibiting such a strategy.

In discussions with licensee and government personnel that have an interest in alder management, a number of issues were identified that may be contributing to the slow adoption of interest in alder management. A few of the major points are described below.

Perceptions of a Conifer Bias

For many decades, red alder was viewed almost exclusively as an unwanted competitor that impeded growth of conifer crop trees, and we spent large amounts of money trying to eradicate it. For some people, it may be a difficult adjustment to move from a management culture where alder is a weed to one

where it is a valuable asset. Human biases are slow to change, particularly in a forestry environment where efforts to validate new paradigms through research and case studies can take many years.

No Commonly Accepted Strategic Direction

There are two primary benefits related to timber production that are commonly cited as accruing from increased management of red alder: amelioration of mid-term timber supply deficits and high log values. Both of these can be achieved through an intensive, short rotation approach to management. In this approach, trees are planted at the moderately high densities needed to promote early development of good stem form, they are thinned to maintain fast radial growth, and possibly are pruned. Mid-term timber supply deficits are reduced by producing a relatively high volume crop within 25 to 30 years, while at the same time producing high value saw logs. Long term timber supply will also benefit, as the mean annual increment (average annual rate of volume growth) for an intensive alder strategy often exceeds the maximum rate achieved by conifer stands on equivalent sites.

The alternate approach is an extensive strategy, whereby alder is both established and grown at high densities. This approach achieves slower radial growth rates, which in turn requires a longer rotation (typically 60 to 70 years) in order to achieve target log sizes. In comparison to the intensive approach, the extensive approach provides no timber supply benefits in the short term, and has a small negative timber supply effect in the long term. This latter effect results from slowing growth rates in alder stands beyond age 30, such that conifer yields will typically exceed alder yields by age 60.

There is no general agreement within BC on the most appropriate strategic approach, if any, to managing the alder resource. Many licensees are quite willing to establish hardwoods on a small percentage of their operating areas, but link this with efforts to minimize overall silviculture costs. For this reason, a considerable percentage of alder stands established to date are based on opportunistic acceptance of naturally regenerated alder on areas that have been or would otherwise have been planted to conifers.

Investment Sources and Links to Benefits

There are two general options for silvicultural investments in BC: public and private. For the most part, public funding for silviculture has been focused on short term and specialty issues, with a major emphasis on basic reforestation and strategic timber supply. To the extent that intensive management of red alder is primarily a financial investment, it seems unlikely to be supported for sustained investment by government. In the short term, it is speculated that public investments could be made for strategic timber supply purposes, but there is no mechanism currently in place to ensure the continued funding required for a full regime of intensive treatments on individual stands.

For private investments on crown land in BC, there are no effective mechanisms in place to ensure that those who invest in a forest crop will be the ones to benefit from the increased future values. Even on fixed area tenures where a licensee is reasonably assured that they will be able to harvest a given stand, the appraisal system provides no assurances as to how future benefits will be apportioned between licensees and the crown. The current Government has suggested statutory or regulatory change to promote private silvicultural investment on Crown land, but to date few details have been provided.

Risks are Poorly Understood

Where most silviculturists are reasonably familiar with the risk factors associated with re-establishing a conifer crop, they are less familiar with those related to red alder. While some factors such as growing season frost and ungulate browsing are common to both, the level of risk may vary considerably with a new and unfamiliar crop species. In a restricted economic climate such as that which we are currently experiencing,

businesses tend to become risk averse, making it difficult to justify forays into unfamiliar territory.

In the spring of 2009, the Silviculture Working Group of the Coast Region Implementation Team (CRIT) released a document titled *Hardwood Management in the Coast Forest Region* [\[link\]](#). This document addresses many of the technical and administrative issues related to establishing alder stands, and some of the issues related to risk. Administrative biases against hardwood management have been further addressed through endorsements from the CRIT co-chairs and the MFR Regional Executive Director.

Building a Multi-Disciplinary, Cross-Organizational Project

Louise de Montigny PhD RPF

How do researchers with a diverse range of interests located in different provinces and even different countries come to collaborate on a multi-disciplinary project? It's both who you know and what *they* know!

The Future Forest Ecosystems Science Council's (FFESC) 2009 Call For Proposals provided a unique funding opportunity. It required pulling together a multi-disciplinary research team that could design adaptive actions to reduce the vulnerabilities of BC's forest and rangelands to climate change. The Council clearly identified the guiding principles for eligible projects, so it was a matter of ensuring the project proposal met the requirements.

We knew that the project was to build on existing knowledge bases of best available science and to take advantage of the province's research networks, long term field experiments, models and databases. Myself and George Harper (MFR Research Branch) had already begun discussing with Phil Comeau (U. of Alberta) about how the FFESC initiative could promote further research using the alder long-term research installation network established in B.C. by Phil and George in the 1990s. Phil could see an immediate link to climate change if we expanded the network of alder installations to include hotter, drier ecosystems of Washington and Oregon. This resulted in an invitation to David Hibbs (Hardwood Silviculture Cooperative, Oregon State University) to join the project team. The expanded network of installations would allow us to address questions such as "What are the effects of climate, age, soil and latitude on growth of red alder and Douglas-fir and the interplay between climate and competitive vs. facilitative effects of red alder?"



Photo: George Harper

The alder installations had all been sampled for soil carbon at the time of establishment, and with additional sampling could address the question of how well alder could sequester carbon. I recalled discussions with Marty Kranabetter (MFR Coast Forest Region) about the dynamics of carbon sequestration under different forest management regimes, and invited Marty to join the team to examine the changes in carbon over time at each of the alder installations. Meanwhile, George was aware of two provenance trials established in northern and southern BC that could provide a genetic link with alder's adaptability to different climates; Phil invited Barbara Hawkins (Uvic) to join the team to address "What is the range of adaptation vs. acclimation in alder's response to variation in climate?"

Another FFESC requirement was that the project be interdisciplinary and, in particular, address socio-economic systems. At this point the research team had little socio-economic expertise, and I called on Bruce Larson (UBC), my past graduate student supervisor from Yale University, for advice. Bruce expressed immediate enthusiasm for the project and suggested that Robert Kozak (UBC) would be a good fit to address "What steps need to be taken to develop an integrated hardwood forest sector value chain industry on the coast?" In addition, Ron Trosper (UBC) could use his expertise in working with First Nations to address "What traditional knowledge can First Nation elders provide that will help us to learn about the potential for future cooperative management of alder in the case study area?" Both Rob and Ron agreed to join the research team.

The FFESC also made it clear that the researchers were to work in partnership with clients. George had recently become a member of the Hardwood Silviculture Working Group (HSWG) of the Coast Region Implementation Team, which provided an ideal client group. Rod Negrave (MFR Coast Forest Region), a silviculture researcher who had collaborated with me on a number of projects, was also a member of the HSWG. Bringing his experience in working with cross-disciplinary teams and with clients groups was seen as invaluable to the project. Rod agreed to join the team to liaise with the HSWG to ensure the information generated was directly relevant to their needs.

A final FFESC requirement was that the project provide useful products within a two-year time frame. The HSWG had created a Hardwood Silviculture Strategy document that indicated

immediate use could be made from answering "Where can alder be planted today that minimizes risk from climate change and maximizes benefits to forest-dependent communities including First Nations?" I had recently been involved with a Future Forest Strategy in which Tongli Wang (UBC) had mapped preliminary climate change predictions for the Strathcona Timber Supply Area. After a quick call from Bruce, Tongli was pleased to join the team to continue the work he had started in the Strathcona.

Finally, the project had a competent team with members that could collectively bring the required training, experience and skills to successfully carry out the research project. We now needed someone who could work closely with the various researchers and graduate students and synthesise the knowledge gained from the multi-disciplinary biological, ecological and socioeconomic projects into an inter-disciplinary adaptation strategy that would reduce environmental, social and economic risks of climate change in coastal B.C. Craig Farnden (UBC), a doctoral student of Bruce's was just completing his dissertation and had both the experience and enthusiasm to meet the challenge.

Sheperded by the lineup described above and aided by a hard working group of graduate students, the project is progressing well. A second meeting of the entire team takes place in October to discuss progress to date and to start the integration process that will lead to a set of cohesive products. Putting it all together will be challenging, but working with such a dedicated and competent team is highly rewarding.

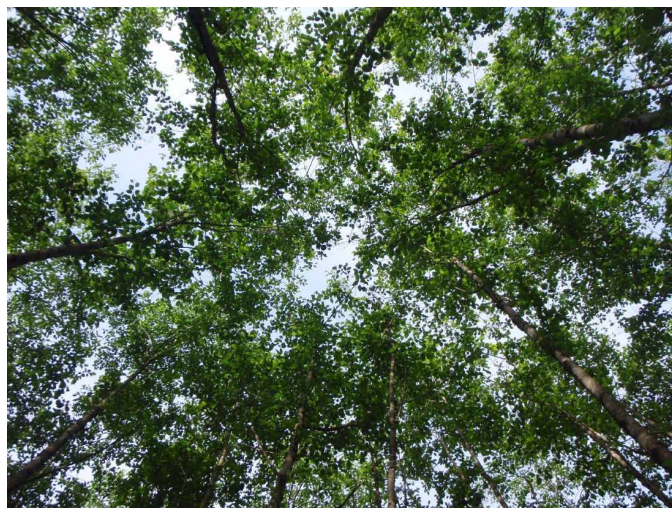


Photo: Craig Farnden

Red Alder and Adaptation to Climate Change

Craig Farnden PhD RPF

In the previous issue of *Aldern*, a relatively narrow definition of “adaptation” was presented that was specific to evolutionary processes, whereby genes that have become advantageous in new or altered environments become more prevalent over many generations. In climate change literature, the term adaptation is given much broader context. The Intergovernmental Panel on Climate Change (2007) defines adaptation as:

“adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities”.

An adaptation strategy for red alder, then, has two distinct but interwoven components relating to the impact of climate change. The first of these is the biological response, which includes both the genetic adaptation and acclimation processes described in the last issue, but also natural patterns of species migration. The second is the human response: all of the actions we choose to take in order to mitigate adverse impacts or take advantage of opportunities that result from potential climate change scenarios. Ultimately, a climate change strategy focuses on the second of these, but must be undertaken with as much knowledge and understanding of the first as possible.

One of the first steps in developing a climate change adaptation strategy is identifying the vulnerabilities of the species or ecosystems of concern. Some of the things we *think* we know about red alder at present and believe to be likely outcomes of climate change include:

- coastal BC is expected to become warmer and drier over the next century, but with a lesser degree of change than most other forested biomes,
- red alder is drought intolerant, with productivity generally high on moist and very moist sites, but dropping off rapidly on drier sites; over the next half century, productivity will likely increase on sites where moisture is rarely limiting but will drop where drought conditions become more frequent and of longer duration,
- red alder is frost intolerant and is susceptible to snow breakage, two factors which currently limit its range; with increased warming, the potential range for red alder will spread to higher elevations and possibly to inland valleys, and

- disturbances (fire, wind, insects and disease) will become more common, and forested landscapes will shift somewhat toward earlier seral conditions.

Managing in response to climate change is very much an adaptive management exercise. In the early stages, we will need to make many educated guesses about future outcomes, and at least some of them will be wrong. The current FFESC projects represent part of the process for ongoing development of new and refined knowledge in this cycle; as better information becomes available it can be incorporated into the next iteration of plans for climate change adaptation.

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Growing Alder and Douglas-fir in Intimate Mixtures

Craig Farnden PhD RPF

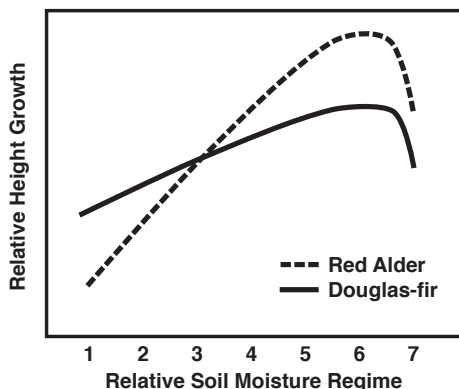
In recent discussions with a number of silviculturists, I have learned that there is considerable interest in establishing intimate mixtures of alder and Douglas-fir on the south coast of BC. There is, however, considerable uncertainty around appropriate site selection and management regimes. Some help along these lines exists in the current literature, and most coastal BC silviculturists can point to case studies where they have observed the species co-existing to produce a timber crop.

Understanding how to grow alder and Douglas-fir in intimate mixtures depends on knowledge of several principles and their interactions:

1. for the purposes of timber production, alder should ideally be established with a relatively high degree of lateral crowding in order to maintain a single vertical stem and minimal branch sizes,
2. alder will usually exhibit faster early height growth than will Douglas-fir, and
3. excessive overtopping by alder will inhibit Douglas-fir height growth.

In intimate mixtures, stand densities for the alder component must be kept sufficiently low so as to not overtop and suppress the Douglas-fir. The corollary, however, is that in doing so there is insufficient alder density left to provide all of the needed crowding. It is evident, then, that some of the crowding must be provided by the shorter Douglas-fir trees, but to do so their crowns must come close in height to those of the alder.

The ability of Douglas-fir to provide this function will depend on the relative height growth rates of the two species, and these rates are highly variable. For example, a study from Oregon contrasted alder/Douglas-fir height ratios at two locations. On the better growing site, height ratios were 4.4:1 four years after planting, and 2.7:1 after a further 8 years. On the poorer site (with lesser stand heights at the same ages), ratios were 1.8:1 and 1.4:1 respectively. On the better site, Douglas-fir will have minimal if any impact on alder stem form, and it is unlikely that desired alder stem characteristics can be achieved from an intimate mixedwood. On the alternate site, outcomes for alder stem form in the mixed stand appear more favourable.



Conceptual diagram of expected unimpeded height achieved by 10- to 15-year old stands of Douglas-fir and red alder across an environmental gradient of soil moisture availability.

Height growth differences can also result in height suppression of the Douglas-fir by overtopping alder crowns. In cases where the early height growth of alder is considerably faster than for the fir, early crown expansion will also be faster. As a result, it will take fewer alder stems to create competitive conditions such that Douglas-fir height growth will be lost. On the poorer site in the study described above where 75% of the 1111 total trees/ha were alder, Douglas-fir height growth was largely unaffected by overtopping competition. On the better site, Douglas-fir growth was significantly reduced where alder composed as little as 30% of the same stand density.

The first step to identifying appropriate sites for establishing intimate mixtures, then, is quantifying the expected growth rates for the two species. There is relatively good information and procedures available in BC for assessing bare ground productivity for Douglas-fir, but not so for alder. There appears to be a general consensus that alder productivity varies considerably with growing season water stress (see Figure below left), but also with factors such as soil pH, soil texture and the frequency and intensity of growing season frost. In the short term, measurements on pre-harvest trees on the same site or nearby post-harvest trees on similar site conditions may be the only sources of site quality measures for alder.

New information that would be useful to provide guidance to silviculturists wanting to establish intimate mixtures of alder and Douglas-fir includes:

1. growth and yield estimates based on varying stand density combinations of alder and Douglas-fir, on sites with various combinations of Douglas-fir and red alder site index, and
2. improved methods to provide bare ground estimates of site index for red alder.

Some of this information is likely to be forthcoming based on a series of trials established by the Hardwood Silviculture Cooperative based at Oregon State University, along with additional trials established by the BC Ministry of Forests. Additional measurement and analysis of these trials is being undertaken by Dr. Phil Comeau and Francesco Cortini as part of the FFESC Alder Adaptation Strategy project (see March 2010 issue of Aldern). Other portions of these information gaps will require new initiatives or additions to existing projects such as the BC Ministry of Forests and Range SIBEC program.

Sources:

Deal, R.L. and Harrington, C.A. (Eds.) 2006. Red alder: a state of knowledge. Gen. Tech. Rep. PNW-GTR-669. USDA Forest Service, Portland OR. Available at: <http://www.fs.fed.us/pnw/publications/gtrs.shtml>

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Research Summary:

Effects of red alder and paper birch competition on growth of three conifer species in southwestern British Columbia

Francesco Cortini

The effects of red alder and paper birch on the growth of western redcedar, western hemlock and Douglas-fir; and the effect of red alder on nutrient availability was examined in a plantation located in the U.B.C. Malcolm Knapp Research Forest near Maple Ridge (B.C.) Trees were planted in 1999 and assessed in 2005 and 2006. Red alder and paper birch were planted alone and as a 50:50 mixture at four densities (0, 277, 556, and 1150 stems/ha). Conifers were planted at 3 m spacing in all plots. Eighty trees of each conifer species were selected and measured over two growing seasons. Light availability was measured at each conifer and competition was measured within a 5.64 m radius around each crop tree. Soil pits, soil samples, foliar samples and ion exchange probes were used to explore broadleaf effects on nutrient availability.

Key findings included:

- among the competition measures tested, light availability generally had the best correlated with conifer growth,
- the strength of relationships between the various competition indices and growth was highly dependent on the species analyzed,
- red alder affects light levels and conifer growth more than paper birch, and
- red alder improved soil nitrate availability; higher levels of Douglas-fir foliar nitrogen and calcium were noted with increases in red alder density

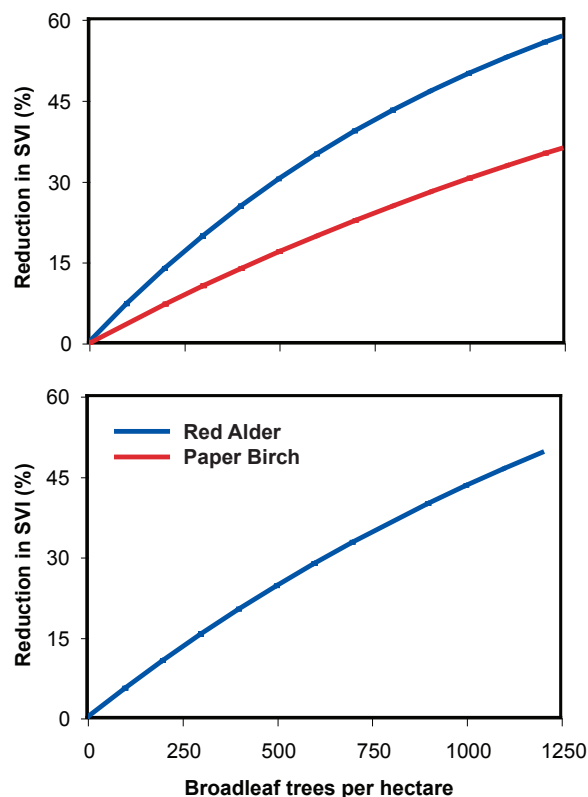
Shade-tolerance and conifer size in relation to the surrounding vegetation play key roles in determining conifer growth responses. The shade tolerant hemlock grew better under competition than the intolerant Douglas-fir; hemlock at age 7 was

unaffected at the highest alder densities studied. In contrast, the shade tolerant western redcedar was highly affected by surrounding vegetation. This outcome is likely a consequence of factors such as slow initial growth and small size for the redcedar, coupled with factors such as natural regeneration of broadleaves, deer browsing, effects of Vexar® tubes and other issues.

For western redcedar, stem volume reductions of 30% or higher occurred with a red alder density of 500 trees per hectare and with a paper birch density around 1000 trees per hectare. For Douglas-fir, major reductions in annual volume increments occurred with red alder densities between 500 and 750 trees per hectare, whereas birch densities (up to 1150 trees per hectare) did not influence Douglas-fir growth.

Source:

Cortini, F. and P.G. Comeau. 2008. Effects of red alder and paper birch competition on growth of young conifers in Southwestern British Columbia. For. Ecol. Manage. 256: 1795-1803.



Percent reduction of predicted stem volume increment (SVI) for western redcedar (top) and Douglas-fir (bottom) in relation to the number of trees per hectare of red alder and paper birch.

Project Group Team

The following individuals make up the team that is delivering the FFESC Red Alder Adaptation Strategy:

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