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Future Forest Ecosystems of BC Symposium

Working Group Report: Species and Genetics

Working group members

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This report documents comments obtained from working group members during a break-out session at the Future Forest symposium December 7, 2006, in Prince George, BC. The working group addressed topics related to the management, current condition, and possible future condition of tree species and genetic composition in harvested areas in BC. The purpose of this report is to document the points raised by the working group members. Therefore, comments have been edited only to the extent required to make them fit the report format and make them understandable to readers. No attempt has been made to reconcile duplicate or conflicting statements.

1. Possible changes and their implications

Working group members were asked to identify i) ecological changes that may occur that could impact tree species and genetic composition (and its management), and ii) the implication of these possible changes. Group members identified themes and grouped their statements by theme.

Anticipated change	Implication	Theme
1) First Nations will play a greater role in forest management and there will be an ongoing need to accommodate.	There will be an ongoing need to accommodate.	First Nations
2) The tree species re-established on harvested areas may change	Constitutional obligations when changing tree species.	
3) Markets will change	These changes need to be considered in current species selection.	Markets
4) New uses for wood may develop	More species will be utilised for speciality products	
5) Wood supply shortages will develop due to losses to mountain pine beetle and the harvest of second growth	Increasing pressure to meet wood supply (volume) needs	
6) Increasing frequency and severity of natural disasters (e.g., hurricanes and fires)	Increasing demand for wood products	
7) The tree species re-established at a given location will change	This change will impact the spatial distribution of other resource features (visuals, water, wildlife, plants, etc)	Biodiversity
8) Temperature will rise	Biodiversity will be impacted	
9) Loss of some species	As a result, the beneficial impacts of some species will also be lost (e.g., predation of the pests of trees).	
10) Loss of old growth retention areas	[not provided]	
11) Tree species composition will change	Wildlife habitat will be affected	
12) Loss of green trees	Impact on air quality and carbon sequestration	Ecosystem services
13) Tree species composition will change	Over time this will negatively impact some animal habitat.	
14) Hydrologic changes	Too much water in the spring and not enough in the summer	
15) Changes in vegetation will change hydrologic function	These changes will affect fish habitats	
16) Changes in the many stands that comprise a landscape	Cumulative, landscape scale, effects on ecosystem function	
17) Tree species composition and tree density may change	These changes will affect soil stability, increase sedimentation, and impact public safety.	
18) Increase in storm events	Various problems	
19) Conservation of water will become more important	This is an example of the need to consider the value of forests and species in very broad terms.	
20) Glaciers will melt	Less water in creeks and rivers	

21) Species may be planted in locations where they have not historically grown well in anticipation of climate change.	The uncertainty around future temperature change makes species shifting a risky undertaking. Need to discuss and resolve who should bear the cost of these moves.	Species and species movement
22) Species may be planted in locations where they have not historically grown well in anticipation of climate change.	Increased diversity of species in some areas but reduced diversity in others.	
23) Moisture and temperature will change	Tree species suitability will be impacted	
24) Conifers will be more difficult to grow in some locations	This may result in greater acceptance of broadleaf tree species.	
25) The environment will change	As a result, it will be possible to grow species in locations where they could not be grown before	
26) The environment is changing	As a result, species ranges and optimum planting zones are shifting	
27) The climate is expected to change	Thus, the following questions must be addressed: What species shifts do we anticipate and how should we manage these?	
28) Knowledge about genetics and the ecology of tree species is improving	Therefore, tree seedlings can be better matched to site conditions - at least in the short-term.	
29) Climate is changing	Locally adapted species and seedlots will be maladapted in the future	
30) Things will become more complex and less predictable	Need for flexibility and need to model complex species growth and interactions	
31) The climate may change	It is uncertain whether this will be positive or negative for natural regeneration	
32) Climate will warm	Could change the need for accepting broadleaf tree species as crop trees in stocking standards.	
33) Climate will warm	Current tree species may be unable to adapt	
34) Temperature and rainfall may change	Could change the best growing species for a given area	
35) Increasing area of complex and multi-species managed stands	[not provided]	
36) Temperature is increasing at a rapid and uncertain rate	Uncertainty in precipitation change and maladaptation	
37) Fire threat may increase around communities	Emphasis will increase on managing tree species composition around communities in ways that reduce the threat	Fire
38) Increased risk of fires	[not provided]	
39) Accumulation of dead and dying trees at a large scale	Fuel build-up that promotes catastrophic fire events with implication for public safety	
40) Temperature and rainfall may change	This change could shift seedlot ranges and seed zones.	Genetics
41) Climate may change	This question must be addressed: How do we determine our tree breeding strategy for anticipated climate change?	
42) Increased availability of tested genotypes (Class A seed from seed orchards)	Better understood genotypes	
43) Climate may change	Therefore, this question must be addressed: What are the potential genetic adaptations as ecosystems evolve with climate change?	

44) Increased percent of landscape a young forest	This raises the importance of ensuring that tree species and genetics are well managed in young stands	Plantation issues
45) Need structure and rigorous process to evaluate options and determine actions	[not provided]	
46) Climate will warm	Need to understand the role of shade and partial cutting in hotter climates	
47) Greater frequency of climatic events	Resulting in tree mortality and growth disturbance (though sometimes increasing growth).	
48) Increasing climatic extremes and uncertainty	Increased risk of plantation failure where management regime is uniform	
49) Increased drought and disease and insect attacks	Increased plantation failures	
50) Increasing extreme climatic events	Increased mortality	
51) Increasing activity of existing damage agents and emergence of new damage agents	More mortality	
52) Increased climatic uncertainty and possibly increased variability	More variation in plantation establishment success	
53) Climate may change	Perhaps improving growth in some cases, but increasing mortality, and decreasing health and growth, in other cases	
54) Easing of factors that limit tree growth (e.g., increased temperature, increased rainfall, increased CO ₂ , lengthened growing season)	Increased growth rates (generally)	
55) Changes required with reforestation growing stock recruitment and future analysis for cut levels, biodiversity, etc	[not provided]	
56) Increased CO ₂ will interfere with ozone layer	Excessive UV radiation	
57) Change in length of growing season (number of degree days)	This change will be more beneficial to pests than trees	
58) Climate may change	This question must be addressed: what is our strategy to promote diversity in the face of changing climate?	Management strategies
59) Need to clearly define risks and rewards of proposed strategies	[not provided]	
60) Need to define (agree upon) potential changes in climatic factors (temperatures, moisture, and seasonal variations).	[not provided]	
61) Reduction in factors that limit pest populations	Increased pest survival, increase in pest ranges, and more outbreaks, resulting in increase in pest damage (losses)	Pests
62) Increase in introduced insects, pathogens and plants	More competition and mortality of crop trees	
63) Change in insect and disease impacts	Thus, the question must be addressed: how do we factor in anticipated changes to insects and disease impacts?	
64) Increase in the number of unplanned situations (e.g., insects, disease, drought)	There will be an increase in risk to either the licensee, the Crown, or both, of catastrophic plantation failure that will substantially influence timber supply forecasts	

2. Current paradigm: Issues, problems and barriers

Each working group member was asked to make a brief comment on the current paradigm for the management of tree species and genetic composition in harvested areas in BC. Working group members were asked to comment on issues relevant to the current paradigm, problems with the current paradigm, and barriers to responding to change. Based on notes taken by both the working group facilitator and leader, this section documents the statements made by working group members.

- a) We need to approach this problem with humility. We need to increase tree species and seedlot diversity on the landscape. Uncertainty is the key. We lack the provenance tests required to devise robust seed deployment strategies.
- b) First Nations are concerned about the genetic manipulation of trees and favour a more natural approach to handling problems. What effect will climate change have on the many plant and animal species used by First Nations? TSR (Timber Supply Review) assumptions drive management and we need to change this or more accurately characterise current management.
- c) How much diversity do we need to meet biodiversity goals? Knowledge is a barrier and an issue.
- d) The current paradigm is leading to a reduction in diversity. Are staff levels in the ministry and industry a barrier?
- e) Species diversity is critical. We need to plant more species. The push to get to free growing at low cost and with high reliability creates problems. The structure of stocking standards in BC is a concern as it allows single species planting.
- f) The conifer bias in the selection of preferred species is a problem. Who should decide which species are preferred? “Fringe species” (e.g., whitebark pine, subalpine larch, etc) are of concern and current reforestation policy takes no notice of them. Current policy is focussed on commercial tree species, but it should consider all species to promote the public good overall. Need more learning, and ongoing learning, to keep up with advances in research.
- g) The current structure of the stocking standard, where every single hectare must meet the standard, leads to a decrease in biodiversity. The bias toward conifer species is a barrier. However, few areas are planted to monocultures. Climate change in the north may increase diversity. The lack of incentives for research by industry on public land is a problem and a barrier to advancement.
- h) Provincial policy that limits broadleaves is a barrier. For example, a licensee on the coast that harvests broadleaf trees is required to reforest with conifers and brush out the broadleaves on most of the areas they harvest. Seed zones, and allowable species ranges, need to expand slowly over time to accommodate climate change. However, there are policy impediments to this.
- i) We need to accept broadleaves, encourage natural regeneration, and plant fire resistant species.
- j) Need to ensure that the selection of tree species meets the needs of fauna (e.g., mule deer and Douglas-fir).

- k) The conifer timber bias is a problem as is managing for corporate profit, scientific arrogance, and uncertainty about what the future may bring. One barrier is the lack of communication on silviculture failures. This slows the learning from past experience. Rather than relying solely on planting, more effort should be made to protect advance regeneration during harvest. In the face of climate change, forestry should move towards uneven-aged management so that there are always green trees left to absorb carbon and protect seedlings.
- l) One problem, and a barrier to advancement, is that we lack a set of metrics to characterise the key aspects of tree species and genetic composition - both within stands and among stands at the landscape or forest level. We lack a system for setting targets and reporting achievements against targets for aspects of tree species and genetic composition that we now recognise as important (for example, diversity of species composition).
- m) We need to revise the species selection guidelines to accommodate climate change. We need to reconsider where broadleaves should be cut/killed. We must reconsider current standards in light of successional pathways. We need a system of incentives to stimulate superior performance, rather than penalties. The “take-or-pay” policy leads to reduced partial cutting. The role of shade in regeneration needs increased attention in light of potential climate change. The current TSR discriminates against better management for diversity through its emphasis on commercial tree species. The current paradigm does not allow for adequate public input. Continuing education is a barrier. The protection of advance regeneration is expensive.

3. Recommendations for change

Each working group member was asked to recommend changes to the current paradigm for the management of tree species and genetic composition in harvested areas in BC. The working group asked the working group leader to find themes in the recommendations and to group the individual recommendations by theme. Based on the notes taken by both the working group facilitator and leader, this section documents the recommendations made by working group members.

3.1 Review and revise free growing and seed transfer policies

Many of the working group recommendations relate to what might be broadly termed “free growing policy,” which includes guidelines for matching tree species to site conditions (tree species selection guidelines), seed transfer rules, the format (or structure) of stocking standards, the choice and approval of tree species as preferred (or acceptable) in stocking standards, and how these requirements are interpreted, administered, and enforced.

Term ¹	Recommendation
S	Review and revise various elements of the free growing policy
?	Lengthen the earliest permissible free growing date to a mandatory 20 years
L	Understand successional pathways and apply this knowledge in forest management

S	Change the species selection guidelines
S	Review and revise the seed transfer rules (and seed zones) using current knowledge of climate change and genecology
S	Examine alternative seed transfer systems that may improve site productivity, accommodate climate change and create opportunities for wider deployment of A class seed
S	Allow some level of broadleaves
S	Eliminate the requirement for every hectare of a standards unit to meet the stocking standard
S	Use future BEC variant maps to guide current species selection
S	Update stocking standards

¹ ? indicates term not recorded in notes.

3.2 Review and revise harvesting and timber pricing policies and practices

Several of the recommendations of the working group pertain to harvesting and timber pricing.

Term	Recommendation
S	Revise the “take-or-pay” policy to eliminate the disincentive for partial cutting.
L	Encourage uneven-aged management (as opposed to clear cutting) whenever possible to mitigate anticipated effects of climate change and sustain ecosystem function in beetle-attack areas
S	Develop mechanisms to promote environmentally sensitive logging, including the protection of advance regeneration.

3.3 Increase research and application development efforts

Term	Recommendation
?	Hire more forest health specialists
S	Fund traditional silviculture research
S	Increase in Ministry of Forests and Range activity in basic silviculture research
?	Increase the recognition of the value of long-term experiments
?	Catalogue and review the performance of outplantings of species outside their native range and provenances moved far from their origin
?	Use stand growth models to simulate the growth of species mixtures to design “smart mixes”
?	Develop mixedwood stand, and young stand, growth models
L	Make the TSR process more transparent
L	Develop realistic TSR spatial adjustments linked to sustainable biodiversity targets

3.4 Change the prevailing management philosophy

Term	Recommendation
S	Promote broadleaf trees
S	Make managing for diversity and resilience a key consideration
?	Change policy to allow for loss of the timber harvesting landbase so that treed areas may convert to parklands, and conifer areas may convert to mixedwoods or broadleaf areas, where appropriate
?	Pay more attention to managing and conserving fringe species and isolated populations.
S	Increase the level of management of young stands after free growing by the Ministry of Forests and Range.
L	Initiate a discussion on how to (and who should) pay for the recommended changes.
?	Promote discussion on what we're managing for (what are the objectives, how should we rationalise tradeoffs among competing objectives, etc).

3.5 Address First Nations concerns

Term	Recommendation
L	Incorporate aboriginal resource values into the planning framework (e.g., stocking standards that recognise the desire for berry production).
S	Recognise title and rights obligations when changing species selection and stocking standards.
?	Develop and update TEK (traditional Ecological Knowledge) databases.

4. Key information required

Each working group member was asked to identify information that was needed to i) improve the management of tree species and genetic composition in harvested areas in BC, or ii) support subsequent analysis of working group recommendations. Based on the notes taken by both the working group facilitator and leader, this section documents the key information requirements that were identified by working group members.

- To help determine when clear cutting should (and should not) be done, better information is needed on the nature of shade requirements for successful tree regeneration - especially in light of climate change.
- Information is required to support the revision of species selection guidelines and the designations of preferred and acceptable species in stocking standards, especially in light of climate change.
- More information is required on the use of broadleaves, and the impacts of brushing, to support a revision of the free-from-brush (free growing) criteria.
- More extension of research results to practitioners is required.
- There is a need to determine and communicate what has, and has not, been working in the management of tree species and genetics to date.

- f) More climate stations, more accurate measurements, and better climate records are needed.
- g) Designed experiments are required to test the movement of tree species and genotypes beyond their current ranges to support seed transfer and species selection policy change and development.
- h) More information is needed on tree species elasticity and species fitness.
- i) There is a need for long-term monitoring of the biotic and abiotic components of forest ecosystems (pests, vegetation, climate, etc).
- j) A growth and yield strategy is required.
- k) More needs to be known about the autecology of species.
- l) More needs to be known about the relation of species choices to future wood supply.
- m) A new generation of multi-species provenance trials is needed – wide-ranging, long-term multi-species productivity experiments to develop species and seedlot selection systems that will maximise productivity and health of plantations in future climates.
- n) Information is needed on the performance to date of outplantings of species that are beyond their native range and provenances that have been moved far from their origin.
- o) Predictions from multi-species stand growth models are required to identify healthy, productive, and resilient species mixes.
- p) Predictions from mixedwood stand, and young stand, growth models are required.
- q) Realistic TSR spatial adjustments linked to sustainable biodiversity targets are required.
- r) Traditional ecological knowledge must be assembled and used.
- s) Operational staff require knowledge in the form of extension of current research results.

5. Summary

A wide range of ecological changes and associated implications were anticipated by the working group. In broad terms, changes in the frequency and severity of natural disturbances (e.g., fires, floods, and drought) were anticipated. Changes in climate were anticipated (e.g., increased mean annual temperatures, altered precipitation regime, and increased CO₂ concentration). Changes in the composition of vegetation communities were anticipated. Changes in risk levels were anticipated (e.g., increased fire risk). Changes in management were anticipated (e.g., changes in the species planted and advancements in the fields of genetics and silvics). Some group members noted that climate change might interact with some of the potential changes and intensify their adverse consequences (e.g., increased activity of insect and disease damage agents as climate change creates conditions more favourable for pest outbreaks). Though the focus of discussion was ecological change, it was clear that potential technological, economic, and societal changes must be considered at some juncture.

The working group identified some of the implications of these possible ecological changes. A wide variety of ecosystem attributes, services, and processes may be negatively affected by the anticipated changes (e.g., biodiversity, wildlife habitat, air

quality, carbon sequestration, fish habitat, soil stability, stream sedimentation, water yield, and species diversity). Many group members noted that a significant change in climate may cause trees that are currently well adapted to become poorly adapted within part of their current ranges. In addition, the anticipated changes may shift species ranges and suitability for given sites, and optimum planting zones. Several group members noted that a modest change in climate may increase stand growth rates in some areas. The anticipated changes will have impacts at multiple scales, so that in addition to local effects, cumulative, landscape-level effects on ecosystem function are expected. Incomplete knowledge and uncertainty around the possible changes and implications make management responses risky and raise questions such as what management strategies to employ, who should pay, and how should the risk be shared among affected parties.

In discussing the current paradigm, group members frequently emphasised the need to increase tree species diversity and manage the genetic composition of tree populations on the landscape. Various aspects of the current free growing policy were criticised as an impediment to improving the management of tree species and genetics into the future. Aspects criticised included the way the free growing requirement is structured, the responses it triggers in licensees, and the way it is interpreted and enforced. Contemporary views that favour conifers over broadleaves were identified as a problem by many members. Some members argued for a broadening of perspective to ensure that species and genetics are managed in ways that recognise the broad range of public values that are at stake. Knowledge, staff levels, and continuing education were considered issues. Uncertainty was identified as a key characteristic of the current situation. Some appraisal policies (take-or-pay) and harvest practices (level of green tree retention) were identified as issues given that they are important drivers of the ultimate tree species and genetic composition on harvested areas. It was noted that the current paradigm is based on penalties for poor performance, rather than incentives for superior performance.

Working group members identified many opportunities to improve various aspects of the current paradigm for the management of species and genetics composition on harvested areas in BC. The first set of recommendations pertain to reviewing and revising various components of the free growing policy, including the i) control over early declarations, ii) species selection guidelines, iii) seed transfer rules, iv) requirement for all portions of a harvested area to meet the free growing standard, and v) impediments to allowing broadleaves to grow on harvested areas. The second set of recommendations relate to harvesting and timber pricing policies and practices. It was recommended that uneven-aged management should be encouraged and practised where appropriate and the “take-or-pay” policy should be revised to eliminate the disincentive it provides to partial cutting. The third set of recommendations relate to increasing the effort on relevant research and application development. The fourth set of recommendations relate to various changes to the current management philosophy including managing fringe and isolated populations, increasing the management of young stands post free growing, and encouraging discussion of management objectives and feasible processes to rationalise trade-offs among competing objectives. The fifth set of recommendations pertain to addressing First Nations concerns, including incorporating aboriginal resource values into

the planning framework, recognising title and rights obligations when changing species selection and stocking standards, and developing and updating TEK databases.

Working group members identified a variety of critical information needs. Research is required into questions relating to shade requirements, broadleaves, climate trends, performance of tree species and genotypes growing outside their native range, tree species fitness, genecology, and the autecology of species. Information is required on the impact of tree species alternatives on future wood supply. Stand growth modelling capability needs to be improved to reliably simulate the development of mixed species, multi-cohort stands, young stands, and conifer-broadleaf mixedwood stands. Improvements in TSR are required to better consider future stand and forest conditions under scenarios of climate change, pest loss, and new silvicultural regimes. Additional extension of research results to operational staff is required. A growth and yield strategy is required. Finally, traditional ecological knowledge needs to be assembled and utilised.