

AFTER THE BEETLE: ECOLOGICAL RESTORATION AND CLIMATE CHANGE IN BRITISH COLUMBIA

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SUMMARY

The widespread decline of lodgepole pine (*Pinus contorta*), in combination with advancing climate change, poses enormous ecological and social challenges. Transformation of the landscape within the next few decades is almost certain. Modern ecological restoration offers strategies to help meet those ecological and social challenges. Only two decades ago restoration concerned itself mainly with rehabilitation or reclamation of specific damaged sites such as gravel pits or mine tailings. The principles and activities of restoration today cover a much broader field, including “the recovery of an ecosystem that has been degraded, damaged or destroyed” (from Society for Ecological Restoration International website <http://www.ser.org>). Modern restoration is a holistic enterprise focused not so much on ecosystem elements but on the ecosystems themselves and their key processes. It concerns itself with the return of natural (native) attributes, stability (or shifting equilibrium) where humans (and their values) are often viewed as part of the ecosystem. The return of the predisturbance condition may be the endpoint of the restoration, though this may not be achievable in practice, especially in the light of climate change.

Recent pine ecosystem restoration efforts (Tomback et al. 2001, Freiderici et al. 2003) reveal the nature of the issues: limited understanding of ecology, complex interactions, competing human values and philosophies, long recovery times (1-2 centuries), and importance of key ecological processes such as fires. An important tool in ecological restoration is the recognition of essential ecosystem characteristics for the ecosystem, followed by an assessment to determine which characteristics are degraded or at risk. To date limited consideration has been given to climate change in developing restoration strategies and prescriptions.

Increasing global and regional temperatures indicate that climate change is underway. It is likely having ecological effects, the mountain pine beetle outbreak itself being one example, the decline of western redcedar being another. If current trends continue, the change will be of large amplitude, will occur rapidly on the geological time scale, and will progress in an oscillating (between extremes) manner rather than gradually. Climate change will be of global extent and occur on relatively disturbed landscapes.

Significant ecological and social consequences are likely inevitable. Data from the recent fossil record in the mountain pine beetle outbreak region, and from models, indicate that we can expect the following: higher than present tree-lines, changes in forest structure and composition, major expansion of grasslands and shrublands, changes in and even disappearance of wetlands, shrinking of lakes, increased fires. New kinds of ecosystems will likely arise. An important consequence will be the “big squeeze”, where a species such as western redcedar will be killed off rapidly in parts of the range where climate is no longer suitable, but unable to occupy potential new areas because of limits to dispersal. The net effect will be a markedly reduced area of occurrence and abundance. Where keystone species disappear and sites are disturbed, invasive weeds will spread likely at unprecedented rates.

The forest industry will face challenges but may also have opportunities. Change is certain, though the path and degree of change is not. Forest composition, structure and productivity will be altered. Growth will improve in the north and mid to high elevations and the choice of species for replanting increase. However there will be decreased or no tree growth in some southern and droughty sites. Climate sensitivity analysis using the fossil record and models can help identify potential future forest responses, types and distributions.

Appropriate forest restoration and management strategies might include: landscape level planning with climate sensitivity analysis, bold experiments such as ecological plantations/agro-forestry of high value timber species, preservation of genetic stocks from hot dry parts of species ranges, development of comprehensive site water balance models, use first of an ecoclimatic decision table (species vs. range of future climates) derived from updated bioclimatic profiles, followed by use of pest/yield etc. vs. climate decision tables, establishment of a comprehensive meteorological network, and minimal soil disturbance.

Ecosystem and landscape level restoration must consider a broader range of strategies, including those that focus on improving and maintaining resilience (capacity of an ecosystem to resist stress). Taking the landscape approach, ecosystems will need to be defined in terms of their key processes rather than specific composition, through the methods of Essential Ecosystem Characteristic analysis. The climate sensitivity of those processes will need to be established and mapped. Local communities, the users of the land, must be educated and involved in developing restoration end-points and carrying out restoration activities. Exceptional efforts will be needed to prevent invasion by exotic species, especially plants. And above all, we will have to prepare for major changes, and not invest in maintaining an eco-static landscape.

Example of a bold experiment: Cut and leave beetle-killed wood on the ground to add to the organic matter and prevent disturbance of the soil. The retained carbon could be compensated for as carbon credits. Organic matter will add soil nutrients, improve porosity and conserve moisture. The soil will have greater resilience to climatic fluctuations and the resultant ecosystem may be less susceptible to rapid transformation. Changes will occur but perhaps more gradually, and involve more native species and lower costs, than more active or invasive restoration. And communities may derive revenue or compensation for being carbon stewards.

Friederici, P. Editor 2003. Ecological restoration of Southwestern Ponderosa Pine Forests. Island Press, Washington, DC.

Tomback, D.F., Arno, S.F. and Keane, R.E. (editors) 2001. Whitebark Pine Communities: Ecology and Restoration. Island Press, Washington, DC.

Powerpoint Slides

THE BIG SQUEEZE

- Climate Change losses more rapid than natural dispersal
- Losses worsened by uncertainty of extremes
- Recovery will be patchy and slow for mid and late successional species
- Strong competition from invading exotics
- Few places to go on a converted landscape

ESSENTIAL ECOSYSTEM CHARACTERISTICS

- (Analysis of priority attributes; degraded or at risk)
- Habitat patterns
- Biotic integrity; biodiversity
- Ecological processes
- Water quality
- Hydrology
- Disturbance regimes
- Soil and sediment processes and quality