Seeking Alternatives to Clearcutting in British Columbia: The Role of Large-Scale Experiments for Sustainable Forestry

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ABSTRACT

Numerous large-scale, forest management experiments have been established in British Columbia as part of a government response to public protests over clearcutting. The experiments test the effect of opening size and concepts such as aggregated and dispersed retention, on an operational scale with experimental units usually exceeding 10 hectares. Most of the experiments are multidisciplinary in scope and, in some cases, they are interdisciplinary in practice. The short-term outputs from these experiments have been substantial. A few have led, directly or indirectly, to major shifts in operational practice. The initial surge of funding has now ended, however, despite these accomplishments. We describe several lessons learned in British Columbia that might have application in future programs with similar ambitions.

KEYWORDS: Clearcutting, forest management experiments, British Columbia.

INTRODUCTION

In 1990, public forestland management in British Columbia, which covers an area of about 25 million hectares (ha), was undergoing severe criticism from environmental groups and the public. This was primarily because of the almost universal use of clearcutting to harvest timber. The criticism focused on the cutting of “big trees” in the temperate rain forest of the southern coast, but echoes of the controversy were heard throughout the province. Although the use of clearcutting was vigorously defended by industry groups, forest professionals, and the government of the day as the safest and most efficient practice, the need for some change was also acknowledged. Part of that change was a government initiative headed by the Ministry of Forests to examine and develop alternative methods of harvesting for forest types throughout the province. A substantial body of research, development, and extension work grew from this Silvicultural Systems Program (Ministry of Forests 1992). As part of the program, numerous large-scale, forest management experiments were established around the southern half of the province, sampling a wide range of ecological conditions.

In this paper, we provide a brief description of the program and the long-term forest management experiments that were established under its umbrella. We draw some conclusions about the success achieved by the experiments, describe the lessons learned during their establishment, and speculate on their longevity.

BRITISH COLUMBIA’S SILVICULTURAL SYSTEMS PROGRAM

The Silvicultural Systems Program was initiated in 1990 to investigate alternatives to conventional clearcutting (defined as clearcutting in large blocks followed by site preparation and planting to create plantations). Over the 8 years of its life, from 1990 to 1998, about $17 million were spent on research, development, demonstration, and extension

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of alternatives.[4] Funding was provided first by the Provincial Silviculture Program and the Canada-British Columbia Partnership Agreement on Forest Resource Development from 1991 to 1995 and then by Forest Renewal British Columbia. Some of the research projects started under the program continue to be funded under successor funding programs.

The declared purpose of the Silvicultural Systems Program (Ministry of Forests 1992) was to encourage expansion in the range of forest harvesting practices used throughout the province. In 1988-89, 91 percent of the 270 000 ha harvested on public (crown) land was clearcut. The remaining area was cut using some variety of selection cutting, mostly by applying diameter limit cuts in the dry Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) stands of the southern Interior. Although the program did not have an explicit goal of changing the mix of forest practices within a specified time frame, the intention of change was clear. Public brochures and publications showed an idealized landscape with many forms of silvicultural systems in use from hilltop to valley bottom. Moreover, the existence of the program was used to provide the people of the province and purchasers of wood products from the province evidence of willingness to change (Benskin and Bedford 1994).

Well over 200 projects were supported over the life of the program. They ranged from long-term, multidisciplinary forest ecology and management experiments to one-day courses on such topics as even-aged partial cutting for professional foresters, and brochures describing the range of silvicultural systems for the general public. In mid-program, when expenditures peaked, about 45 percent of the funds were spent on long-term research trials, 30 percent on short-term biological and regeneration issues, 15 percent on issues such as timber pricing impediments to the implementation of clearcutting alternatives, 5 percent on extension, and 5 percent on administration. A companion initiative to the Silvicultural Systems Program was undertaken by the Ministry of Forest's Small Business Forest Enterprise Program. Government foresters worked successfully with small business operators over several years to create examples of silvicultural systems in several coast and interior parts of the province (Bancroft et al. 1997).

The program ran with substantial budgets for about 6 years, and severely reduced budgets for 2 more, before expiring amid a welter of political, institutional, and economic change. The long-term experiments initiated under the program received continuing funds from new funding sources for several more years until very recently, when a number of them have suffered funding cutbacks.

LARGE-SCALE SILVICULTURAL SYSTEMS EXPERIMENTS IN BRITISH COLUMBIA

We have documented 24 large-scale,[5] forest management experiments dealing with alternatives to clearcutting in British Columbia. They can be found throughout the southern half of the province. Two of the experiments were established many years ago, one of which was abandoned and the other recently re-established. Eighteen of the experiments were established in the course of the Silvicultural Systems Program. One has been established since the program ended. Almost all had, or have, the purpose of demonstrating alternative practices to clearcutting and compare clearcutting to some silvicultural alternatives. One examines only uneven-aged management. Several experiments were designed to examine opening size or overstory retention levels rather than textbook definitions of silviculture systems. Most consider more than timber values. They are also generally cooperative, multidisciplinary, and by necessity, interagency projects. The projects are listed in table 1, and their general location is shown in figure 1.

Major Accomplishments of the Forest Management Experiments

All of the experiments showed that at least some alternatives to clearcutting were operationally feasible. Detailed cost studies on some projects showed that some alternatives could be implemented with existing logging machinery and were not prohibitively expensive (e.g., Mitchell 1996, Phillips 1995). The experiments also showed that many of the environmental concerns regarding clearcutting were either not a concern (e.g., regeneration), or exaggerated (e.g., soil erosion and nutrient losses), at least in the short term (Arnott et al. 1995, Huggard and Vyse 2002b). These results have probably supported a reluctance to move away from clearcutting throughout the province. In 2002-03, clearcutting with reserves retained for either riparian protection or wildlife habitat was the dominant logging practice.
(text continues on page 160)

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[5] We define large-scale experiments as having treatment units larger than 1 ha.

Table 1—Large-scale experiments investigating alternatives to clearcutting in British Columbia

Name of experiment and year initiated	Ecological zone[a] and location	Treatment, size of treatment units and replications	Ecosystem response variables studied
1. Aleza Lake, 1930s to 1950s	SBS Central Interior Plateau; near Prince George	Clearcut and shelterwoods with 50% retention; no replication	Tree growth, vegetation, climate
2. Bolean Lake, 1951	MS Fly Hills; near Falkland	Clearcut, 50% retention in stripcuts, group selection, individual tree selection; 5-10 ha.; no replication	Tree regeneration, tree growth, bark beetles, windthrow Project terminated in early 1970s
3. Quesnel Highlands, 1990	ESSF Quesnel Highlands; near Williams Lake	Clearcut, group selection with 1, 0.13, and 0.03 ha openings; 3 replications	Climate; soil; tree regeneration; tree growth; vegetation; aboreal lichens; snow
4. Uniform Shelterwood, 1990	SBS Fraser Plateau; E. of Williams Lake	50 and 70% dispersed retention; shelterwood; 1.4 ha; 3 replications	Climate; tree regeneration; windthrow; vegetation, small mammals
5. Boston Bar, 1991	IDF Fraser Canyon; near Boston Bar	Clearcut, seed tree, shelterwood; 2 replications	Climate; soil; tree regeneration; vegetation; windthrow; logging costs
6. Date Creek, 1991	ICH N.W. Interior-Coast transition; near Hazleton	Clearcut, group selection with 30% removal and 60% removal; 11-38 ha; 4 replications	Soil and soil organisms; tree regeneration; aboreal lichens; vegetation; sporocarps, birds, bats, amphibians, small mammals; water; windthrow
7. Lucille Mountain and Northern Wet belt Project, 1991	ESSF/ICH Cariboo Mountains and Rocky Mountains; E. of Prince George	Clearcut, shelterwood, single tree selection; small patch cuts of 0.2 ha; 1-20 ha; no replication; 7 operational trials underway or planned in Northern Wet belt	Climate; soil; tree regeneration; tree growth; vegetation; aboreal lichens; windthrow
8. MASS, 1991	CWH Central Vancouver Island; near Campbell River	Clearcut, patch cuts, single tree retention, shelterwood; 5-40 ha; 3 replications	Climate; soil and soil organisms; vegetation; aboreal lichens; tree regeneration; birds; canopy arthropods; logging costs
9. Opax Mountain, 1991	IDF Thompson Plateau; Kamloops	80% and 50% retention, aggregated and dispersed; openings 0.1, 0.4, and 1.6 ha; 20 ha; 2 replications	Climate; soil and soil organisms; coarse woody debris; tree regeneration; tree growth; aboreal lichens; ground arthropods; vegetation; sporocarps; songbirds; woodpeckers; small mammals; snow; windthrow

Table 1—Large-scale experiments investigating alternatives to clearcutting in British Columbia (continued)

Name of experiment and year initiated	Ecological zone[a] and location	Treatment, size of treatment units and replications	Ecosystem response variables studied
10. "Beetle proofing" mature lodgepole pine, 1992	IDF/MS S. Rocky Mountain Trench; near Cranbrook	Clearcut and thinned to 4 m and 5 m spacing and fertilization; 10-20 ha; 3 replications	Climate, tree regeneration, bark beetles, windthrow, root disease, vegetation, thermal cover for mule deer, logging costs
11. Cats Ears Creek steep slopes, 1992	CWH Central Vancouver Island; near Port Alberni	75% dispersed retention and aggregated retention with 0.15, 0.3 and 1.4 ha openings; 4-7 ha, no replication	Tree regeneration; windthrow; vegetation
12. Roberts Creek, 1992	CWH South Coast; near Sechelt	10% dispersed retention; 50% aggregated retention; 5-10 ha; no replication	Climate; Soil; timber; wildlife except large animals; fungi; water; logging; worker safety costs
13. Sicamous Creek, 1992	ESSF Shuswap Highlands, South-Central BC; near Sicamous	10- and 1-ha clearcuts; array of 0.1-ha openings; single tree selection; all 33% removal; 30 ha; 3 replications	Climate; soil and soil organisms; coarse woody debris; tree regeneration; aboreal lichens; vegetation; sporocarps; ground arthropods; songbirds; woodpeckers; spruce grouse; small mammals; snow; streams; windthrow; bark beetles; logging costs
14. West Arm Demonstration Forest, 1992	ICH Kooenay Lake; near Nelson	Clearcut; seed tree; shelterwood; patch, single tree and woody debris retention; 4500 ha; operational trials only; no replication	Climate; soil; coarse woody debris; tree regeneration; vegetation; water quality and quantity
15. Westwold, 1992	IDF Okanagan Plateau; near Kamloops	15, 20 and 25 m^2 basal area retained; 2 Q values; 1 ha; 3 replications	Tree regeneration; tree growth
16. Mount Seven/ Ice Road, 1993	ICH Columbia Mountains; near Golden and Nakusp	Clearcut; low dispersed retention 30%; high dispersed retention 50%; 1 ha; 4 replications	Climate; soil; coarse woody debris; tree regeneration; tree growth; vegetation; root disease
17. Itcha/Ilgachuz Alternative Silvicultural Systems, 1994	SBPS/MS Chilcotin Plateau; W. of Williams Lake	Clearcut 50% aggregated retention with stems or whole trees removed, 70% retention stems only; 6-10 ha.; 5 replications; two additional operational trials	Climate, soil, tree regeneration; tree growth; vegetation, terrestial and arboreal lichens, bark beetles, dwarf mistletoe, sporocarps, windthrow, wildlife, snow

Table 1—Large-scale experiments investigating alternatives to clearcutting in British Columbia (continued)

Name of experiment and year initiated	Ecological zone[a] and location	Treatment, size of treatment units and replications	Ecosystem response variables studied
18. Bald Range, 1995	MS Okanagan Plateau; near Summerland	Regenerated clearcut; 36% retention and uncut; Retrospective study on effects of retained structures; >10 ha; 3 replications	Small mammals, vegetation
19. Fort Nelson Mixedwoods, 1996	BWBS Near Fort Nelson	Group shelterwood with .13 and 1 ha. openings; 4 replications	Snags and coarse woody debris; light; vegetation; tree regeneration
20. Rennell Sound steep slopes, 1996	CWH Graham Island, Queen Charlotte Island	Clearcut, 50 and 70% aggregated retention, 70% dispersed retention; 5-10 ha; 2 replications	Tree regeneration; windthrow; vegetation; logging costs
21. Viewland Mountain, 1996	ICH Quesnel Highlands near Williams Lake	20% removal; group selection; 0.25-2 ha openings; no replication	Mule deer; tree regeneration; climate; vegetation; root disease; bark beetles; windthrow; logging costs
22. HYP[3] –Pattern Process and Productivity in Hypermaritime forests, 1997	CWH NW Coast; near Prince Rupert	Diameter limit logging of low productivity timber; 50 ha; 2 replications	Soil; tree regeneration; vegetation; logging costs; water
23. Mount Tom Adaptive Management Trial, 2000	ESSF Quesnel Highlands near Williams Lake	Group selection 33% removed; 0.1-3 ha openings; >10 ha; 9 replications	Mountain caribou; arboreal lichens; tree regeneration; windthrow; vegetation; snow; logging costs
24. STEMS – Silviculture Treatments for Ecosystem Management in the Sayward, 2000	CDF/CWH Central Vancouver Island; near Campbell River	Clearcut, patch cut, group selection, aggregate retention, dispersed retention, commercial thinning; 3 replications	Climate; tree regeneration; tree growth

[a] Ecological zones are described in Meidinger and Pojar 1991.

BWBS= black and white boreal spruce; CDF= coastal Douglas-fir; CWH= coastal western hemlock; ESSF= Engelmann spruce-subalpine fir; ICH= interior cedar hemlock; IDF= interior Douglas-fir; MS= montane spruce; SBS= sub-boreal spruce; SBPS= sub-boreal pine spruce.

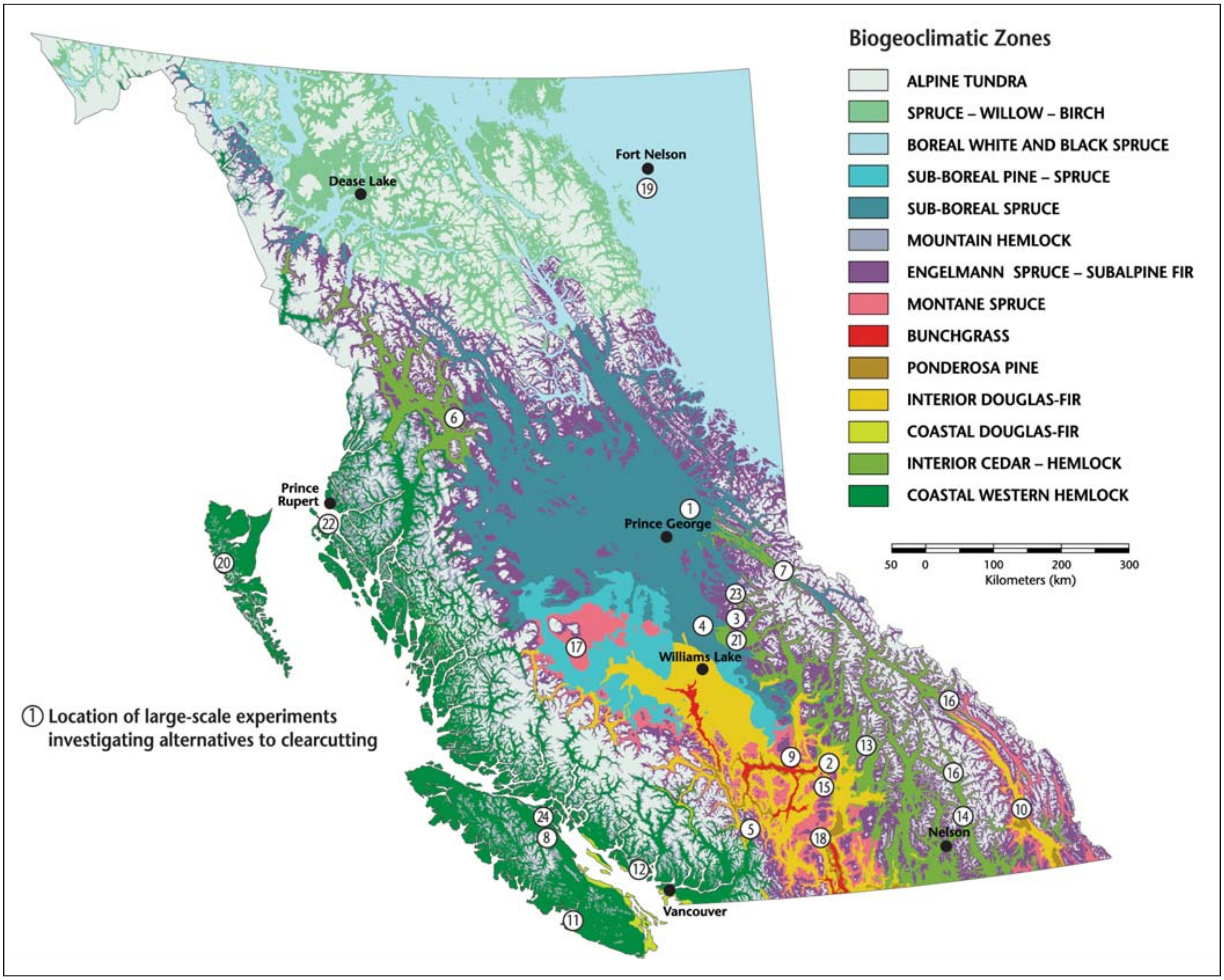

Figure 1—Location of silvicultural systems trials in British Columbia.

However, on the lower coast, where social pressures were most intense, the Montane Alternative Silviculture Systems (MASS) project led, directly or indirectly, to large-scale changes in operational practice. There the predominant cutting method changed from clearcutting to variable retention. In the Interior, the Quesnel Highlands and Itcha/Ilgatchuz Alternaive Silviculture System projects have led to changes in operational practice to a group selection treatment based on protecting habitat for the endangered mountain eco-type of the woodland caribou (*Rangifer tarandus caribou*).

The more comprehensive trials have shown that all alternatives have some negative effects on components of the forest ecosystem. As a consequence, they provide support for the adage "don't do the same thing everywhere." Widespread application of a single practice is unlikely to be sustainable. These trials have also provided information on how negative effects could be mitigated. Edge effects associated with openings were shown to be less intrusive than previously thought. For example, at Sicamous Creek, edge effects for many variables were no more than half a tree height into the forest or into the opening (Huggard and Vyse 2002a). Windthrow, which is always raised as a major concern by operational foresters in any discussion of alternatives to clearcutting, was shown to be damaging no matter what system was used, but less damaging than expected at least in the province interior. In addition much information was gained on the response of tree seedlings to light environments and to site preparation. And the response of little-studied elements of the forest ecosystem to forestry practices, such as small mammals, invertebrates, soil organisms, lichens and mosses, was recorded.

Most of the experiments have been measured at least once since the treatments were imposed. Some elements, such as tree seedlings and windthrow, have been measured several times. And in the case of a few readily assessed ecological indicators, such as seedfall and songbirds, measurements have been made annually. Although this is a substantial achievement, much more needs to be done. We expect that some responses will take much longer than a decade to manifest themselves, and we also expect that there will be changes in response over time. One example is the invasion of an experimental site by ants and pocket gophers that may have been attracted by the disturbance created by cutting openings. Their interaction with other established organisms on the site is unknown.

The scientific output of the program has been substantial. About 80 journal articles have been published to date, and more appear every year. There are also many more publications in agency publication series. However the output is very uneven. Three projects account for 90 percent of the journal articles (Sicamous Creek, Date Creek and MASS).

Forest researchers are often accused of failing to communicate the results of their work to operational foresters. However, in the case of the Silvicultural Systems Program, the possibility of communication failure was dealt with from the beginning. Researchers were encouraged to discuss the findings of their work at formal and informal gatherings of practitioners. Extension notes were produced to apprise practitioners of the latest findings and who to contact for more details. Specific courses on silvicultural systems were designed and delivered through the Forestry Continuing Studies Network and the Silviculture Institute of British Columbia. Summary documents were prepared for professional and public audiences alike.

Some Lessons From the British Columbia Experience

The British Columbia experience in establishing numerous large-scale forest management experiments in a short period offers several lessons for future efforts of this magnitude. We have summarized these lessons as seven rules for success.

1. Foster strong project leadership and succession. Projects without effective and committed leadership will flounder and continuity will be threatened. Good leaders promote, coordinate, synthesize, integrate, and plan for all of the research initiatives.
2. Engage operations in research. Project establishment and continued measurement is expensive, and planning experiments with operational partners is essential. Constant communication with operational foresters can help maintain interest in the experiment results, but it does not guarantee continued support.
3. Plan multidisciplinary and interdisciplinary experiments. Given the pace of societal change, issues of relevance today may not be the issues of pressing concern a decade from now. An ecosystem approach provides a route around such difficulties, and there can be economies with investigating many ecosystem responses at once, but the absolute cost is high. Although there are advantages to imposing a common sampling scheme on an experiment, such a scheme does not guarantee interdisciplinary work. The risk of failure may be higher in interdisciplinary work.
4. Plan your project scale and scope carefully within your expectations of future resources. Projects at a single location may have limitations, but the cost of servicing multiple locations may prove to be an insurmountable hurdle.
5. Design robust experiments with strong contrasts. Remember that biological and statistical significance are separate concepts. Given that the cost of establishment is high and the pace of institutional change is rapid, only experiments that have strong contrasts and highly visible results are likely to have continued scientific and operational appeal.
6. Maintaining relevance leads to longevity. Plan for short-term outputs from long-term projects to keep your project in the eye of funding agencies and supporters. However, operational relevance can differ strongly from scientific relevance. This has become a problem in British Columbia where funding agencies have required applicants to promise operational change through research results. Scientists control neither the rate nor direction of change, and this is doubly true for forest scientists who must cope with extremely long periods over which change is measured and assessed. They can contribute knowledge and elevate the understanding of practitioners, but these are rarely compelling forces for change. The increasing demand for scientifically credible forest management activities, backed by certification, may help close the gap between operational and scientific

relevance, but fundamental differences mean that regular communications between project scientists and sponsoring forest managers are essential.

7. Protect your investment. Scientists are sometimes uncomfortable with promoting their efforts, but promotion of your experiment is essential. Seek a trade mark for your experiments and publicize your efforts whenever possible. However, even these efforts may fail and funding may dry up. Recognize from the outset that specific research funding efforts rarely last 5 years. Build a "sleep mode" into projects so you can ride out periods of low funding. Make sure you have data protection and management protocols that enable the project to be successfully resuscitated after hibernation.

CONCLUSIONS

Long-term forest management experiments examining alternatives to clearcutting in British Columbia have shown, and communicated clearly, that there are many advantages to alternatives. They have also demonstrated that the many supposed negative effects of clearcutting are either exaggerated or without foundation. But they have not provided any compelling reasons for adopting a wider range of forestry practice. This may be why these projects are now stuck in a funding backwater. Their individual contributions are valued, the need for long-term research is acknowledged, but their upkeep is expensive, and other priorities beckon. This outcome should not have come as a surprise to the scientist engaged in the projects. There are numerous examples of similar projects in British Columbia and elsewhere that have met a similar fate (Smith 1993).

How do we change this less than encouraging picture? For those charged with the responsibility of funding forest research and determining priorities, there has to be acknowledgement that research results and their communication are not the most important elements leading to change. The British Columbia experience suggests that success defined as changing practice or making an economic contribution is impossible to predict amid a welter of rapidly changing social and economic factors and events. Research success, so defined, has little to do with sound scientific practice or the communication skills of scientists. If this observation is generally sound, then the focus of research programs has to change. Short-term expectations of individual projects should be much less important than the long-term expectations, with respect to the whole portfolio of efforts to improve forestry practice. This is especially true in British Columbia where the landscape and forest ecosystems are so varied, and public concerns about the management of public lands are so volatile.

For forest scientists, we suggest that working together to promote the concept of long term funding for long-term projects might be fruitful. We need to find a way of keeping the forestry community's feet to the fire. Everyone acknowledges the need for a long time horizon in forestry and the need for long-term research, but no one seems willing to pay despite the low cost. Even at its funding peak, the annual cost of the Silvicultural Systems Program was less than 1 percent of the stumpage value of logs removed from public lands. In British Columbia we have been developing the concept of Living Forest Laboratories, supported by an endowment or endowments. We propose to promote the concept of long-term forest experiments to the funding agencies and the public using the familiar idea of scientific laboratories (de Montigny et al. 2004). If the public is willing to support building very expensive laboratories for cancer research, perhaps they might also be willing to support much lower cost living forest laboratories for forest management research.

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