March 1990

FRDA Memo No. 136

Synopsis

Topic Summary for the Operational Forester

The Challenges of Regenerating Sites in the Interior Cedar-Hemlock Zone of the Southern Interior of B.C.

Introduction

The Interior Cedar Hemlock (ICH) zone contains the most productive forest lands in the interior of B.C. But they can also be difficult areas to manage as evidenced by the accumulation of backlog sites: those which remain not satisfactorily restocked (NSR) many years after harvesting. It is estimated that between one-third and one-half of the area denuded between 1965 and 1985 was classified as NSR in 1987 when this project was completed.

FRDA Project 3.47 was initiated as a retrospective analysis of this backlog problem in the nine ICH subzones and variants in southern B.C. These are listed on page 6 of this summary along with the researchers who did this study.

Although the ICH zone extends north to the Prince Rupert and Prince George Forest Regions, this study was confined to the southern interior. The units studied range from the Horsefly Forest District in the north to the U.S. border in the south. Climatically they range from the very wet and cool ICHb (ICHvk) in the Salmon Arm and Revelstoke area to the dry and warm ICHa1(ICHdw) around Nelson and Castlegar. Figure 1 illustrates the climatic variation represented by the subzones that were studied.

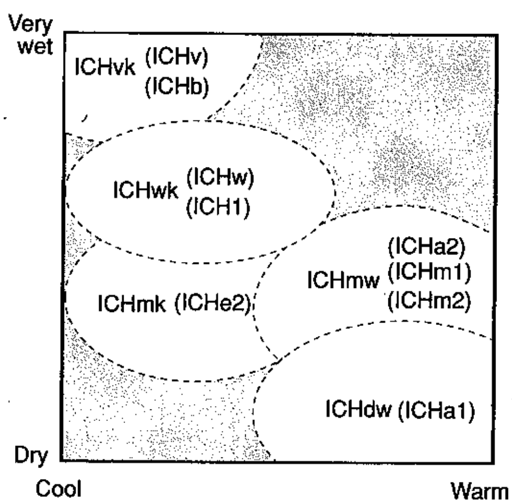

FIGURE 1. Generalized climatic distribution of ICH subzones and variants.

The Project

1. Describe the extent of the backlog and identify why it occurred, i.e. what were the obstacles to successful regeneration?
2. Make recommendations for rehabilitation of backlog areas.
3. Make recommendations for successful regeneration of sites currently being harvested.

The units studied and the research reports are detailed at the end of this summary. When this summary was prepared, the naming of the biogeoclimatic units was in transition to a new provincially correlated system. In the Kamloops Forest Region the transition is complete and the new names are used in this summary; for units in the Cariboo and Nelson Forest Regions, the old names are used. The new names have been added in parentheses.

This study spanned approximately 25 years of forestry history and evolving management practices. The reconstruction of silvicultural history to pinpoint what happened, and why it happened, was difficult. The researchers blended the available written information (silviculture history records and historical files) with field data and observations to reach their conclusions.

Sites that were denuded between 1965 and 1985 were evaluated in this project. The graph in Figure 2 shows the percentage of satisfactorily restocked (SR) sample sites within each unit studied. This demonstrates the extent and variability of the backlog reforestation problem. It is important to recognize, however, that recent changes in stocking standards and the influence of older stems would likely reduce the area currently classed as NSR.

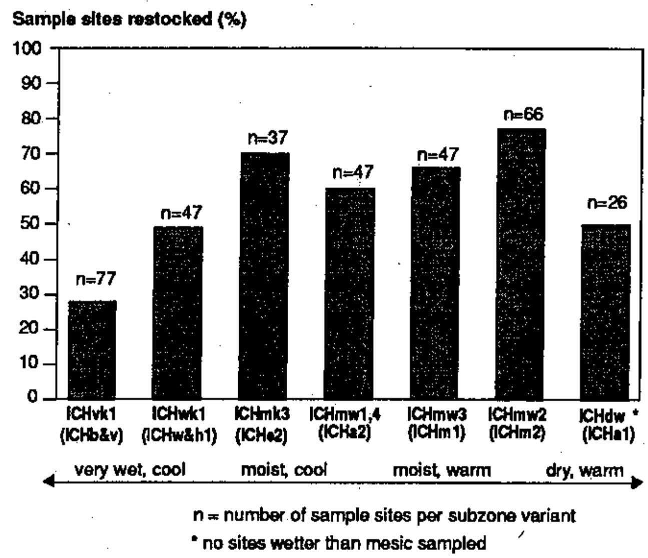

FIGURE 2. Sample sites restocked (%).

The poorest regeneration occurred in the ICHvk1 (ICHb and ICHv) with only 28 percent of the sample sites classed as stocked. The best success was on warm moist sites (ICHmw2) where 77 percent of the sites sampled were classed as stocked. The average overall is 55 percent stocked. That means close to half of the backlog areas studied were not reaching their productive capabilities.

I. The Past: Success and Failure

Silvicultural factors (harvesting, site preparation and regeneration methods) and ecological factors (frost, cold soil, excessive moisture, vegetation competition, etc.) are considered important to successful regeneration.

Figure 3 portrays, in a generalized way, the extent to which research identified each factor as being limiting across the range of site conditions within the ICH zone, from dry to very wet.

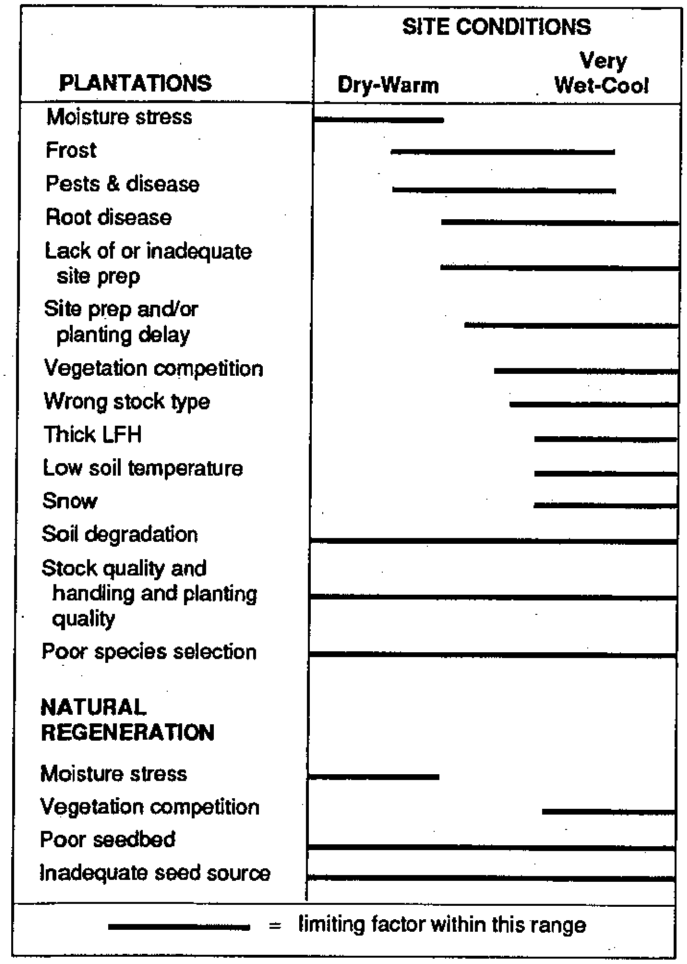

FIGURE 3. Factors identified as affecting regeneration success.

Although not shown in Figure 3, failure in many cases was attributed to poor planning or inappropriate application of silvicultural systems, such as prescribing partial cuts in old-growth cedar-hemlock stands, or delaying site preparation for as long as 20 years.

Prompt sequencing of treatments was consistently identified by the researchers as an important variable, and one that is quite easily controlled, compared to most others. For example, planting delays of more than two years after denudation or site preparation regularly contributed to plantation failure, especially on wet sites.

Certain knowledge was also lacking. For example, the vulnerability of Douglas-fir to frost was not recognized and, therefore, this species was planted on an inappropriately wide range of sites. As well, institutional constraints contributed to failures; for example, lack of seedlings, or funding for site preparation.

The following sections summarize the main conclusions about regeneration success and failure in each unit studied.

Very Wet-Cool Unit

ICHvk1 (ICHb)

Regeneration failure was highest in this unit and could be attributed to high levels of competing vegetation. Fireweed was the main competing species.

Clearcut, burn and plant spruce or Douglas-fir had the most success, but survival still only averaged about 50 percent. A lack of, or inadequate, post-harvest site treatment which left residual slash, brush, deep duff and unacceptable advance regeneration inhibited the establishment of new regeneration. Poor quality stock and planting delay also caused regeneration failure.

In the eastern portion of the study area (the Golden Forest District), researchers found that regeneration success was only slightly better on planted units (34 percent SR) than on unplanted units (29 percent SR), irrespective of site preparation. However, broadcast burning significantly improved plantation success.

Primary causes of failure of natural regeneration were lack of an adequate or appropriate seed source, lack of an adequate seed bed (i.e., deep humus layers) and high percent cover of competing vegetation.

Wet-Cool Unit

ICHwk1 (ICHh1)

On the mesic sites sampled, regeneration success was highly correlated with a hot broadcast burn followed by planting within two years. The difficulty in achieving hot burns, however, was indicated by the high number of sites with a light burn, i.e. 9 of 13.

Moist-Cool Unit

ICHe2 (ICHmk3)

On drier sites, a hot broadcast burn followed promptly by planting was successful, independent of species planted. Failure to plant resulted in regeneration failure. The same held true for mesic sites except that natural regeneration, while not providing the most preferred species, was successful on the three sites sampled. Wetter sites were a major problem because the high vegetation cover and difficulty in achieving a hot burn resulted in poor planting conditions.

Moist-Warm Units

ICHa2 (ICHmw1&4)

The best success was attained with broadcast or spot burning, followed by planting, especially for Douglas-fir plantations. Douglas-fir stocking success increased with the use of broadcast burning and decreased with increasing elevation.

Plantation failures were attributed to poor stock quality, moisture stress and frost. Vegetation competition did not correlate with failure except on the wettest sites.

Poor success of natural regeneration on untreated units was attributed primarily to moisture stress and unsuitable conditions (specifically, inadequate seedbed and seed source).

ICHmw2

Success was relatively easy to attain. The most successful treatment was burning or mechanical site preparation (MSP) followed by planting Douglas-fir, interior spruce or lodgepole pine. Plantation survival averaged 70 percent, with the less successful plantations on mesic and wetter sites.

Natural regeneration was attained after burning or MSP on sites having larch, Douglas-fir or lodgepole pine seed sources. Birch competition and *Armillaria obscura* infections contributed to stocking reduction in older plantations. Many backlog sites are only marginally NSR, having close to the minimum number of well-spaced acceptable stems.

ICHmw3

Success was attained on mesic and drier sites with site preparation (either broadcast burning or mechanical) followed by planting Douglas-fir or lodgepole pine. Success decreased on wetter sites but was loosely correlated with a prompt, hot burn and no planting delay.

Dry-Warm Unit

ICHa1 (ICHdw)

No units wetter than mesic were surveyed and only 6 percent of the total number of openings sampled had been planted. Of the untreated and naturally regenerated openings, 66 percent were satisfactorily restocked. Moisture stress, lack of seed trees and poor seedbed accounted for failures.

On plantations, vegetation competition, soil degradation and moisture stress were inferred to be contributors to failure.

II. The Future: Learning from the Past

The research results contribute knowledge useful both for rehabilitation of backlog sites and for successful regeneration of current sites. The table on this page refers to options for current sites. In either situation it is first necessary to understand and identify the factors that limit regeneration. The next step is to design a treatment or series of treatments to ameliorate these limiting factors.

The difficulty, as the researchers repeatedly found, is that the limiting factor or factors may not be readily discernible: is it frost or is it vegetation competition? or both? and how do they interact? The inter-relatedness of the factors affecting regeneration success must be considered carefully. Indeed, the researchers all refer to the idea of a factor-complex, the interacting factors which individually and in combination determine the success of regeneration.

CURRENT SITES: A summary of regeneration limits and treatment options

Site Group	BEC Units		Moisture Regime	Limiting Factors	Recommended Treatments: Site Prep	Recommended Treatments: Tree* Species
PAXISTIMA-LICHEN	v. wet-moist cool	ICHvk (ICHb)	x-sx	(veg. competition)	burn	Fd Pl Pw
		ICHwk (ICHh1)	x-sx	snow	mechanical	(Sx** Cw)
		ICHmk (ICHe2)	sx		(herbicide)	
	moist-dry warm	ICHmw (ICHa2)	sx-sm	moisture stress	piling	Fd Pl Pw Lw
		ICHdw (ICHa1)	sx-m	surface soil temp.	mechanical	(Cw Sx Py)
					burn	
MOSS	v. wet-moist cool	ICHvk (ICHb)	sx	veg. competition	burn	Fd Pl Sx
		ICHwk (ICHh1)	sx-sm	snow	mechanical	(Pw Cw Bl Hw)
		ICHmk (ICHe2)	sm		herbicide	
	moist-dry warm	ICHmw (ICHa2)	m	(veg. competition)	burn	Fd Lw Pw Sx
		ICHdw (ICHa1)	m		mechanical	(Pl Cw Bl)
					(herbicide)	
OPLOPANAX-GYMNOCARPIUM	v. wet-moist cool	ICHvk (ICHb)	sm-hyg	cold, wet soil	burn	Sx Fd Cw Bl
		ICHwk (ICHh1)	m-hyg	thick humus	herbicide	(Hw Pw)
		ICHmk (ICHe2)	m-hyg	veg. competition		
				snow		
	moist-dry warm	ICHmw (ICHa2)	m-hyg	thick humus	burn	Sx Lw Fd Cw
		ICHdw (ICHa1)	shyg+	veg. competition	mechanical	(Bl Pw Hw)
			herbicide			

* ecologically preferred species are listed first; acceptable species are in parentheses. Natural range must also be considered

** Sx: interior spruce, generally a hybrid of white and Engelmann spruce

Abbreviations:

Moisture regime:
- x xeric
- sx subxeric
- sm submesic
- m mesic
- shyg subhygric
- hyg hygric

Notes:

- Regeneration limits common to all units include: pests and disease, frost, poor prescriptions, poor quality work, and treatment or planting delays.
- These generalized recommendations must be applied on a site-specific basis.

EXAMPLE: Approaching a site with a moderate vegetation cover, one might conclude that the obstacle or limit to successful regeneration is competition for light, water and/or nutrients because of the vegetation. In fact, the limiting factor may be frost and cold temperatures, and the brush actually serves to partially mitigate this factor by protecting the young seedlings. Brush may also contribute to site quality through nutrient cycling.

EXAMPLE: Frost is expected to occur on lower slopes, valley bottoms and depressions due to cold air drainage, making such sites unsuitable for Douglas-fir. However, one of the researchers reported finding Douglas-fir affected by frost on gently sloping sites with relatively thick humus layers.

BACKLOG SITES: Rehabilitation options

Disturbance Type	Objective	Considerations/ Limitations	Options
Partial Cut	• increase regen. stocking	timber volume and value, access, proximity to mill, presence of good regen.	fill plant; salvage log; knock down, pile or windrow, & burn; thin poor quality stems
Clearcut No Brush Problem	• increase stocking	slash load	pile, pile & burn; broadcast burn; leave
		high surface soil temp.	microsite planting
		low soil moisture	early spring or fall planting
		cold soil	MSP (trails, spots); broadcast burn
Brush Problem	• reduce vegetation competition	type of competition — hardwood	aerial spray; girdle; hack & squirt; knockdown & burn; pile or windrow & burn; manage for hardwoods
		type of competition — herbaceous	herbicide; MSP (and grass seed); high-impact burn; screef planting sites; manual/mechanical cutting; sheep grazing
		wet, cold soil	plant on hummocks; herbicide driest areas; prepare planting mounds

Notes
- Table assumes immediate planting (within 2 years) after treatment, using appropriate stock. For example, on sites with moisture stress, use stock with good root growth capacity; on sites with vegetation competition, use large-caliper stock.
- These generalized recommendations **must** be applied on a site-specific basis.

Nomenclature, description and location of units studied

BEC Subzone	Nomenclature Old	New	Forest Region	Description/ Location	Research Author
Very Wet Cool (vk)	ICHb	ICHvk1	Nelson	Valley bottoms & lower slopes in northern Selkirk & Monashee Mtns.	Mather and KNIL*
	ICHv	ICHvk1	Kamloops	Valley bottoms & lower slopes on western side of Monashee Mtns.	Mather
Wet Cool (wk)	ICHw	ICHwk1	Kamloops	Replaces ICHmw3 at higher elevations & in northern portions of major river valleys (North Thompson, Adams)	Madrone
	ICHh1	ICHwk1	Cariboo	Lower slopes around Quesnel & Horsefly Lakes, foothills of Columbia Mtns.	Madrone
Moist Cool (mk)	ICHe2	ICHmk3	Cariboo	Fraser Plateau, bordering SBS	Madrone
Moist Warm (mw)	ICHa2 (south) ICHa2 (north)	ICHmw1 ICHmw4	Nelson	Valley bottoms & lower to mid slopes in southern Monashee, Selkirk, Purcell & Rocky Mtns.	KNIL
	ICHm2	ICHmw2	Kamloops	Rolling terrain in Shuswap Highlands	Mather
	ICHm1	ICHmw3	Kamloops	Valley bottoms & lower slopes in southern portions of major river valleys (N. Thompson, Adams)	Madrone
Dry Warm (dw)	ICHa1	ICHdw	Nelson	Valley bottoms & lower slopes in south. Selkirk & Monashee Mtns. below ICHmw1	KNIL

Abbreviation: KNIL - Kutenai Nature Investigations Ltd.

* Mather worked in Revelstoke Forest District and KNIL in Golden, Arrow and Kootenay Lake Districts

In addition to actual limits to regeneration, potential limits that may be created by harvesting or site treatment must be considered.

EXAMPLE: Sites likely to develop a fireweed problem were characterized by one researcher as mesic to subhygric, mesotrophic to permesotrophic. On such sites, care must be taken not to enhance fireweed competition by low-impact site treatment (such as a moderate broadcast burn). A high impact site treatment followed by immediate planting with large-caliper stock should ameliorate the problem.

The reports on which this summary is based are available from the FRDA Program Management Assistant, Research Section, Kamloops Forest Region.

Silvicultural Practices and Forest Regeneration in the ICH Zone in the Clearwater and Horsefly Forest Districts: A Problem Analysis. Gordon Butt and Bryce Bancroft, Madrone Consultants. 1988.

Assessment of Silvicultural Practices used in the Interior Cedar Hemlock Zone of the Southern Interior. Jean Mather. 1988.

ICH Problem Analysis: Backlog Silvicultural Problems in the ICHa2, ICHa1 and ICHb. Gerry Still, Steve Thompson and Gregory Utzig, Kutenai Nature Investigations Ltd. 1988.

Information compiled by:
Donna Macdonald
Kutenai Nature Investigations Ltd.
602 Richards Street
Nelson, B.C. V1L 5K5
(604) 352-5288