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THE EVOLUTION OF A BRITISH COLUMBIAN FOREST LANDSCAPE, AS OBSERVED IN THE SOO PUBLIC SUSTAINED YIELD UNIT

by

ERIC CARL YOUNG

A.B. Hons., University of California, Berkeley, 1972

A THESIS SUBMITTED IN PARTIAL FULFILLMENT

OF THE REQUIREMENTS FOR THE DEGREE OF

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ABSTRACT

The study examines the evolution of forest policies, institutions and practices in British Columbia with particular reference to the Soo Public Sustained Yield Unit. The field area was chosen because of a well-documented history of logging and because resource conflicts are intensifing as recreational pressure from metropolitan Vancouver increases.

The analysis focuses upon: 1) the policy and institutional framework of forest land management, as determined from published documents and interviews; 2) the record of successive logging practices in the Soo, e.g. road construction, cutting, burning and replanting; and 3) the body of literature on logging technology, forest practices and their impacts upon the environment. A specific resource use conflict (road construction in the upper Lillooet valley) is used to illustrate changing policy and planning practices. The physical capabilities and constraints of the study area are assessed. These include slope, climate, forest type, wildlife and recreational values.

The study concludes that there have been several key legislative and policy decisions that have shaped the evolution of the Soo forest landscape. The early decision to retain Crown ownership of natural resources was critical because it

enabled the Crown to periodically modify its resource legislation as technologic conditions changed. Contrary to this trend, the issuance of 300 Timber Licenses between 1905 and 1907 forfeited Crown ccntrol over the majority of the Soo's prime old growth stands. Industry has depended upon these stands for more than half of its timber supply since the 1930's, and it is upon them that the greatest environmental disruption in the Soo has occurred. The founding of the Forest Service in 1913 was the first attempt to recoup some of the lost ccntrol and gave the Crown an administrative arm through which it could monitor the forests. A major watershed was the Crown Commission of 1944, which led to the establishment of the Tree Farm Licenses and Public Sustained Yield Units. The formation of the Soo Unit regained some control over the forest by more closely involving industry in the management of the resource. Recent major advances have been the Folio system and the Planning Guidelines fcr Coastal Logging Operations, which have again broadened the sccpe of decision making to include other governmental and private sources.

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There are many people to whom I am indebted and wish to extend my thanks. Certain among them deserve specific mention. I wish to thank the company that logged certain of the eastern portions of Manning Park and thus incited the anger which provided the impetus for this thesis.

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CHAPTER 1

INTRODUCTION

Unlimited natural wealth, boundless plenty, inexhaustible natural resources were the claims first used by early promoters of British Columbia, as they had been for most areas of North America. The Pacific Northwest was portrayed as a magnificent storehouse of riches to all of Europe and eastern North America. With such promises in mind people came to the Northwest to find their fortune in the use of its land and resources. In time their views would change, valuing some resources above others. Unlike funds in a bank, the resources of a landscape fluctuate in worth through time depending upon conditions of accessibility, markets and perceived desirability. An understanding of those conditions and the changes they produce, though often overlooked in the past, is of prime interest to anyone concerned with current resource policies and practices.

The principle questions addresses in this study are: 1) to determine the pattern of human activities in the forest landscape of Coastal British Columbia; and 2) to determine the impact of those activities upon that landscape. To provide a back-ground for these questions, the perceived land values and jurisdictional framework of laws, institutions and policies,

that British Columbians have adopted through the years, will be sketched, briefly. Once these decisions have been identified, the pattern of forest practices and impacts that they have fostered will be traced from the foundation of the Crown Colony to the present day. trends of that pattern should help identify future decisions The Soo Public Sustained Yield Unit serves as a case study in which the pattern of decisions and institutions and its impacts are more clearly illustrated and identified.

The first Anglo-Europeans to come to the Northwest were fortune seekers in the most glorious sense of the word. The hunters, trappers and traders of the Northwest Company, and later the Hudson's Bay Company, perceived the land as a cornucopia of riches waiting to be scooped up. At first they came to hunt the seal and otter, followed by the beaver and mink, for which there were expanding markets in China and Europe (Harris and Warkentin, 1974).

As the California Gold Rush waned, the Forty-Niners moved north to dig up the stream bank gravels of the Fraser, the Kootenay and then the Caribco, in search of their precious yellow metal. They likewise ascribed to the philosophy of "Grab the Goods and Run," caring not at all for the future of anything they touched. At the time, however, it served the purpose of bringing money and people to an otherwise wilderness area.

After the Gold Rushes subsided in the late 1860's British Columbia became a Province and its populace, settlers still drawn by the promise of a bright future, took on the task of establishing themselves and a society in its wilds. They viewed the landscape as a bountiful one. It was easily capable of supporting their endeavours, providing that they were willing to exert themselves and bring it under their control.

At first the forests were a hindrance, an enemy even, to the progress of establishing arable farms and grazing land. In many cases the trees were simply burned off to clear the land for the more immediate need of food production (Haig-Brown, 1961). Upon the arrival of steamships and railroads, however, these views soon gave way to those of using the timber and minerals and salmon for commercial purposes. The bounty of the land could, in the settlers eyes, easily support farming, ranching, logging, mining and fishing, though perhaps not all in the same place. In their eyes the Province was so vast that they couldn't conceive of it being totally used up. In the 1880's, a new wave of exploitation was ushered in by these new transportation possibilities. It was not as blatant as the early trappers and miners had been. At the turn of the century the Province still retained its break-neck, stage, boom-town air. At that point, with the impetus of steam-driven engines, development took off full speed ahead.

At the same time however, ideas of conservation began to filter across the border from the south where the fundamental argument between John Muir and Gilford Pinchot concerning the principles of preservation versus development was underway (Nash, 1967). Muir held that wilderness possessed intrinsic value regardless of human actions. Wilderness environments should be preserved because of the rejuvenating effect they have upon people, because they maintain a complex gene pool and because they provide a natural scale against which man can measure his achievements. Pinchot felt that lands were only of value when they could be put to human use. Men should determine what the most valuable uses were for each landscape and then develope it such that it would provide the greatest good for the largest number of people over the longest time. Eventually the ideas of Pinchot were adopted. In a land where the use of resources was the very cornerstone of society, it could hardly have been otherwise (Ross, 1968).

Likewise, in British Columbia the ideas of development worked their way firmly into the minds and hearts of a people dedicated to building a viable modern economy based upon natural resource extraction. Pinchot's ideals of development concerned the wise, planned, controlled use and protection of resources for the optimal public benefit. The complete absorption of these ideals took place over many years, from the

early 1910's to the late Thirties. During that period, the Province grew out of its adolescent boom-town ways and began to concentrate in a few large urban centres (Haig-Brown, 1961). The march towards a high standard of living, that comes as a by-product of urbanization founded upon resource extraction, was begun in those years.

The Depression and War shook society's economic stability but not its belief in rational development as the key to future prosperity. After the War, British Columbians reaffirmed their faith in the ability of the land to adequately support society by adopting criteria and techniques which allowed them to more concisely control and plan the use of its ever abundant resources. They chose principles of economic return to guide their conservation and dominance over nature in order that they might stabilize the future as being an increasingly prosperous one (Pearson, 1944; McConnell, 1954; Gregory, 1955). At the same time, the fruits of previous labours began to ripen in the form of increased leisure and recreation time.

Subsequently, a conflict between the heavy emphasis upon economic return from resources and the trend towards increased leisure developed. In recent years this has caused a number of important contradictions to surface. While the ideas of development and man's dominance over nature have not been

seriously challenged, a reassessment of the relative values of different development possibilities has been necessary (Johnson et al, 1967; Smith, 1970; Whaley, 1970). British Columbians have come to see the forest landscape as an outlet for many more facets of their livelihood beyond just being the founding blocks of their economic welfare. They have incorporated other values, e.g. recreation, wildlife and fisheries, into their appraisals of land capabilities.

The material employed in this study to illustrate the evolution of the Soo forest is drawn from primary sources, secondary sources, and field observation. The primary data for the study are of three types: 1) governmental legislation; 2) maps, documents, records and published reports of governmental agencies; and 3) personal correspondences with governmental and academic personnel. The principle pieces of relevent legislation are the various British Columbian Statutes which deal with natural resources and in particular the various Forest Acts. These have been used to establish the legal and institutional framework within which forest activities take place in British Columbia. The governmental documents have come primarily from the British Columbia Forest Service (Department of Lands, Forests and Waters) and the Fish and Wildlife Branch (Department of Recreation and Conservation). These data, in conjunction with the personal correspondences,

have been used to establish: 1) the policies under which forest activities have taken place; 2) many of the physical capabilities and constraints of the Soo; 3) the types of activities that have taken place in the Soo, and 4) the external effects of those actions and the severity of their impact.

The secondary sources of data have been employed to augment the information from the primary sources. Several comprehensive accounts of the provincial legislation have help clarify its intricacies. Numerous scholarly works have completed the account of the Soo's physical properties. However, the major usage of literary sources has been to establish: 1) the specific practices that have been employed in the Soo forest; 2) the effect of each type of activity upon the forest environment; and 3) the impact that each type of action has upon the forest in various circumstances.

Field observation was valuable because it allowed the author to check: 1) the applicability to the Soo forest of the scholarly reports concerning environmental impacts of forest activities; 2) the accuracy of the governmental data concerning past forest activities in the Soo; and 3) the recovery rates of various sites after they were disturbed by human activities.

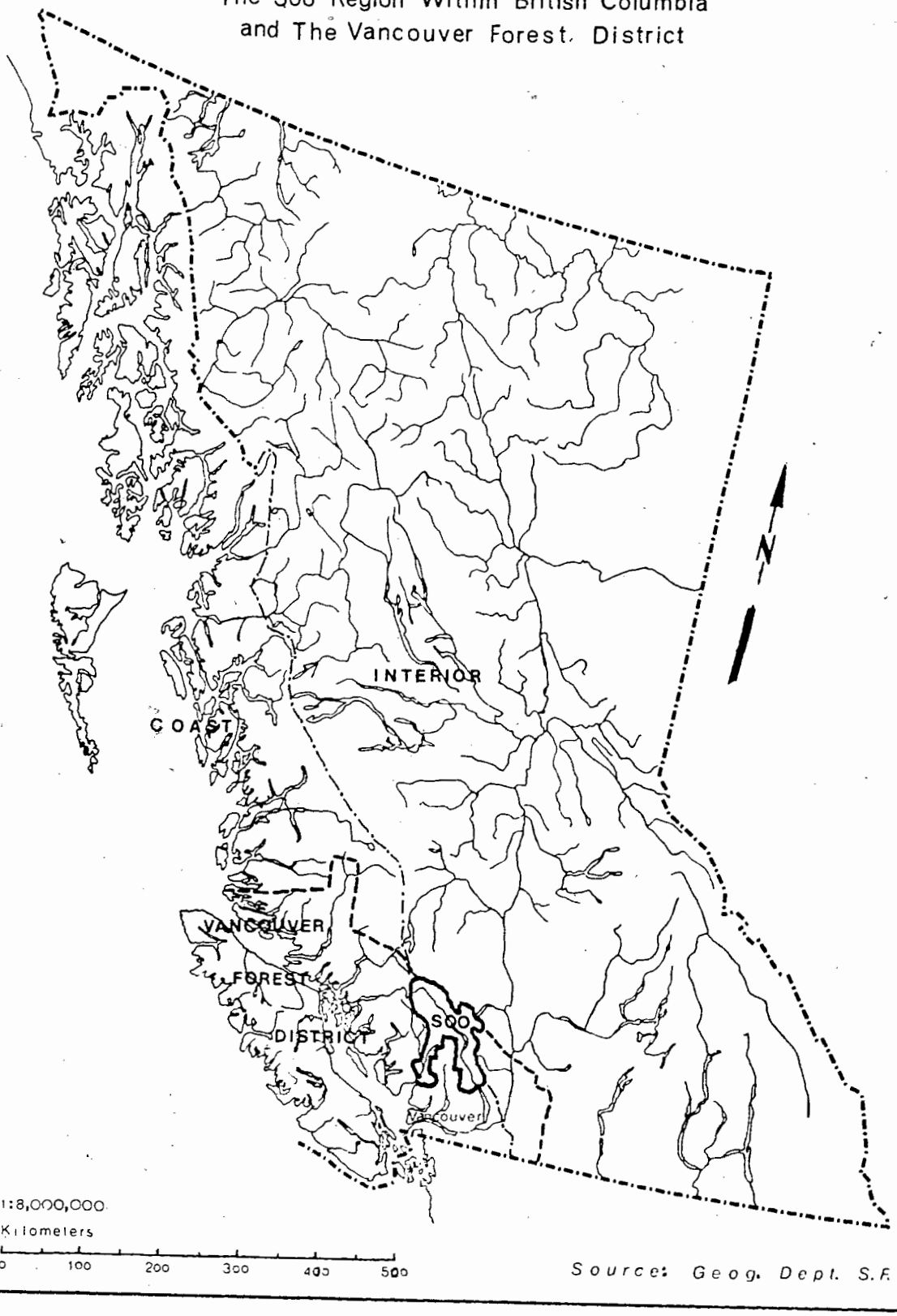
The organization of this study is two fold: on the one hand it proceeds from the general to the particular and on the other it deals with events chronologically. Thus, chapter two sketches the legislative and policy frameworks under which forestry activities have taken place. It begins with the establishment of the Crown Colony of Vancouver Island and British Columbia and progresses up to the latest changes that have come out of the new environmentalism of the 1970's.

Chapter 3 addresses the various types and methods of forest activities. Emphasis is placed upon logging activities in terms of their potential for causing major environmental changes. take place in a forest are examined and then the types of activities are linked to the impacts they produce.

Chapter four addresses the study area and ascertains its physical capabilities and constraints. Map overlays are used to determine those sites which are more fragile and hence where environmental impacts would be more critical. The Soo Public Sustained Yield Unit is used as the case study for a variety of reasons (see Map 1 for location of the Unit). Its history is easily traceable from the earliest years of European contact to the present, and contains all the various phases (i.e. man power, steam power and modern diesel power) through which forest development has passed. Timber extraction has been a

MAP 1

The Soo Region Within British Columbia
and The Vancouver Forest District



Source: Geog. Dept. S.F.U.

major activity in the area since the founding of the Forest Service in 1913. It represents the overall physical conditions found in the coastal sector of the Province, while at the same time hinting at those found in the Interior. The Soo region is distinctive in that the adjacent metropolitan centre of the Lower Mainland, with its increased leisure and mobility, has led to intensified conflicts between recreation and timber extraction. In recent years those conflicts have received increased public attention through the focusing of recreational demand upon Garibaldi Park (which is bordered on three sides by the Soo). The evolution of the forest land use pattern in the Soo serves to illustrate the potential conflicts that can emerge in other sectors of the province as demand for recreational resources increases.

Chapter 5 presents a detailed examination of the actual events that have taken place in the Soo forest and the effects that they have had upon forest landscape evolution. Once again map overlays are used to illustrate sites which have experienced specific kinds of activities and impacts. The sequence of maps is interpreted in light of the institutions and policies that fostered each set of actions. As a further indication of the process by which forest activities and impacts have come about in the more recent past, the

construction of the Forest Development Road into the upper Lillooet valley is used as a small scale study. In the final chapter conclusions are drawn concerning trends which have emerged from the past and the possibilities which exist for the future of the Soo Region.

CHAPTER 2

FORESTRY INSTITUTIONS AND POLICIES IN BRITISH COLUMBIA

In 1857, when Vancouver Island and the Mainland were united as the Crown Colony of British Columbia, the leaders of the colony set about the task of transforming it into a modern worldly society. In 1858 they passed the first Act which had important implications for forest use.(1) The Land Act (1858) authorized the sale of land in the form of Crown Grants at the price of ten shillings per acre. These grants carried with them the rights to all resources found on or in the piece of land. The price was changed, in 1861, to four shillings twopence per acre, and again in 1870 to one dollar per acre. The issuance of these grants was intended to open up the Colony to settlement by providing settlers with a secure stake in the land.

As early agrarian settlements began to expand and the need for construction timber grew, the Colonial government created a system of Timber Leases in 1865.(2) This system was intended to facilitate the production of lumber by allowing any mill owner to lease from the Crown any acreage of timber land, at negotiable terms, for use in his mill. The main stipulation

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1. B.C. Revised Statutes. 1859. 22 Victoria, no. 14.
2. B.C. Statutes. 1865. 47 Victoria, no. 17.

was that the leasee had to own a mill which operated at least six months of the year. Much more significant however was the idea that the Crown, ie. the public, retained ownership of the land and the ability to grow timber. Only the right to cut that timber was being leased. This Act set the precedent of public ownership, with private exploitation of natural resources in British Columbia which has been followed ever since. The Act was a foreshadowing of the timber boom the Province was to experience later, but at that time, it was mainly intended to promote local development. (3)

On a policy level the government determined that special clearance from the Lieutenant-Governor would have to be obtained if any timber taken from a Timber Lease were to be exported unsawn. This stipulation was intended to insure that any profit from secondary production of wood products accrued to the residents of the Colony rather than to some foreign source. In practice however, the acquisition of such a permit was not a difficult task.

A second policy matter was that Crown Grants were intended to be issued solely for cultivation. Thus, the ownership of timber lands was discouraged. In actual practice persons

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3. For a more detailed examination of the history of the changes in the various Timber Acts see British Columbia, Commission on Forest Resources (1956) and Cail (1974).

continued to acquire prime timber lands under the grant system because there were no practical means of checking all the grant applications.

These early years, 1865-1880, were marked by the need for lumber principally for construction purposes on a local scale. There was some export of sawn and unsawn lumber to San Francisco and the Orient; but it was on a very small scale. Local initiative was the principal aim because the rest of the world was too inaccessible. By the 1880's the principal method of freight transport, railways and steamships, had progressed to the point where British Columbians could effectively enter world markets with any non-perishable goods. It was at this time that the full value of the forest resource was realized. (Table 1 summarises the important Acts cited in this chapter.)

In an attempt to open up the lumber industry, the government in 1884 created another form of temporary tenure, the Timber License.(4) These were to be 1000 acre stands of timber issued to one person for a four year period at a fee of $10 per year and were non-transferable. For an operator to receive a License he did not have to own nor operate a mill, as was the stipulation with a Lease. In the same year the fee for a Crown Grant was raised to $2.50 per acre for farming and $1.00 per acre for other lands, and the size was restricted to 160 acres. In 1886 the Hand Loggers License was created. On a

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4. B.C. Statutes. 1884. 47 Victoria, c. 16, s. 35.

TABLE 1

KEY FORESTRY LEGISLATION 1857-1975

Date	Act	Purpose
1858	Land Act	Established sale of Crown Grants to provide land for settlers.
1865	Forest Act	Established principle of Crown ownership of resources by creating Timber Leases as temporary tenures.
1884	Forest Act	Created Timber Licenses as investment possibilities for forestry.
1905	Forest Act	Liberalized terms of Timber Licenses to induce full scale development of lumber industry.
1907	Forest Act	Banned further issuance of Timber Licenses and Timber Leases to halt the timber rush.
1912	Forest Act	Created Forest Service as governmental bureau to coordinate timber activities.
1945	Forest Act	Created Tree Farm Licenses and Public Sustained Yield Units to reorganize and stabilize provincial forestry.

Source: British Columbia, Commission on Forest Resources, 1956.

one year basis they covered a non-specific area of timber for a $10 fee. The fee was not changed to $25 per annum until 1908.

In 1887 the Timber Licenses were assessed a tax, or royalty, of 20 cents per thousand-feet board measure and 10 cents per tree. This was to ensure a return to the Province from the lease at the time of cutting. In the same year a royalty of 25 cents per thousand-feet board measure was levied on any timber taken from a Crown Grant. A further change required an affidavit stating that any new Crown Grant was not being taken out primarily for logging purposes. In practice it seems that this was a "rubber stamp" procedure that was more or less unenforcable and generally ignored.

In 1888 a major revision was made in the whole system of timber alienation.(5) The Timber Licenses were made out non-transferably to one person covering 1000 acres for one year renewable periods, at a cost of $50 per year with the above mentioned royalty. The Timber Leases were assessed a royalty of 50 cents per thousand-feet board measure with a rent of 10 cents per acre on unlimited acreage but the period of the Lease was extended to 30 years. The stipulation of mill ownership was strictly retained. At the same time, the royalty on the Crown Grants was raised to the same level of $.50 per thousand-feet board measure but their size was increased to 640

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5. B.C. Statutes. 1888. 51 Victoria, c. 16, s.21.

acres, theoretically for non-lumbering purposes. This meant that if one could accumulate the capital for a mill the Timber Lease was the cheaper option, while if one could not the Timber License provided a more expensive means of entering the timber market. If a person was willing to lie, he could still own timber lands, within Crown Grants, but at a considerable price.

In 1896 another attempt was made to prohibit the outright ownership of timber lands under the Crown Grant system by defining timber lands as those which contained greater than 8000 board-feet per acre on the Coast and 5000 board-feet per acre in the Interior.(6) Sale of any lands fitting these descriptions was then prohibited. In practice, the Provincial Lands Office was often unable to obtain the necessary details and Grants that were forested were issued anyway.

In 1891 and 1892 a few more minor changes were made to the leasing system.(7) First, they were awarded to the highest bidder at an auction; a practice which did not work so well, because a system of pre-bidding developed. Secondly, the tenure was changed to a 21 year period and non-mill owners were

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6. The differentiation between Coast and Interior was chosen because of the natural differences in the forests of the two areas. The characteristics of the Coast region allow for much faster tree growth and hence for a denser, higher volume forest. In the Interior the growth rate is much slower and thus the forest is more spacious and of lower volume per acre. The two classifications, which are still in effect at the present, were intended to take these facts into consideration.

7. B.C. Statutes. 1891. 54 Victoria, c. 15, s. 4 and 13.

allowed to hold them. However, the latter's rent was to be 25 cents per acre as opposed to the increased 15 cents per acre for a mill owner. As a matter of policy the stipulation of manufacture within the Province was then enforced and export licenses were no longer obtainable.

More changes were made in 1901.(8) Timber Licenses were restricted to 640 acres, but a licensee could take out two of them. In addition, the rent was increased to $100 per year and raw cut lumber was non-exportable. The Timber Leases were at that time made renewable annually for 21 year periods at whatever was the current rate, which at that time was left unchanged. At the same time, provision was made for a Pulp Lease which was identical to a Timber Lease but pursuant to a pulpmill and at two-thirds the cost. In 1903 the rents on Timber Licenses were altered again to be $140 per year on the coast and $115 per year in the interior for the 640 acres. The royalties were also altered to 50 cents per thousand-feet board measure for saw lumber and 25 cents per thousand-feet board measure for cord wood.

Two years later, in 1905, the most significant provincial decision concerning forest tenures, specifically the Timber License, was made.(9) It was felt that not enough investment

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8. B.C. Statutes. 1901. Ed. 7, c. 30, s. 8.
9. Canada. Commission of Conservation, Committee on Forests. 1918. by H.N. Whitford and R.D. Craig. Ottawa.

was being made in the Timber Industry of the Province and in order to spur employment and economic growth the forests had to be opened up. It was decided that Timber Licenses should be a) made annually renewable for 21 year periods, equal to the Timber Leases; b) transferable; and c) there should be no limit to the number that could be held by one person or company. Rents and royalties would remain the same at that time. These changes had the immediate effect of creating a stampede of Mid-Western American Lumber Barons and various local pretenders to the throne, which clamoured after the timber of the Province. In two years, until 1907 when all further issuance of Leases and Licenses was banned, over 15,000 Timber Licenses were issued covering more than 3,846,000 hectares of forest; much of which had hardly been seen by European eyes and all of which was prime timber. At that point there were also 251,000 hectares within the 172 Timber Leases and 158,000 hectares in 178 Timber Berths. (10)

During this entire quarter century up to 1907 the entrepreneurs of British Columbia were attempting to establish a sound economic community upon which they could depend for a

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10. To induce entrepreneurs to open up the Province, the Government adopted the policy of offering large sections of land to any company that would build a railway line. These tracts extended for twenty miles on either side of the line and were deeded upon its completion. Within these belts the companies, principally the Canadian Pacific Railway, offered tracts of land for logging purposes. Presently the government treats those tracts that are still valid as if they were Timber Leases but retains the distinctive name of a Timber Berth.

stable, high standard of living. At the same time the Legislators were attempting to find efficient means of allowing private enterprise to explcit the Province's natural resources while publicly receiving payment in the form of rents and royalties. It was not until the decision to "wholesale" Timber Licenses was made that they truly received an appreciable amount of funds from these sources. In the two year scramble, 1905-1907, the Provincial treasury received over $13,000,000 from Timber Licenses, as opposed to the previous average yearly receipts of $3,000,000, of which approximately $450,000 came from the forests (Commission on Forest Resources, 1956). The provincial coffers were no longer anemic and the idea of a timber famine, which had arisen, was squelched.

After the two-year rush the provincial legislators realised that their scheme for opening up the forests had worked only too well. Perhaps too many Timber Licenses had been issued. Perhaps too much control was in private hands, which could not always be counted on to act in the best interests of the Province as a whole. A mood of constraint catalysed by the Conservation Movement in the United States, was felt in Victoria.

The government spent the next five years formulating a new act that would consolidate all the previous forest acts and cover all the aspects of forestry in British Columbia. In 1912

the Forest Act was passed.(11) The main thrust of the act was to create the Forest Branch, later the Forest Service, as an administrative bureau to control the provincial forests. The Service was charged with numerous responsibilities including cruising timber, defining the limits and checking the validity of Timber Licenses, Timber Leases and Crown Grants, operating ranger stations in the forest areas, administering fire protection systems and selling further rights to cut timber. This last responsibility was written into the Act as the Timber Sale, which was envisaged as a replacement for the other temporary tenures covering Crown timber. A Timber Sale was a definite contract entered into by the Forest Service and a logging company, to cut a specific amount of timber over a certain time period, usually 1 to 3 years. It was not left to the discretion of the company to cut when it saw fit , as with the Timber Licenses and Timber Leases. Rather they had to remove the timber according to specifications laid down by the Forest Service in the contract. These specifications were left as a policy matter by the Forest Act, and for a few years were very inexplicit. Presently, they deal with utilization standards(12), slash burning, size of cut, method of cutting and the time allowed for completion of the contract. The

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11. B.C. Statutes. 1912. 2 Geo. 5, c. 17. ss. 105-133.

12. Utilization standards are the criteria which determine the minimum size of tree that the Forest Service will require to be cut on a Timber Sale. They are set in terms of the minimum height of the stump and the minimum diameter of the tree at its stump and top. Specific standards will be discussed later in the text.

rental for the Timber Sales was the same as that of a Timber License in 1903, 21.88 cents per acre per year ($140 per section) on the coast and 15.62 cents per acre per year ($115 per section) in the interior. Provision was made for Pulpwood sales at half that price, but they were only to be made to pulp mill owners. Later, between 1919 and 1921, provision was made by the government for owners of Timber Licenses to convert them to Pulpwood Licenses. These required association with a mill and included the same half price stipulations as did Pulpwood Sales.

Also laid out in the Forest Act was a system of fire protection. All forms of temporary tenure had to pay a Fire Protection Tax of one cent an acre which was used by the Forest Service solely for providing fire control systems, lookout towers and equipment. This tax was raised several times until it reached six cents an acre, in 1939. To date it has remained at that level.

During the early years, Forest Service policy centered mainly upon Timber Sales and upon the task of deciding exactly what was the best set of specifications to place on timber cutting. The Forest Service had ample time to determine those specifications, because demand for Timber Sales was low following the massive issuance of Timber Licenses. At first, rough utilisation standards were used: cutting all trees of an 18 inch diameter on a two foot stump and a ten inch top

diameter. Large clear-cuts of 240 to 400 hectares were common, with slashburning afterwards to reduce fire hazard. In general, this period was one of "wait and see" without any radically new policies while the Forest Service established its control over the approximately 30,365,000 hectares of commercial Crown timber. The total Provincial forests encompass 59,920,000 hectares but exclude the 6,623,000 hectares of commercial timber held under some form of private tenure: 2,227,000 in Crown Grants, 3,846,00 in Timber Licenses, 251,000 in Timber Leases, 158,000 in Timber Berths, and 142,000 in Pulpwood Leases (Commission on Forest Resources, 1956).

During the interwar period the greater part of logging in the Province took place on forest lands held in some form of private tenure. Private interests had secured the rights to so much timber that they felt very little need to buy any more from the Crown. As the Prairies bull market faded after 1913 the lumber companies were reluctant to buy more timber. Not even the opening of the Panama Canal in 1914, which made shipment to Europe and eastern North America much easier, could stir them. This situation was more strongly reinforced when the world markets crashed leading to the Depression of the Thirties. Hence, there was very little pressure on the government to change any part of the new Act during that time. The Depression placed some pressure on the Legislature to use

the forests to somehow alleviate people's hardships, but there was very little that it could do legally to combat the world wide recession.

Most of the changes that took place during this time were policy decisions made within the Forest Service. High grading and selective clear cutting had been all too common practices before that time, and to combat these wasteful practices the Forest Service tightened its utilization standards to what is now called intermediate utilization. This meant that all trees of 14 inches diameter on an 18 inch stump and an 8 inch top had to be cut. The Forest Service also decided that generally it would require slash burning in order to reduce the danger of wildfires, to retard the growth of "weed" trees such as alder, and to prepare the soil by returning nutrients to it in the form of ash. Wherever climatic, slope and/or soil conditions were favourable this technique was used. Until 1944 an average of 79 percent of cut areas in the Vancouver Forest District were "broadcast burned" (Commission on Forest Resources, 1956). At that time the practice was questioned by the Crown Commission on Forest Resources which subsequently suggested that it no longer be required. By 1955 the annual average burned hectarage had dropped to 45 percent of cut areas.

As war followed Depression, shortages of capital and labour replaced the shortage of markets. In response to these difficulties the government employed the Provincial Inquiries

Act (1931) to establish a Crown Commission to investigate the Provincial forestry situation. The Commission was headed by Chief Justice G. McG. Sloan, and was charged with fully investigating the timber industry and making recommendations concerning its stabilization and recovery. The Commission tabled its non-binding report in 1945, following a year of hearings. Originally, the intention was to hold a commission every ten years to reassess the forestry situation. Only three have been assembled, the second one headed by Justice Sloan in 1955 and a third presently headed by Dr. P. H. Pearse.

As could be expected the major problems cited by Commissioner Sloan were the general instability of the industry with regards to markets and capital and the undesirable character of the fluctuating employment situation. The principal recommendation put forward in the report was the establishment of a system of Forest Management Licenses and Public Working Circles to organize the administration of the Provincial Forests. These systems were subsequently adopted by the Legislature. The Forest Management Licenses were designed as large tracts of forest, generally entire drainages, that would combine private tenure timber with Crown timber into a unit that would be managed by the company which had owned the private tenures. (Considerable consolidation of Timber Licenses and Timber Leases had taken place since 1907 such that it was common for one company to hold all the tenures for one watershed.) The Public Working Circles were intended to be

areas of forest set up by the Forest Service to be managed as distinct units. Each circle would be managed separately from the others within the same forest district, with Timber Sales being the means of releasing timber for cutting. The Forest Management Licenses and Public Working Circles have since been renamed Tree Farm Licenses and Public Sustained Yield Units.

As an integral part of this system the policy of Sustained Yield Management was proposed and subsequently adopted. It maintained that within a given unit the board footage of timber cut over any time period could not exceed the growth of timber in that time period. Thus, by never allowing the total volume of timber to diminish the productivity of the forest was maintained at a certain level. The yearly amount of logging is therefore determined for each unit by an "annual allowable cut". In any single year the allowable cut may be surpassed, as long as the five year running average remains below its acceptable level. One of the key pieces of information necessary for this system is the length of maturation period for the trees in the unit under consideration. Given an average rotation period of eighty years, it was reasoned that each parcel could be cut every eighty years without any loss of productivity. Eighty years is actually the lower limit for regeneration which has been determined for prime coastal sites in Douglas Fir-Hemlock forests (Commission on Forest Resources, 1956). In more critical areas, and in the Interior the range is much longer, reaching 140-160 years for some Interior White

pine forests. In some cases the over-all quality of the forest may be improved over time because its growth can be more effectively controlled, and poor growth can be removed to allow only good growth to continue. (13)

Both the Tree Farm Licenses and The Public Sustained Yield Units were to be administered using this system of management. One major problem that was initially overlooked was that the period of forest environment regeneration might not be the same as that of the trees alone. Trees may be able to grow back in 80 years but they do so on the strength of past nutrient fixing. Although they have matured, the overall environment might still require another 80 or more years at that level to reach its optimum. To cut again after only 80 years could therefore be disastrous. These circumstances are particularly

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13. The objectives of this system were to establish a solid base upon which the forest industry could build a permanent structure. The larger companies were assured of timber to cut in perpetuity because of the large areas of timber they were managing on the sustained yield basis. Thus they could plan for constant steady growth in the future and could therefore provide a stable investment opportunity. This, in turn, offered a more stable employment picture because industry could know its needs far in advance and hire accordingly. In addition, if the market rose suddenly, companies could augment their supply of lumber by purchasing extra timber sales. Often however, this has not been necessary because the allowable cut has not been reached every year and the system thus has accumulated some extra allowance. Within the system the smaller operators still had to buy their timber through the sales method, but these were offered on a sustained yield basis in a Working Circle by the Forest Service. The more stable condition of the general market, due to the stability of the larger companies, would, hopefully, add stability to the small operators.

true of high alpine, steep slope and/or thin soil areas where the ecologic balance is more critical (Kimmins, 1973 and 1974). Recent objections to Sustained Yield forestry techniques will be discussed later in this chapter.

A concomitant adjustment that followed the War was the adoption of the doctrine of multiple-use. Multiple-use was at once a philosophy and a technique. Its philosophical base stemmed from Pinchot's idea of "the greatest good for the greatest number over the greatest time" (Nash, 1967). Multiple-use held that all resource uses were possible, even desirable, such that the optimal human benefit could be derived from an area. As a technique, multiple-use attempted to set up a means for determining the priorities of each potential use (Dana, 1943; Pearson, 1944). In British Columbia, as elsewhere in North America, those values were determined by using criteria that were basically economic. The resource use that contributed the greatest economic return was given the highest priority. Other uses were allowed or encouraged to the extent that they did not detract from the primary use, with each having priority according to its economic return (McArdle, 1953; Neff, 1961; Davis, 1966). This system of thought has been termed "Dominant Use" (Hall, 1963). An inherent bias was incorporated into this technique by the adoption of economic principles as the primary decision-making criterion. This was quite acceptable at the time, because British Columbians were most concerned about their economic well-being.

In the late 1950's the Forest Service once again tightened its utilization standards to close utilization. Under this standard, all trees of an 8 (or 10) inch diameter on a 12 inch stump and a top of 6 inches had to be cut in the coastal areas. In the Interior the figures are a 6 (or 8) inch diameter on a 12 inch stump and a 4 (or 6) inch top. These standards are generally still employed throughout the Province but in some cases intermediate utilization is used.

The use of sustained yield management and the multiple-use doctrine by the Forest Service placed heavy emphasis on silvicultural techniques. As an extension of this emphasis and in response to adverse public opinion concerning the visual scars left by clear cutting, the Forest Service, during the 1960's, adopted a policy of requiring replanting in cut over areas. Small areas, less than 50 hectares, where natural regeneration would be rapid did not necessitate replanting, but all larger areas were supposed to be restocked. In the Tree Farm Licenses reforestation was to be undertaken by the company in charge, while in the Public Sustained Yield Units the Forest Service gave out contracts for replanting. In practice, on a Provincial basis and in the Soc, approximately 25 percent of cleared lands have been replanted. Approximately 50 percent of those replantings were carried out with Douglas Fir because of its propensity for rapid, straight, and tall growth.

When groups of recreationists, environmentalists and ecologists vocalized their displeasure with the overspecialization towards timber production, the Forest Service and other agencies within the Provincial Government responded by initiating a series of hearings in the late 1960's and early 1970's (Pearse, 1974). One of the more significant results from these inquiries has been the instigation of a referal system, whereby the Forest Service relays all five year cutting plans, compiled by timber firms, to the Fish and Wildlife Branch for consideration. The Branch may request additional restrictions on the plans before they are approved by the Service. The emphasis of the system is on assuring that interests other than board-footage and silviculture are incorporated into forestry planning.

In response to public criticism of poor practices, and to help the smaller operators, the Forest Service initiated a system of Timber Sale Harvesting Licenses, in 1968. These licenses were intended to cover regular timber sales but for a ten year period in stead of three. The operator, in conjunction with the Service, needed to devise two five year cutting plans from which he would work. The intent of the system was to cut down on the risk and difficulty inherent for the small operator in having to bid and fight for timber sales every few years. By adding more stability to the smaller operations it was hoped that certain environmental corners would no longer need to be cut.

The "Planning Guidelines for Coast Logging Operations" issued by the Forest Sevice in September 1972 were another outcome of the debates that had taken place. (They were to be followed by guidelines for Interior and high altitude operations; but while working copies of these have been formulated, they have not been issued.) The guidelines are a policy statement which sets out required logging procedures that have been determined as the most desireable by the Forest Service. They cover all aspects of the logging operation, setting out their specifications in qualitative terms. The Guidelines focus upon overall environmental quality, water quality, fish and wildlife values, recreation values, park environments and fire protection. The techniques mentioned as being key to the maintenance of these values include 1) clear cutting to a maximum size of 80 hectares with proper aspect and orientation; 2) alternate cut and leave patches; 3) proper siting of yarding; 4) leave strips of deciduous or coniferous trees along water courses; 5) adequate preparation of the site for restocking after logging has ceased; 6) extremely careful planning of all roads to match the situation on the site and Forest Service specifications; and 7) cooperation with other agencies in determining site specific standards. Their intent was to minimize the adverse environmental effects of logging and to incorporate values other than timber into the operation.

The most recent restructuring of forestry decision-making, in the form of the Folio system, is a direct outgrowth of the referal system. The new system is intended to provide a resource folio for any watershed in which development is foreseen. A full inventory of resource values is made for the watershed and then a development plan is drawn up by a multi-disciplinary committee. The Forest Service in conjunction with other agencies (e.g. the Fish and Wildlife Branch, the Parks Branch and archeologists of the provincial government, the Fisheries Service, Geological Survey and Soils Survey of the federal government, and private companies) undertake the collection of inventory information. From their staffs are chosen the members for the planning committee.

Since the resource values of the watershed are ascertained before any planning or develcpment takes place, potential conflict areas can be identified at an early stage and special attention can be paid to their specific values, and their resolution. The planning committee is multi-disciplinary and therefore can devise compromises that will be mutually agreable to the agencies concerned and will minimize resource conflicts. Binding restrictions concerning critical areas or specific types of development can be explicitly incorporated into the development plan to insure that different parties do not infringe upon each other. In this manner the resources of the area may be used optimally and the maximum societal benefit may be achieved.

The adoption of the Folio system has come hand in hand with a redefinition of multiple-use. The new approach is intended to move away from the bias that was incorporated into the earlier multiple-use system, towards a more integrated resource management perspective.(14)

A hinderance to the Folio system is its newness. Because the province is so vast and detailed knowledge of its attributes is relatively limited, folios can at present only be drawn up for the most important watersheds where development is immanent. Completion of the folio is always hurried by the pressure to commence developing the area. Also, the folios must be constrained to manageable proportions (i.e. to watersheds rather than to regional areas).

As a decision-making tool the Folio system seems to be primarily tailored to reducing conflict. It is a forum for the various governmental and industrial organizations to air their particular concerns to one another. It does not specifically elicit opinions from other less "formal" groups. While many more information sources are being accepted into the decision-making process the stress seems to be upon finding

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14. The re-orientation of multiple-use was followed by a shift in hiring policy that saw foresters with expertise in recreational or game management being taken on by the Forest Service and industry. They were hired in an attempt to broaden the perspective of the industry and guard against the "tunnel vision" of which it had been accused.

solutions that are compatable to the agencies rather than upon finding the solution that best suits the watershed. The final plan may make specific recommendations about certain areas but it leaves the determination of "good" practices for other areas in the hands of the agency in charge. By addressing themselves to prospective development the planners rarely entertain the idea that perhaps the watershed should be left undeveloped. In all these respects the system seems basically to be a means of reducing inter-agency and inter-corporate strife.

The management perspective is thus "integrated", but is basically the same developmental philosophy supported by Pinchot. New information sources must now be accepted by the Forest Service but their philosophies are essentially the same as those of the earlier decision-makers.

In recent years the ideas embedded within sustained yield management of forest lands have come into question. It has been argued that the fundamental principle of sustained yield (which maintains that in order to perpetuate timber harvesting logging must only remove as much timber volume as is grown in one year) does not take into account the essential fact that resource industries are heavily dependent upon market conditions. When the price is low, it makes little sense to cut simply because the trees have grown. Conversely, and

regardless of the stabilizing effects such practices may have, when prices are high it makes no sense to hold back because the trees have not grown enough. It has been put forward that the industry needs the fat years to pull it through the lean ones (Haley, 1966; Smith, J., 1969; Pearse, 1970). In addition, only approximately 50 percent of the usable timber lands should be rotated because of the problems associated with regeneration, altitude, distance from markets, etc. Yet the timber that is beset by these problems may be perfectly usable, but only on a single clearance basis (which does not imply that the forest will be destroyed by the cutting, though in some cases it may be). It has been argued that the prime half should be rotated to provide a steady base for the production of forest products and the use of other half be planned such that it can be taken only in the good market years (Kimmins, 1974). It has been claimed that in such a large Province there is more than enough good second class timber to sustain even a prolonged boom period. Waste and degradation need not occur as long as planning takes place with at least a ten year lead-time. Especially with the planning of the Folio system, environmental deterioration need not be feared.

These arguments have been acknowledged by the Forest Service and the Government. At present the agencies feel that the arguments do not negate Sustained Yield as a concept but rather call for its readjustment. They maintain that some

accounting of forest activities is necessary and counter with the argument that Sustained Yield is still the best basic technique for planning use of the forest. They feel that it only needs to be made more flexible and better tuned to the fluctuations of the market. It seems that a compromise will be achieved that will satisfy both industry's economic needs and government's desire for controls.

The growth in ecological awareness of the late 1960's and 1970's has led to numerous policy shifts in provincial forestry. In the main, they have been attempts to get away from the parochial stance forestry had developed through over-zealous adherence to the principles adopted after the war. They were intended to broaden the scope of logging and make it a more ecologically comprehensive operation.

Since colonial days, the Legislators of British Columbia have made many key decisions concerning the Provincial forests. The fundamental piece of legislation came in 1865 when they decided that control of natural resources would be retained by the Crown for the public good. The Legislators devised various forms of temporary tenures, e.g. Timber Leases, Pulp Leases, Timber Licenses, Pulp Licenses, Hand Logger Licenses and Timber Sales, to regulate the forests use. In 1912 they created the Forest Service as the administrative agency for the forests. It was charged with regulation the forests in the best

interests of the Province. Then, in 1947, the Legislature established the system of Tree Farm Licenses and Public Sustained Yield Units to be the format through which the forests would be controled.

Through the years there have been numerous policies which have also greatly effected forest evolution. In 1905 the decision was made to spur timber development by greatly relaxing the controls on Timber Licenses. The increased benefits were an inducement to private enterprise to invest in the Province's future. Tc increase the efficiency of logging the Forest Service devised utilization standards which regulated the size of trees which had to be removed from a site. These standards have been upgraded through the years as conditions of production have changed. Another policy which was aimed at better utilization of forest resources was that of replanting trees following logging operations. The first attempts in this line were made in 1934. The policies of Sustained Yield and multiple-use were developed after the war to aid the implementation of the Tree Farm License and Public Sustained Yield Unit systems. Since their inception various adjustments have been made in these policies to keep them relevent to changing conditions. Concurrent with those adjustments was the formulation of the "Planning Guidelines for Coast Logging Operations," which have set down the most desireable practices as determined by the Forest Service. Most

recently the Folio system has been devised to incorporate a broader range of values into the decision-making process and more completely plan the developement of forest areas. Beyond the regulations set by this framework of institutions and policies, forest users have had to adapt themselves to the technologic conditions of the times.

CHAPTER 3

FOREST PRACTICES AND THEIR EFFECTS

In British Columbia forest practices have centered around the growing and cutting of trees for commercial purposes principally because such pursuits provide the basis for the Provincial economy. Forest practices that address themselves to grazing, animals or recreation, if they have existed at all, have been secondary. Because silviculture and logging have occupied this primary position and their environmental effects are more potent than other uses, it seems desirable to examine the evolution of logging practices in detail before proceeding. Then, from the literature an appraisal will be made of the environmental effects that any action may produce, in order to assess the inherent costs involved.

There are numerous phases of a logging operation, each one a detailed subject in itself. It will be best to trace the evolution of each phase separately rather than approach the entire operation in a chronologic manner, which might prove confusing. In addition , the various aspects of the operation have widely differing effects which can better be illustrated when each is viewed separately.

LOGGING TECHNOLOGY

The initial phase of any logging operation is the selection of the site. While this is the first decision to be made, it is difficult to discuss before the other phases of the operation because it has no physical effects of its own and is the point where many external criteria are balanced, e.g. economics, aesthetics, and especially the technology available for the operations other phases. However, site selection has a marked effect upon the severity of impact from the other phases. It will therefore be discussed after the other practices, in the hopes that they will generally explain many of its influential factors.

Felling and Bucking

At the logging site the initial actions are the felling and bucking of the trees. From the earliest days of logging in British Columbia felling was done by hand with either a single or double bladed ax. In the 1880's the cross-cut saw was introduced and became prevalent throughout the Province's woods. Methods of bucking the fallen trees have always closely paralleled those of felling, though most often the implements have been smaller in size.(15)

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15. The history of logging technology and practices is principally drawn from Lawrence (1957), Tuomala (1960) and Walsh (1975).

In British Columbia this muscle power method of falling remained unchanged until 1936 when the Bloedel Co. brought over from Germany the first Stihl chainsaws. They weighed 40 kilos and required two operators, but they were the first practical mechanical means of dropping a tree. The war halted their importation but when it ended, improved mechanical saws, both local and foreign, soon asserted their dominance over hand methods.

The major effect of this change was in terms of the return per unit labour. Each faller could immensely increase his production with the aid of a mechanical saw, in some cases up to one hundred trees a day. Man's ability to totally change the forest environment, through systematic removal of trees, was increased by an order of magnitude.

Yarding

When trees have been felled and bucked they must be yarded together before they can be transported to a mill. In the earliest days most logging took place along shorelines. This was principally because water was the only efficient means of transporting the logs but also because gravity could often be relied upon to naturally draw the bucked logs down to the shore. By the 1860's many logging sites were too far from the coast to be able to count on gravity to self yard the logs. Teams of oxen or horses were then used to drag the logs the two

or three kilometers to the water's edge. At first the logs were simply dragged along the surface, but "nosing" and "hang-ups" were too frequent. To overcome these difficulties skid roads were employed. They were made of fir logs, seven meters in length and 25-30 centimeters in diameter, which were half imbedded at three meter intervals. This allowed a seven meter log to be continuously above the ground as it was skidded. For the haul, the logs were usually attached end to end in long trains, and perhaps four runs would be made in a day.

The first major improvement over muscle power yarding in British Columbia came in 1902 when a steam "donkey" yarder was used at Chemainus. The steam engine drove a "gypsy" spindle which drew in the log from where it lay to the yarding platform, by means of a long line. Through the years numerous improvements were made upon that initial steam yarder. More efficient power sources were fuel oil in 1916, gasoline in 1922 and diesel in 1924. Improvements in the yarding systems were the highlead in 1904, skyline in 1905 and slackline in 1908. By 1915 the highlead system, using a spar tree with numerous blocks and a haulback line, had become the most popular yarding system in British Columbia. It has maintained that popularity to the present.

The only major advances following the breakthrough to mechanical power have been the gradual reduction in size and

weight of the units and, more rapidly, the shifting to mobile units since the last war. The same systems are used, but they are mounted upon self-contained, self-propelled vehicles, complete with one hundred foot towers and lightweight high power diesel engines.

The major advance in yarding came with the use of mechanical energy. While initially logs were still drawn across the ground, the return on labour input was greatly increased. The highlead system raised one end of the log off the ground and therefore greatly reduced the drag and hang-ups. The skyline and slackline systems went one step further by raising the logs completely off the ground by the use of tongs and later grapples. The modern shift to mobile yarders once again increased the return on labour input by reducing the non-productive rigging and de-rigging time. In order to gain their reduced labour costs and increased scope of activity, all of these improvements have necessitated increased capital expenditure in the form of more costly equipement.

Loading

Loading of the logs must take place once they have been yarded together. Initially this was simply a matter of rolling them into the water at the shoreline and hauling them back out again at the mill. When other means of transport became prevalent a loading problem arose. The first loaders were just

booms, with blocks and tackle, attached horizontally to a topped tree. With a tong they lifted the log off the ground and swung it over the transport vehicle. The two main types of loading were the "heelboom" and "crotchline" methods. The former had only one tong which raised one end of the log up to touch the boom and with leverage lifted the other end off the ground. The latter used two tongs and simply drew the log off the ground. Similar systems were developed for use at the mills to pull the logs out of the holding ponds.

Power winches were added to these log loading arrangements at roughly the same time that they were used for yarding purposes. They greatly increased the log handling abilities of the systems. The first mobile loaders were used with the railway lines. They were power driven, had vertically swinging booms, and could rotate circularly on their platforms. The same two lifting methods were used by the railroads (and continue to be used today.) Since the War there has been the same shift from staticnary and rail mounted loaders to mobile self-contained loaders that simply are driven into position near the yarders. The change from tongs to grapples also took place in loading, along with a change from winches to hydraulic power in the late 1950's.

The major change was once again from muscle power to mechanical power. Since that time, only refinements have been made upon the basic systems, particularly in the fields of

mobility and the finesse with which the units operate. All advances have followed the pattern of reducing labour needs and increasing capital investment in move expensive and complex machinery.

Transportation Methods

The methods of log transportation have followed a parallel path to those of yarding and loading. In the first half of the Nineteenth Century most logging was undertaken in close proximity to the mill to minimize transportation altogether. When the distance from the mill was increased in the latter half of that century most long transport was by water, either along the coasts, in lakes or down rivers. Log booms were at that time, and remain today, the principle means of controlling logs for water transport. In most cases though, this is beyond the realm of the forest. If the distance from the mill was not too great the logs were painstakingly hauled over skid roads by oxen.

The breakthrough in transportation came in 1900, again at Chemainus, with the utilization of railroad lines to haul the logs. The early steam driven engines were of both "geared" and "rod" types. At first the rails were just logs set in the ground, but iron soon became the norm. The early cars were also quite crude. At first they were the frame and undercarriage from stripped boxcars. These were replaced,

after a decade, by specially designed "skeleton cars". The railways increased in importance until the mid teens and then began a gradual decline into the middle thirties, except in the Interior regions where they remained moderately strong until the war.

Shortly after the turn of the century the first practical mobile machines made their way into the provincial forests. Tractors came first in 1904 and trucks followed ten years later. The efficiency of those early models was so low that they caused no great realignment of existing systems. Larger scale use had to wait until the 1930's before satisfactory inprovements, to be discussed in detail below, were made. Following the war, trucks and tractors completely asserted their dominance in the field of log transport, and have continued to maintain that position.

The first major advances in transportation of logs came with the use of mechanical energy in 1900. The railroads allowed the logger to move away from waterbodies into the valleys, especially the interior valley regions. They allowed him to step up his operation from a local endeavour into a regional industry related to the world market. A second major shift came with the shift from capital intensive railroads to less intensive and more highly mobile trucks and tractors. This shift allowed the lumbermen to modularize their operations and thus greatly increase the size and scope of logging.

"Traction" engines were a relatively early invention for the British Columbian logger. The first one, a steam powered, steel wheeled, top heavy, chugging monster, was used in 1875 on Vancouver Island to replace oxen on a skid road. Their awkwardness and restriction to flat terrain, limited the use of early tractors. It wasn't until 1904, when John Holt, of Sacramento, replaced the large steel wheels on his machines with treads, that tractors could negociate the forests. The resultant contraption was nicknamed a caterpillar, and thence the name has stuck (and in fact has been copywritten). When gasoline powered internal combustion engines were added in 1908, the tractor was even more suited for use in the woods. These crawler tractors became very popular in the late Twenties. They were mainly used for yarding purposes but short hauls to the mill, of up to eight kilometers, were frequently undertaken. To elevate the front ends of the logs on these hauls, a four wheeled platform, called a "bummer", or a two wheeled "arch", was hitched behind the tractor. Nosing and hang ups were thus avoided. This was the method that became known as "cat logging" and up to 15,000 board-feet could be handled in one load.

Diesel power plants were first used in tractors in 1931, which greatly increased their power/weight ratio. This, along with the addition of plows and shovels, enabled tractors to be employed as earth moving machines and road builders during the Second World War. This switch was a major advance and allowed

the subsequent shift to entirely automotive transportation of logs. The poor quality of early roads (often made of planks and with no sense of permanency) was one of the major plagues afflicting automotive transport systems. The more recent addition of hydraulic power systems has enhanced the road making abilities of tractors by adding an element of finesse to their use.

Motor trucks entered the forests in 1913, as stated above, but they were troubled initially by the same faults that had been evident in the early tractors: awkwardness and terrain limitations. One of the prime reasons for this was their restriction to solid rubber tires which had relatively poor tractional capabilities. Trucks did not begin to come into their own until the 1930's. In order to maintain an adequate supply of timber it was neccessry to reach further into the valleys, where railroads were not profitable. With the advent of the heavy duty pneumatic tire and tractor plows during the War, the two major obstacles for trucking were removed and logging could progress up the valley walls as well as to their heads.

The advancement of tractors and trucks in logging strengthened the trend towards greater and greater capital investments in machinery to compensate for and offset increased labour costs. This is one of the facets of the shift towards larger scale business operations that has taken place in this century.

LOGGING METHODS

Logging methods are critical to the site selection process. Many aspects of the early logging period were constrained by the technology they had at hand. Lumbering could only exist on a small scale, run by local operators, because means of moving and handling large volumes of timber were not available. This restriction meant that selection was limited to the area adjacent to a mill, which would have been located at tide water to take advantage of the easier transportation. Oxen and horses expanded the realm of choice to some extent but only by three or four kilometers at most. For these reasons mills were often quite temporary and would be moved every few years once the accessible timber of the hinterland had been logged.

These factors also had a direct influence upon how the forest was cut. With muscle power as the loggers only asset, it was nearly as difficult to handle a small tree as it was a mammoth one. Since there was much more good timber in one big tree than there was in several smaller ones, fallers definitely preferred to spend their energies on the mature forest giants. With the larger trees the return on a crew's labour was sufficient for them to profitably undertake the venture. Smaller trees if they were felled or got knocked down were most often left to rot where they lay. More often the smaller, though still usable, trees were simply ignored, with no heed

being given to whether they got blown down by high winds, infested by insects or disease, or burned by fires, which were often set intentionally to clear the land. These cutting procedures were very selective and quite wasteful in their utilization of the timber resource. Such practices have been termed "high grading" because they utilized only the high value timber of a forest and disregarded the rest. They were the standard practices for Nineteenth Century logging in British Columbia.

The turn of the century marked the beginning of the mechanized logging in British Columbia. Steam power was employed to do many of the tasks that hitherto had relied on human or animal power, thus the lumbermen were released from many of the constraints that had bound them. The introduction of railroads allowed the loggers to choose sites away from the coast, in the many well forested valleys of the interior. The steam donkey engine allowed them to cut in previously unfavourable aspects because it gave them the means of yarding the logs out of tight corners. With the various yarding systems, from 200 to 500 meters on either side of a rail line could be utilized economically. Vast areas were opened up for the lumberman who could gather together the capital required for investment in the hardware.

Technological invention also brought about many changes in the manner in which forests were used. The emphasis shifted

away from marginal return on labour, towards return on capital investment. Operators could no longer afford to simply high grade the forest. To pay off the cost of a rail line, more than just the biggest trees had to be cut. Prime stands with massive board footage per hectare were still sought after, but the loggers were placed in a position were they would have to utilize more of the trees on the site. The new yarding methods also required a much clearer work area because they could only pull logs in straight lines. In response to these needs, the practice of clear cutting stands of timber became dominant.

However, even though every tree needed to be cut that did not mean they all had to be removed. Once the capital outlays in equipment had been justified, there was still a marginal point at which the labour and time required to remove and haul away every smaller tree was not justified by the return it generated. While clear cutting was the rule, many of the smaller and/or broken logs were commonly left on the ground. Loggers cut more or less indiscriminately, took what they wanted and felt no compunction about leaving the rest. It was these practices that prompted the Forest Service to initiate what are now termed, "rough utilization standards" (in the 1920's) and then "intermediate utilization standards" (in the 1930's). These standards required companies to take out all logs greater than a certain minimum size, in order that more complete use would be made of the forest resource. During this developmental period in British Columbian logging, burning of

cut areas continued to be an intermittent practice that was carried out more or less haphazardly if it was felt that the risk of spontaneous wild fires was too high. Thus the great amounts of debris might have been cleared, but as often as not they were just left to rot.

Following the war most of the technical advances in logging were refinements of the basic mechanical methods that had been invented in the previous four decades. In particular the designs of chainsaws and hydraulic lift systems were perfected. Along with trucks and tractors, these improvements allowed another expansion in site selection, to include practically all of the forested lands of the Province, if the economic demand deemed them profitable. In practical terms, technology had advanced to the point of allowing nearly complete freedom such that other considerations (economic, ecologic, policy and political) could assume greater relative importance.

Technologic improvements also led to major expansions in the size and scale of operations. This was mainly an effect of the modularization of the overall operation into units that could operate more or less independently. Each phase could be scheduled to move in immediately following the completion of the previous stage, while in the mean time its crew could be working at an entirely different site. This was made possible by mobilization of each activity into self-contained vehicles.

The point of marginal return was once more lowered to include smaller and smaller trees. A company was much happier to cut only very large trees, but they could profitably take the smaller ones. In the late 1950's, the Forest Service instituted "close utilization standards" to insure that the fullest possible use was made of the forest resource. At the same time, sustained yield policies were instituted. The board footage accounting procedures of sustained yield also required diligent use of the forests resources if a realistic rotation time was to be found. Thus, as in many other cases, the increased freedoms of modernization have brought with them, in some senses necessitated, increased restrictions and regulations regarding the acceptability of each possible action.

ENVIRONMENTAL IMPACTS

The effects of removing forest cover are many and may vary greatly in relation to the different logging practices employed. Often one particular practice can itself have widely different effects depending on exactly how, when and where it is used. It seems best to examine all of the possible impacts and then relate them to the specific practices in question, because it will show under what circumstances and in which situations an effect may be considered harmful or beneficial.

A forest with a stable species-mix is an ecological community that has reached a steady state which is attuned to solar radiation, annual precipitation and soil nutrient factors. The steady state represents an essentially closed system in which the necessary nutrients are cycled from the soil to the flora and fauna, and returned to the soil (which is the nutrient reservoir for the system). When the equilibrium of the system is disturbed, as in clearing, the forest looses most of its mobile nutrients, and some of its stored nutrients through removal and subsequent erosion. The severity of a disturbance may vary widely and therefore produce different adjustments and recovery periods. Normally, however, the full degradational effects will be felt within five to ten years. The regeneration process is a fairly random one that depends upon the availability of seeds buried in the soil and those from remaining local species, as well as upon physical environmental processes. The effects of and adjustments to a disturbance are of course not felt exclusively by the floral community of the forest; many of them are experienced to varying degrees by the faunal and/or human sectors of the forest environment.

Removal of Cover

The first and foremost class of effects occur in response to the removal of the forest cover. The extraction of trees

from a forest removes a portion of its nutrients. The percentage of nutrients lost obviously increases with the amount of cover removed and can reach 85 percent of the mobile nutrients if no debris is left behind as is the case with a particularly intense fire.

A second loss in this class is the reduction in water retention capacity of the forest. There are many factors involved in the ability of an area to retain water which are altered by the removal of the tree cover. The more major among them are: the breaking effect of the foliage upon precipitation, the sponge effect of the humus accumulation, the water pockets around tree trunks, the absorption of water by the trees through their root systems, the retention of soil porosity through root action, and the retardation of surface runoff. The removal of this cover markedly reduces the water retention capacity and increases the height and rapidity of runoff maxima following rainfall and during the spring freshet. It also lowers the minimum stage of any stream in the forest during the summer and autumn dry periods (Rothacher et al, 1967; Brown and Krygier, 1970a; Lantz, 1971).

A third effect is experienced in the temperature regime of the cut over area. The forest canopy reduces both the input of solar radiation to, and the loss of terestial radiation from the soil surface, thus modifying the annual and diurnal temperature regime. More extreme conditions occur when the

trees are removed, allowing the sun, rain and wind to bear down more harshly upon the exposed area. These changes are in the micro climate of the area. However, if the cleared area is extensive the effects can greatly disrupt and retard regeneration. Stream temperatures also show a marked rise after clearing due to the direct action of the sun on run-off and stream waters (Chapman, 1962; Levno and Rothacher, 1967; LaPointe, 1973; Brown and Krygier, 1970a).

A major part of the forest ecosystem is its nutrient sub-cycles. Numerous species adapt to the evolving forest system and depend upon its workings for their particular niche. One such cycle might be, trees providing a habitat for insects, which in turn provide for fish, which provide for bears etc. The removal of the producer organisms drastically alters the food-chains of the other inhabitants. Removal may also allow the establishment of other plants which support other food-chains. For example, the removal of forest cover allows the growth of shrubs and young trees, which provides browse for deer, which are prey for cougars etc. (16) The removal of forest cover may also be the first phase of a completely new cycle, such as the transfer of forest to agricultural land (Sheridan and McNeil, 1968; Lantz, 1971).

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16. In this regard the removal of cover is generally accepted as being beneficial because it greatly expands the ranges of deer and other browsing ungulates. At the same time, it restricts the range of other species which are dependent upon the wooded forest, e.g. various birds, rodents and predatory cats.

Another set of impacts associated with removal are those perceived by man. An immediate effect is the visual disamenity that a logged site presents for many people. Old age stands, where trees are infested or are dead, may be seen as beautiful or as diseased and over-mature by different people. Such trees form a natural part of the forest ecosystem, because many parasites depend upon dead or dying matter. For human purposes, however, they may be perceived as waste which should be cleared away, i.e. worthless wood occupying the place where a healthy tree could stand. Regardless of the fact that these are human concerns, we are a part of the natural forest ecosystem and must acknowledge our own responses to its changes.

Removal of forest cover may bring about the destruction of the forest in question. Coastal forests seem to undergo constant fluctuations. Some are internally produced by the forest's growth, i.e. mature Douglas fir makes the forest shadier and moister and thus brings about its replacement by hemlock and cedar. Other fluctuations are due to changes in external factors, radiation, precipitation, or predator pressure, which could bring about the expansion of some species at the expense of others. Or, one of these three major conditions may have been naturally altered to the point where the forest is still capable of maintaining itself but could not regenerate to its present state if it were removed. The present conditions would not reproduce the present species-mix.

Major, or perhaps even minor, disturbance of such situations effectually eliminates the present forest because it can not recover adequately from the alteration. Some other type of forest might replace it or the area might become shrub or grass land. Sites that are at high altitudes, poorly drained, on severe slopes, on thin soils, in dry belts and/or in transition zones are most likely to be in these critical conditions (Kimmins, 1972-73-74).

Overall, the severity of any of the effects in this class are partially related to the initial state of the ecosystem and partially to the extent that the forest cover is removed. If removal is complete (i.e. a clear-cut) then the size of the area involved assumes increased importance. Size will eventually negate any of the ameliorating effects of the three main factors, energy, precipitation and nutrients.

Soil Disturbance

The second class of effects concerns the forest soils. When forest cover is removed from an area the soils will be disturbed to some extent. First, there are the effects that are coincident with the alteration of the entire ecosystem. The mobile soil nutrients are cycled through the vegetative detritus and animal fecies, the sources of which have been removed. Initially some of the soil nutrients are removed through the increased leaching while there is no floral cover.

More importantly, the soil particles themselves may be easily eroded once the moderating effects on wind and water have been taken away. The fertility of the soil is reduced as a result of cover removal (Bolle et al, 1973).

Secondly, there is direct physical damage to the soil during the process of removal. This physical alteration may be of greater or lesser extent depending upon how the forest is removed. Generally, it can be categorized into three groups: 1) disturbance, where the humus and "A" horizons are mixed, compacted, partially removed or otherwise scarred; 2) breakage, disturbance where the "A" and "B" horizons are locally laid bare by scrapping, uncovering or extraction; and 3) removal, where large areas of the entire soil structure are removed leaving partially weathered rock. In that there are naturally extensive areas with incomplete soil horizons and bare bedrock in a forest, these occurrances are not necessarily detrimental by themselves (Frederikscn, 1970).

Two effects whose magnitudes seem to be directly linked to the amount and severity of soil disturbance are 1) the concentration of increased runoff into existing and/or new channels, and 2) the deposition of material in other locations. In part, the increased runoff is due to soil disturbance itself, but in addition, disturbed areas are generally lower than the normal surface and thus lend themselves to accumulation and the eventual flow of water. This

concentration increases the water's erosive capacity which in turn will bring about greater disturbance of the soil. The greater this entire erosional process is, the heavier will be the deposition of material in the drainage net of the area. The key effect of this deposition is the clogging of gravelbeds that provide the spawning grounds for indigenous and anadromous fish populations. The adverse effects upon the fish may be to decimate their numbers. Again the intensity of these effects is directly related to the magnitude of the soil disturbance, unless soil removal is complete, which may happen due to subsequent erosion but rarely during cover removal. This is in contrast to the removal of cover which most often is initially complete and produces maximum effects from the outset (Cordone, 1956; Sheridan, 1968; Meehan et al, 1969; Ringer, 1970).

Burning

The third class of effects is that which involves fire. This category involves many of the impacts mentioned above, and in fact may be the initial cause of the process, if a wild or man-made fire was the method of clearance. Fires often produce more severe effects than other actions. In some cases they are simply harsher facets of other effects and in other cases they are unique to fire alone. Fires provide an efficient means of reducing the mobile nutrient base by consuming, as fuel, some of the available organic matter. The ashes that remain are also easily removed due to their solubility and easy transport

by the winds. In addition, fire may provide another means of disturbing the soil. During a fire, the humus layer and much of the organic material in the horizons are often destroyed. If the fire is intense the structure of the soil may be altered. The resultant soil is more completely weathered and broken down into smaller particles which may be more easily removed (Willington, 1969).

On its own, fire is an effective means of disposing of the waste from some other form of cover removal, e.g. the familiar slash-burn. This operation is usually carried out in a controlled manner which reduces the chance of wild fires starting in waste piles. The possibility exists that a controlled fire may escape and do damage to the surrounding forest. A unique effect of fire is that it will retard the regrowth of certain species, e.g. the alders, while at the same time enhancing the regeneration of others, e.g. the Douglas fir. However, if a fire is intense, it may kill many of the seeds within the soil that could have produced a more rapid regeneration of cover had the area not been burned. In this, fire is also a very effective means of eliminating pests and diseases that may have infested an area, and therefore may be a key management technique.

Replanting

The final class of effects concerns the replanting of trees in a barren area. All of the effects sited above will, to some extent, be mitigated by rapid regeneration of the forest cover, because their duration will be decreased. While the effects of removal can never be eliminated, their minimization can be achieved by rapid replanting of seedlings. In addition, the seedlings that grow from replanting will all be healthy, "good stock" trees. They should grow at a maximum rate because they are well spaced over the forest surface. The result will be even stands of timber which reach maturity in a shorter time than if natural regeneration had taken place.

There are some potential disadvantages stemming from this practice. A clearcut replanted to a single commercial species, such as Douglas fir, may yield more revenue in the next rotation than a stand that undergoes natural regeneration, but the long-term effects of monospecific planting may be less desireable. A single species has specific nutrient requirements which, through repeated replanting, will deplete the soil of those nutrients and thus lead to diminished yields. Certain non-commercial species which perform beneficial functions may be excluded from the site because of the head-start and aggressiveness of the planted seedlings. For example Douglas fir can exclude red alder which is a nitrogen fixing species. While the replanted trees may mature, the ecosystem

they represent may not be as complete as would normally be the case, because several intermediary processes were omitted. Continued removal and replanting would then lead to a degraded environment and perhaps to elimination of the forest cover (Kimmins, 1973). These concerns are critical at high altitudes, on sites with steep slopes, thin soils and low precipitation.

The uniform nature of the replanted forest also represents a simplified ecosystem which is more susceptible to infestation by pests and disease. In effect, a replanted forest is very much a "tree farm," using the Forest Service nomenclature. While the effects of this uniformity have not been as closely studied as those of the removal soil disturbance and fires, their presence has been identified (Kimmins, 1973).

THE EFFECTS OF LOGGING PRACTICES ON FOREST ENVIRONMENTS

The various facets of a logging operation have been summarized and need now to be linked with the changes they produce in the forest. The three key factors of site selection that determine the level of impacts are its altitude, slope and size. Altitude is important because it is a key factor in determining the relative severity of the repercussions. At higher elevations the climate will be harsher and consequently, the forests capability for growth and recovery will be lower. On the Coast the 1100 meter level seems to be a critical one.

This height is the mid point of the apline fir/mountain hemlock forest at which snow fall becomes very heavy. According to Wardle (1974), however, summer warmth rather than winter cold is the major determining factor for the growth of a forest. It is at the 1100 meter level that, in favourable aspects, small patches of snow will remain well into August, evincing the marked decrease in summer temperatures. Hence at this level growth begins to be stunted. Though it does not necessarily pose the upper limit for commercial logging, the 1100 meter elevation is the point where environmental fragility increases greatly. On the other hand, as one proceeds inland, the continentality of the climate increases, and with it the range of annual temperature maxima and minima. Thus the critical level can be expected to rise away from the Coast as summer temperatures become higher and snowfall decreases due to rainshadow effects. On the eastern margins of the Soo this gain may be as much as 200 meters.

Slope is important because it has a direct effect upon the erosive capacity of runcff waters and the ability of the forest to maintain mature soil profiles. The greater the slope, the more critical are the factors. A key slope angle seems to be 50 percent.(17) Above this point the ability of a slope, forested or clear, to retain water and thereby reduce erosion is greatly diminished (Proceedings, Practical Forest Watershed Management Conference, 1974 [18]). The single most important

factor in a logging operation is the size of the cut. It not only influences the type of technology employed, but also has a direct influence upon the impacts of all other aspects of the operation. There is a geometric relationship between size of cut and recuperation time. The range in size that is critical is between 80 and 100 hectares (B.C. Dept. of Lands, Forests and Water Resources, Forest Service, 1972). Below this "moderate" level, the factors of nutrient loss, erosion, temperature change, water capacity and visual rearrangement can be contained by the surrounding forest. Natural regeneration, for example, will be able to proceed rapidly through the invasion of seeds from the surrounding trees. Above this size the ability of the forest to effect recovery is greatly reduced both by the magnitude and momentum of the degradational forces. The degradational factors which are most closely linked to site selection are those due to removal, i.e. nutrient loss, temperature increases and reduction of water capacity.

The first actions on the ground are the felling and bucking of timber. The most important function of this operation is the removal of the forest and its host of effects:

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17. This is equivalent to 22.5 degrees, the average slope of an intermediate ski run. The angle of repose for unconsolidated material is 60 percent, or 27 degrees (B.C. Dept. of Forests, 1975).

18. In British Columbia logging cuts have been allowed on slopes that approach 80 percent, whereas in the United States the limit is 60 percent and in Scandinavia it is 40 percent (H. Waehlti, B.C. Dept of Forests, personal communication).

nutrient loss, erosion, loss of water capacity, temperature imbalance and visual blight. Little more need be said other than that the amount of felling has some impact. It has been established that patch logging is far less detrimental than clear cutting (Wood, 1971). However, on the coast, clear cutting has been the practice almost without exception, hence the importance of size mentioned above. It seems that the technology of felling makes no difference to the other effects, except to the degree in which it allows greater freedom of site selection.

The second set of actions is the yarding of timber. The three important features involved in this operation are the power source, the type of system and the aspect of the operation. The importance of the power source is felt mainly in the difference between muscle power and any form of mechanical power. Mechanical power exponentially increases the potential for destruction that any operation holds. The type of system is important because it determines how much contact the log will have with the ground and thence the level of impact (Rothwell, 1971). Direct skidding (tractors, etc.) or "primitive" lead systems greatly chew-up the ground and could be termed "heavy" impact types. High-lead and railroad systems are less destructive because the log only partially touches the ground. These could be called "moderate" impact types. Balloon, helicopter, Sky-line and Slack-line systems suspend

the log and could be termed "light" impact types. Because high-lead is by far the most widely used system in British Columbia, the third feature becomes important. If yarding is carried out in a downslope direction then the "roads" will all converge on a central low point. This leads to concentration of water flow in the roads, at the landing and subsequently to increased erosion (Willington, 1969; Rothwell, 1971). Unfortunately down slope yarding is most prevalent, due primarily to economic reasons (certainly for railroads and most often for trucks and roads). The factors that are most closely linked to the yarding operation are those associated with soil disturbance and erosion.

Loading is the next phase of the operation. This phase is of lesser relative importance because it tends to be uniform in all operations. Wherever power yarding takes place there must be landings upon which to store the logs. Since in modern times this has almost always been the case the impact of loading becomes a given for any operation. Its effects are mainly the compaction or possible destruction of the soil at the loading platform (Dryness, 1967).

Transportation of the logs from the site is the next step in the operation. The important aspects here correspond to the advancement of technologic methods: early skidding, railroads, tractor hauling and trucks on roads. The early skidding

techniques caused the same damage as did similar yarding techniques, e.g. heavy soil disturbance through disruption and compaction. The railroads may have had varying effects. If their construction was carried out carelessly, erosion and siltation may have been caused. Even so, because of its confined nature, this should have had a relatively light effect. The actual operation of the road most likely caused a minimal amount of damage, unless a spark from one of the engines started a wild fire. This must have been a constant danger until the Second World War when diesel powered engines became dominant. Tractor hauling caused the heaviest environmental damage due to the dragging of the logs and the weight of the vehicle.

However, it is the roads and trucks that seem to hold the greatest damage potential. Critical factors include their size, placement, and the methods of construction (Frederiksen, 1970; Rothwell, 1971; Logging Practices Seminar, 1974). If a road is to be put into an area there will be great disturbance, at least equal to removal of forest cover. The question then becomes one of minimization of external impacts. In general any road can be classified as a "very heavy" impact regardless of how well it is built. Roads necessitate the destruction of the soil structure, the bridging of streams and the filling of depressions. After their construction they also accelerate the catchment of runoff. Their size and placement are therefore

important factors. The smaller they are, the more detailed their planning and the more careful their construction, the lower will be the chance or the extent of erosion, gullying, siltation, a washout or some other mishap. However, unless one witnesses the construction and use of each road in an area it is very difficult to estimate the differential impacts that resulted from their various localities. To make matters worse, the Forest Service clears its files on all facets of a logging operation after fifteen years. For the purposes of this study the existence of a road network will have to be considered the critical factor in ascribing "heavy" impacts to an area. The impacts of all transportation methods are related to soil disturbance and erosion. They may range from slight disturbance to total destruction of the soils.

OTHER FOREST USES AND THEIR EFFECTS

Since sixty per cent of the land surface of British Columbia is forested, it is only reasonable that the timber industry should be very prominent in provincial affairs. However, because so much of the Province is wooded and other lands are limited, other activities, e.g. mining, grazing, recreation, etc., have had to compete with the timber industry for the right to use forest land.

In contrast to logging, impacts from other forest uses have been relatively minor, in the past. In British Columbia

mining activities have tended to be highly localized. Beyond the initial prospecting phase, development has always entailed the establishment of a community to attend the workings of the mine. Its major effect upon the forest landscape is to alter the timber status around the site thus limiting its resource potential. In the case of Britannia Mine this removal is quite considerable; the mineral claims extend five kilometers along Howe Sound and up to ten kilometers inland. In relation to the total acreage of the coast forests even this is negligible. Other aspects of the mining operation, e.g. pollution plumes, waste accumulation, etc. may effect the surrounding forest. For example, the nature of the impact of metal-ore smelting at Trail has been documented by Archibald (1975). However, because mining tends to be highly localized, its effects upon the forest and other uses are more aptly treated site specifically than from a broad, regional perspective.

Grazing as a forest use is of a different nature. With careful management it may very easily take place without drastically altering the physical environment. Under suitable conditions, e.g. open understory and limited shrub growth of an Interior forest, grazing can be a very productive use. On the Coast and in the Soo the understory growth is generally too heavy to allow widespread grazing within the forest. However, in certain localities (e.g. Miller Creek, and the Birkenhead and Soo Rivers) alpine meadows are used by local Pemberton

farmers as cattle grazing stations during the summer. As yet the impact of these activities is poorly understood (B.C. Fish and Wildlife Branch, personal communication).

Recreation, with its scenic, fish and wildlife values, is the other major use of the coastal forests. On a macro scale, a primary effect of recreation is that the establishment of parks may reserve large areas of forest in their natural state. These are essentially large scale single-use preserves. Commercial recreational developments may also withdraw tracts from forest lands. On a micro scale, the effects of recreational activities, though numerous, are less immediately noticeable. However, compaction of soils may stem from over use of trails (e.g. Black Tusk Meadows, in Garibaldi Park; Parks Branch, personal communication). Pollution may stem from hikers and packers leaving behind their wastes, and there always remains the possibility of a wild fire being started through someones carelessness.

Very often the principal impetus behind forest recreation is the desire to remove oneself from the pressures of urban life and seek rejuvenation in the wilderness. Recreationists want at least the illusion that they are in a non-urban place (Nash, 1967). The extension of these ideas has formed the crux of the fallacy which has afflicted the National Park system. While they attempt to preserve Nature in a pristine condition, parks often bring about the partial destruction of wilderness

values through over-zealous human use of certain areas. Most glaringly this can be seen on Black Tusk Meadows, where, in summer a tent city of 500 residents springs up each weekend. In another vane, park policies of controlling and preventing all wildfires, whether of natural or human origin, actively change the landscape. Human ideals concerning the appearance of nature will cause it to become increasingly tailored and standardized. Eventually certain species may be forced out, while those that remain become more homogeneous (Byrne, 1968). This is a very real concern for the park lands of the province. Is it desireable for Garibaldi to have much the same appearance as Strathcona Park, and for both to be much the same as Tweedsmuir and Wells Grey?

Hunting and fishing are important facets of forest recreation. Of prime importance for these recreational values are the wildlife habitats. The extent to which other uses may damage or enhance those areas is critical because they are limited to certain specific sites which are not readily replaceable.

In any landscape the level of impact or conflict is determined by the location, timing and magnitude of the various activities. Under some circumstances certain actities will be compatable, while under other conditions they will be absolutely incompatable. Locationally, logging will have much greater external impacts if it is carried out at excessive

altitude or directly adjacent to a major stream. The effects from road construction will vary greatly depending upon whether the soils are saturated, as in winter or spring, or are dry, as in summer or early autumn. The possibility of conflict increases greatly if logging is timed to coincide with summertime recreation and the closure of access roads is necessitated. The magnitude of operations is important when mining or logging encompass an entire drainage and thus greatly increase their effects. When large numbers of recreationists and timber firms seek to use the same forests the battle for priority heightens. That the intensity of a situation increases with the number of people involved in it, is a primary reason for choosing the Soo region as a base to illustrate the effects of forest practices.

CHAPTER 4

THE PHYSICAL BASE OF THE SOO PUBLIC SUSTAINED YIELD UNIT

GEOLOGY

The Soo Public Sustained Yield Unit encompasses the Lillooet River watershed and the Squamish-Pemberton corridor, which includes the Green River and Cheakamus River watersheds. This area of 6165 square kilometers lies within the southern part of the Coast Mountain complex of western British Columbia.(19) The Coast Mountain complex is one of the youngest mountain systems of North America, being of middle and late Mesozoic origin. The oldest rocks found in the Soo region are igneous and sedimentary rocks formed in late Triassic and/or early Jurassic times. These rocks have since been highly metamorphosed, such that their positive identification is very difficult. The massive batholiths of grano-diorite and quartz-diorite which intruded in either late Jurassic or early Cretaceous times were probably responsible for much of the metamorphism. The batholiths produced the Coast Mountains, pushing up the earlier sediments to summits some of which still remain above 3000 meters (Camsel, 1917; Cairnes, 1925; Roddick, 1965).

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19. This is equivalent to 2380 square miles or 1,523,562 acres, of which 541,928 acres are considered to be forest land by the Forest Service.

This intrusive period was closely followed by deposition of Cretaceous sandstones, shales and conglomerates. This in turn was followed by a period of volcanism which corresponds with the activity in the Cascade Range further south. The Black Tusk and Mount Garibaldi are products of this phase. The geothermal resources of the upper Lillooet valley are another remnant of this volcanism.

Most of the valuable mineral deposits are found in conjunction with the smaller scale Cretaceous intrusive dikes and veins within the earlier Jurassic rocks. Gold, silver and copper occurences are numerous, with small deposits of iron ore, talc, zinc (Camsell, 1917; Cairnes, 1925). Most of the showings are of low quality but some have been mined intermittently for many decades. For example, the adjacent areas of Brittania and Eralorne have been mined almost continuously for copper and gold, respectively, since the 1910's. At present a gold, silver, lead and zinc mine is being brought into production on Callaghan Creek.

Many traces of volcanic activity have been destroyed by the Pleistocene glaciers which were responsible for the sculpturing of the area into its present form. There are numerous morainic and glacio-fluvial deposits to be found throughout the region. The major result of the glaciers, of course, was the deepening of valleys into the classic "U" shape with the concurrent hanging valleys and tarn lakes, etc.

In essence then, the basal and surficial geology of the Soo region is very similar in all respects to the rest of the Coast Mountain complex. No peculiar forces have been at work in the Soo that have not been active elsewhere along the Coast.

HYDROGRAPHY

From its headwaters in the glaciers of Mount Dalgleish, the Lillooet River flows roughly 180 kilometers in a south-westerly direction to its mouth at Harrison Lake. In its upper reaches, the river braids continually until it reaches North and South Creeks where the valley floor widens to approximately 1.0 kilometers. This width is maintained over the next 30 kilometers as far as Pemberton Meadows. From this point the river slowly meanders across its floodplain for 20 kilometers down to Pemberton and Lillooet Lake. The meadows are at an altitude of 215 meters and vary in width from 2.0 to 2.5 kilometers. Lillooet Lake is 30 kilometers in length and is approximately 1.5 kilometers in width. From the Lake's outlet the river drops 150 meters in elevation over the 45 kilometer distance down to Harrison Lake. Over these final reaches, the valley floor is relatively narrow, between .5 and 1.0 kilometers.

The corridor from Squamish to Pemberton, roughly 80 kilometers in length, was also glacially sculptured, although erosion did not reach the same extent as in the Lillooet

valley. From its high point of 630 meters at Alta Lake, the corridor drops northeast to Pemberton and southwest to Squamish. While the Green River has not reached a mature stage and is still downcutting, its valley has a narrow floor which fluctuates between 500 and 750 meters in width. To the south, the Cheakamus River is of similar description, until it disappears into the Cheakamus Canyon below Daisy Lake. When the river emerges from the canyon its floor is once again 750 meters wide until it joins the much larger Squamish River near Brackendale. Here the corridor widens to approximately 4.0 kilometers and becomes a floodplain for the combined rivers. The combination of extensive forest cover and heavy precipitation (especially snowfalls) gives the Soo high runoff capabilities. All of the major rivers and their tributaries maintain relatively high stages throughout the dry periods of summer and fall. The supply of water in the region is usually fully adequate and constant for all users year around. The only problems are the possibilities of flooding and pollution through improper land use practices. For agricultural concerns, water represents a problem by being over-abundant rather than scarce. Slaymaker (1974) provides a more detailed discussion of the region's hydrologic characteristics.

SOILS

Because the Soo region is structurally relatively young and was heavily glaciated, the only well developed soils are found

in the valleys. In these settings they are mainly alluvial in character. The largest pocket of soil occupies the Pemberton Valley from the head of Lillooet Lake almost to Meager Creek, approximately 12 kilometers past Pemberton Meadows. This area is the floodplain over which the Lillooet meanders and hence the greatest drawback of the soils is poor drainage. If the drainage difficulties can be overcome the Canada Land Inventory classifies these soils as being 80% first class and 20% second class for agricultural purposes. Scattered over the floodplain are nonagricultural (class 7) gravel benches and swales left by the meandering river, and various pasturage areas (low fertility, class 5). Together these areas comprise approximately 15% of the valley floor surface (Faulkner, 1951).

While the soils of the Squamish-Cheakamus floodplain are lesser in extent than the Meadows this area has identical drainage problems. If they can be dealt with the Canada Land Inventory has determined that the good agricultural soils will be approximately 60% first class, 30% second class and 10% third class. In contrast however, these soils comprise only half of the valley floor. The other half is divided almost equally between pasturage (class 5) and worthless (class 7).

In the other valley areas, along the Cheakamus, the Green, the Birkenhead, the Gates, and the upper Lillooet Rivers, the soils are of low quality pasturage and non agricultural types, with the distribution being slightly in favour of the former.

While these soils are considered to be suitable for pasturage by the Canada Land Inventory, very little use is made of them except in the Squamish and Pemberton areas where they are used by the local farmers who are working adjacent first and second class lands.

Beyond these valley areas the region is too steep for soil accumulation. Over much of the area, a thin and often discontinuous podzolic covering has formed in conjunction with the forest cover. These podzols are not particularly well developed and the discontinuities increase as one approaches the tree line at approximately 2000 meters. At this point the stoney phases become complete, and the mosses and lichens take over.

In comparison to the rest of coastal British Columbia, the agricultural soils of the Soo are limited but quite fertile. The forest podzols on the other hand are wide spread. Though the non-agricultural valleys are wooded the majority of the region's forest soils are found on the valley slopes. While other areas in the coastal region have more fertile bottom lands under forest cover, e.g. particularly northern and western Vancouver Island, the forest soils of the Soo are certainly equivalent to those throughout the coast region.

CLIMATE

The Soo region lies entirely within the Coast Mountain Complex. However, because it spans three separate ranges and includes a series of rain belts and shadows, the climate varies considerably. The Soo is close to the boundary between Coast and Interior, and the climate generally becomes more rigorous towards the east and north (Kendrew and Kerr, 1955). The southwestern edge of the region, at the head of Howe Sound, experiences a North Pacific maritime climate. The moderating effects of the adjacent ocean are felt in conjunction with the high precipitation of Pacific weather systems. However, it seems that this portion experiences some rain shadow effect, as can be seen by comparing the Squamish and Woodfibre precipitation averages. These two sites are at the same elevation have identical snowfall records (145.5 centimeters/year) and are barely ten kilometers apart, but their annual precipitation differs by 86 centimeters (See Table 2).[20]

At the other end of the scale is the Pemberton Pass area. It is beyond the easternmost valley in the coastal system and therefore is furthest from the ocean's moderating effects and

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20. All of the stations in this table are situated in valleys. Thus, the climates they represent are milder than those throughout the region because of the difference in relief. However, inferences may be drawn about the overall conditions of each area.

TABLE 1

CLIMATIC NORMALS FOR METEOROLOGIC STATIONS IN THE SOO

MDT = MEAN DAILY TEMPERATURE (IN C°)
MRAIN = MEAN RAINFALL (IN MM) MSNOW = MEAN SNOWFALL (IN MM)
MPREC = MEAN PRECIPITATION (IN MM) D/S = DAYS WITH SNOW
MONTHS WITH FROST ARE UNDERLINED

Source: B.C. Dept. of Agriculture, Climatic Normals, 1941-1971.

SQUAMISH 2 METERS 49°42'N-123°09'W

CLASS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
MDT	0.5	3.3	5.1	8.3	12.0	14.4	16.9	16.4	13.8	9.6	4.9	2.2	9.0
MRAIN	226	200	160	140	72	69	54	53	120	273	280	277	1927
MSNOW	644	171	102								77	470	1464
MPREC	290	218	170	140	72	69	54	53	120	273	285	323	2072
D/S	6	1	1								1	5	14

WOODFIBRE 3 METERS 49°40'N-123°30'W

CLASS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
MPREC	400	302	253	218	114	86	70	85	155	410	441	484	3020

GARIBALDI 368 METERS 49°59'N-123°08'W

CLASS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
MRAIN	114	104	95	103	66	56	45	54	98	222	197	153	1309
MSNOW	1317	771	457	83						48	383	1193	4252
MPREC	246	184	136	111	66	56	45	54	98	227	235	270	1733
D/S	12	7	7	2						1	5	12	46

ALTA LAKE 727 METERS 50°09'N-122°57'W

CLASS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
MDT	-4.4	-1.0	0.3	4.4	9.0	12.7	15.1	14.6	11.8	6.4	1.0	-2.0	5.7
MRAIN	47	57	36	60	48	47	28	52	82	161	121	94	842
MSNOW	1658	1019	779	212	13				T	199	725	1364	5968
MPREC	213	159	114	82	49	47	28	52	82	181	194	230	1439
D/S	18	12	6	1						3	9	16	79

PEMBERTON MEADOWS 224 METERS 50°27'N-122°56'W

CLASS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
MDT	-5.9	-1.7	2.7	8.1	13.4	16.0	18.6	17.0	13.4	7.5	0.9	-3.4	7.2
MRAIN	87	43	52	43	31	38	27	28	64	138	118	77	745
MSNOW	825	432	120	18						46	442	957	2840
MPREC	169	86	64	45	31	38	27	28	64	142	162	173	1029
D/S	6	4	1								3	6	20

BRALORNE 1020 METERS 50°47'N-122°49'W

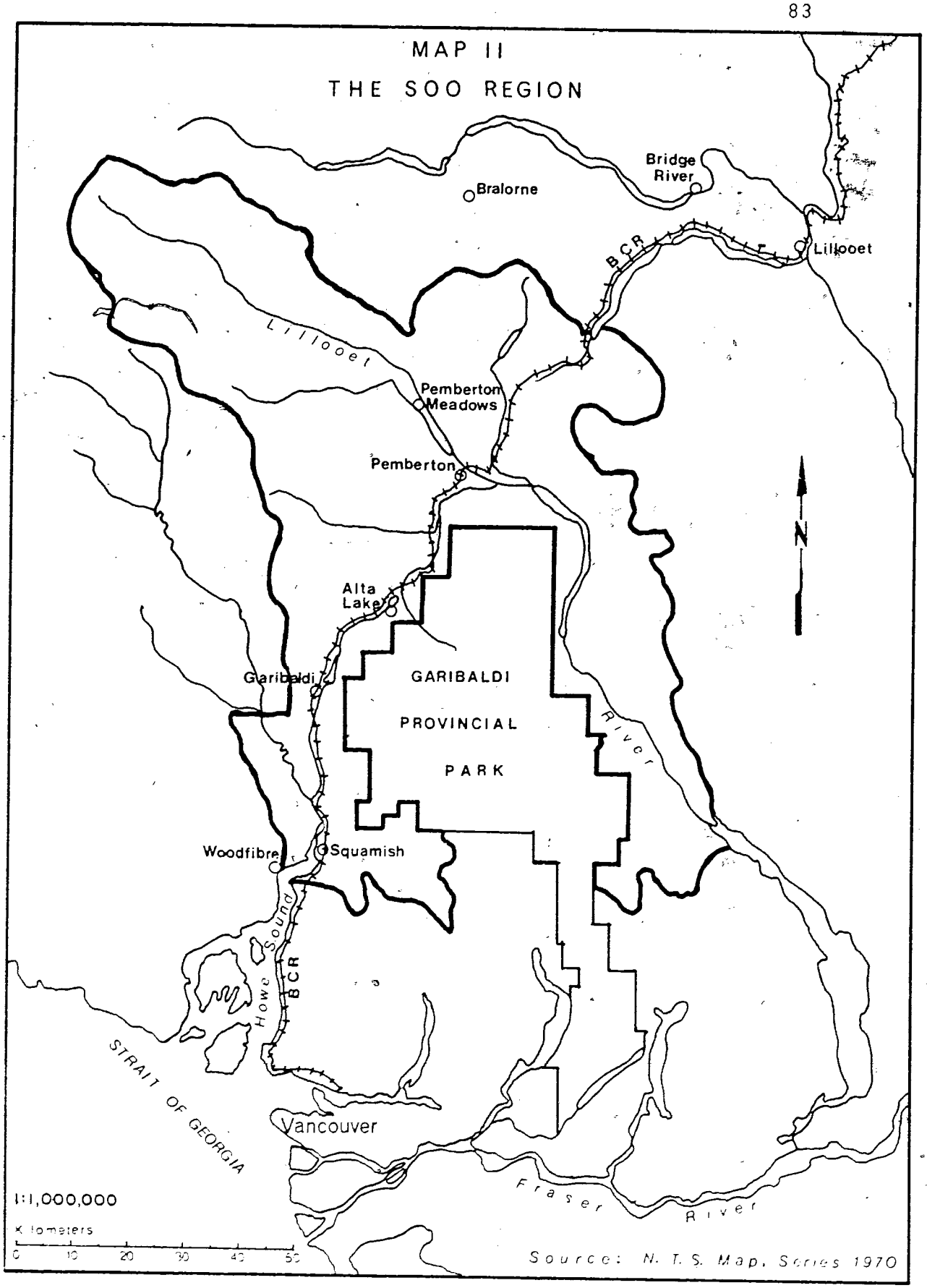
CLASS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
MDT	-7.7	-3.2	-0.3	4.4	8.9	11.7	15.0	14.2	10.8	4.9	-1.6	-5.8	4.3
MRAIN	46	19	18	17	25	43	34	33	42	83	49	59	470
MSNOW	641	411	306	105	23	T			T	110	493	577	2657
MPREC	110	60	49	27	27	43	34	33	42	94	98	117	736
D/S	8	5	5	3	1					2	7	8	39

BRIDGE RIVER 254 METERS 50°48'N-122°15'W

CLASS	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
MRAIN	34	27	23	23	15	23	19	32	28	57	29	46	358
MSNOW	511	270	102	15						8	204	409	1519
MPREC	85	54	33	25	15	23	19	32	28	58	49	87	510

experiences the greatest rainshadow effect. The winters are cold and snowy while the summers are hot and dry, but overall, its climate is milder than in the true Interior to its east. The principle features of this area are the three mountain ranges which block the inland passage of maritime air masses with their moisture and moderating effects. While neither the Bralorne nor the Bridge River meteorologic stations are in the Soo Public Sustained Yield Unit, they are sufficiently close to serve as a proxy for eastern high altitude and low elevation sites, respectively (See Map 2).

Between these two extremes there is a full range of climatic conditions. The major factors behind this distribution are the distance from the sea, relative placement in relation to mountain ranges and their rainshadows, and elevation. Temperature variations become more extreme as one moves inland. The western slopes of the mountain ranges receive more precipitation than the eastern sides. Each successive eastern range experiences a greater rain shadow. Elevation has the normal adiabatic effect on temperature and precipitation increases up slope. The combination of these factors produces very heavy snowfalls in the western areas adjacent to Garibaldi Park and to the west of the upper Lillooet. This accounts for the presence of glaciers in both areas, whereas they are absent on peaks of similar altitude in the eastern portion of the Soo.


MAP II
THE SOO REGION
Bridge River
Bralorne
Lillooet
B C R
Lillooet
Pemberton Meadows
Pemberton
N
Alta Lake
Garibaldi
GARIBALDI
PROVINCIAL
PARK
River
Woodfibre
Squamish
Howe Sound
B C R
STRAIT OF GEORGIA
Vancouver
Fraser River
1:1,000,000
Kilometers
0 10 20 30 40 50
Source: N. T. S. Map, Series 1970

The climatic regime allows a seven month growing season in both of the high quality agricultural areas, Squamish and Pemberton. From April to October the mean temperature is above 6 degrees Celsius. This maximum is diminished by altitude and/or Interior factors to six months at Alta Lake (May to October) and to five months at Bralorne (May to September.) It can be presumed that the growing seasons for Garibaldi and Bridge River are approximately six months (See Table 1). The length of growing season will progressively shorten at higher elevations. A critical altitude seems, from observation, to be approximately 1100 meters. This is the approximate level at which snow, in small amounts, will remain without completely melting from June until October. It signifies the altitude at which the climatic conditions become severe and limit the growth of forest cover.

NATURAL VEGETATION

The more rigorous nature of the Soo's climate is reflected in its tree growth, which, in a natural state, covered most of the land surface excluding the floodplains and alpine areas above the tree line. According to Forest Service records, the most prolific species is the balsam, a misnomer for the various sub-alpine firs (Abies amabilis and Abies lasiocarpa) of the Pacific Northwest which grow on the extensive mountain slopes throughout the region. The Forest Service calculates that, by volume, 35 percent of the forest falls under this heading

(See Table 3). Following the balsam firs, hemlocks account for 30 per cent of the forest. Western hemlock (Tsuga heterophylla) prefers the lower valley sites and is found in the higher precipitation zones from the Lillooet River to the Coast. Mountain hemlock (Tsuga mertensiana) occurs with sub-alpine firs at higher elevations. Twenty-two per cent is made up by true fir group. This includes the interior Douglas fir (Pseudotsuga menziesii glauca), which takes over from the hemlocks in the eastern valleys, and the coastal Douglas fir (Pseudotsuga menziesii), which mixes in with the hemlocks in the western valleys. Nine per cent of the forest is western red cedar (Thuja plicata) and two per cent is yellow cedar (Chamaecyparis nootkatensis). These two moisture loving species are restricted to the coastal area around Squamish, especially in the Mamquam River valley. In the extreme eastern margins, where the climate is much drier, there are also some small quantities of Sitka spruce (Picea sitchensis), white pine (Pinus monticola) and Lodgepole pine (Pinus contorta). Hardwoods are scattered amongst the other species, e.g. black cottonwood (Populus trichocarpa) in poorly drained areas, red alder (Alnus rubra) in recently cut areas, and western white birch (Betula papyrifera).

Throughout the rest of the Vancouver Forest District the coastal Douglas fir dominates. Its prevalence is due mainly to the moderate aspects and fairly high precipitation of the

TABLE 3

VOLUME OF SPECIES ON CROWN CONTROLLED LANDS
(IN 10,000's OF CUBIC METERS)

	SOO P.S.Y.U.		VANCOUVER FOREST DISTRICT P.S.Y.U.'s	
	VOLUME	PERCENT	VOLUME	PERCENT
FIR	18,044	22%	77,285	10%
RED CEDAR	7,124	9%	167,871	21%
HEMLOCK	24,519	30%	297,316	38%
BALSAM	28,864	35%	178,723	23%
SPRUCE	450		18,392	2%
YELLOW CEDAR	171,362	2%	34,177	4%
CONIFEROUS	80,361	98%	773,763	98%
WHITE PINE	403		2,816	
LODGEPOLE PINE	387		4,157	
YELLOW PINE	2		13	
COTTONWOOD	396		1,018	
ALDER	24		686	
MAPLE	30		215	
BIRCH	25		101	
DECIDUOUS	1,267	2%	9,048	2%
TOTALS	81,628	100%	782,811	100%

Source: B.C. Department of Forests, Forest Service Inventory Division. Forest Inventory Statistics of British Columbia. 1975.

West-coast Marine climate. Only in the extremely moist areas of western Vancouver Island is the fir superceded by the cedars. This is due to the latter's adaptation to excessive precipitation. These two species are the preferred trees of the lumberman. Reforestation operations on the coast almost always use Douglas fir (greater than 80%), because of its rapid growth, straight tall trunk and fire resistance.

In comparison with the Vancouver Forest District, the Soo does not have the highest yield potential. Its rainshadows and extensive mountain slope areas are less productive than the broader forested valleys of Western Vancouver Island and the North Coast (See Table 4). However, in terms of its timber resource the Soo compares favourably with the Interior regions due primarily to climatic factors. The Interior climates favour the growth of the pines and spruce more readily than the Douglas fir and these species are of lesser value because of their shorter stance and longer growth period. Once again the eastern Soo is close to the dividing line between the two regions.

FISH AND WILDLIFE

With the expansion of the Metropolitan Vancouver Region into the Fraser Valley many natural wildlife habitats have been lost. Directly to the north, the Soo region still provides opportunities for recreationists to experience various

TABLE 4

NET ANNUAL GROWTH AND MEAN ANNUAL INCREMENT
ON CROWN CONTROLLED IMMATURE FOREST LANDS
(IN CUBIC METERS)

	SOO P.S.Y.U.		VANCOUVER FOREST DISTRICT P.S.Y.U's	
	GROWTH	AVE./ACRE	GROWTH	AVE./ACRE
GOOD SITES	26,192	123	302,979	118
MEDIUM SITES	74,625	61	1,903,423	84
POOR SITES	109,272	36	728,270	52
LOW SITES	325	18	1,266	18
TOTALS	210,414	46	2,942,705	68

Source: B.C. Department of Forests, Forest Service Inventory Division. Forest Inventory Statistics of British Columbia. 1975.

aspects of the relatively untouched natural environment. The commercial value of the Soo's fish and wildlife is minimal, but because of the multitude of different settings in which they are found their recreational value is quite high (See Map IV, [21]). Anglers have a wide range of species and locations to choose from in pursuit of their hobby. The hunter's choice is restricted to certain areas but covers various species throughout the region. At a time when the salmon runs of Pitt River and Stave Lake are diminishing rapidly and it is increasingly difficult to find deer and goats in the North Shore Mountains, these opportunities assume even greater importance. While for the most part, the areas frequented by recreationists are concentrated in and/or adjacent to the Garibaldi Park, there are equally as many beautiful lakes, streams and meadows throughout the region. As in the past, access continues to be the key to the use of these other areas.

The fishery capabilities of the Soo vary greatly depending upon locality. For spawning anadromous fish there are several excellent streams and many lesser ones. While the Lillooet and the Squamish-Elaho are large rivers with fine runs, theirs are quite minor in comparison with the major rivers of the Province; the Fraser, Skeena and Stikine. Thus, though the Lillooet does form a part of the Fraser runs, the Soo region

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21. Map IV and the information in this section were taken from Fish and Wildlife Branch records. Quantitative information concerning fish and wildlife populations is limited.

has no commercial fishery values However, it is prized for sport fishing and local Indian food production. The larger Soo runs are quite strong and can maintain heavy use, whilst providing for the angler pleasant and varied settings. These same qualities hold true for the numerous fresh water fishing streams and lakes of the area.

In most cases the Soo's high fishery capabilities are due to the strong year round stream-flow and the numerous gravel beds of glacial and recent origin. In the Squamish drainage both the Squamish and Mamquam Rivers support high salmon runs (family Salmonidae) while the lesser creeks do not. Mamquam Lake, Lake Lovely Water and Alice Lake support stocked populations of Rainbow Trout (Salmo gairdneri) while the latter also has some Cutthroat Trout (Salmo clarkii) and Dolly Varden (Salvelinus malma). In the Cheakamus drainage area the Cheakamus and Brohm Creek are major salmon spawning areas. All the other creeks have resident trout populations, with the exception of Marble Creek. Dolly Varden are found in Callaghan Creek and Kokanee (Oncorhyrcus nerka, a landlocked Sockeye) in Whistler Creek. All lakes, except Callaghan Lake, support natural or stocked Rainbow Trout. Dolly Varden and Kokanee are present in Cheakamus, Daisy, Alpha, Nita and Alta Lakes. Alta is the most productive of all the lakes in this drainage. The Green River is only capable of supporting anadromous fish below Nairn Falls. Above that point and in the coincident creeks and Green Lake, there are small resident spawning populations of

Rainbow Trout and Dolly Varden. The Soo River itself is an exception in that its populations are quite productive.

In the Lillooet drainage, the Lillooet and Ryan Rivers both support good anadromous fish and resident trout populations. In addition, Fire, Twin, John Sandy, North, Rogers and Joffre Creeks support some trout and salmon and/or Steelhead (Salmo gairdneri, a migratory Rainbow Trout), though in certain cases only in the lower reaches due to unfavourable channel topogaphy up-stream. Sloquet Creek has in the past supported quite heavy salmon runs but these have been practically eliminated by heavy siltation resulting from extensive logging. Lillooet Lake supports large populations of many salmonid species while the other lakes, Fire, Glacier, Little Harrison and Lizzie appear to have good potential spawning areas. Little is known about their populations. Tributary to the Lillooet, the Birkenhead River has very important Steelhead Trout, Coho (Oncorhyncus kisutch) and Sockeye (Oncorhyncus nerka) runs as well as resident Rainbow Trout. In the lesser creeks of this drainage, Phelix, Spetch, Tenquille, Owl and Sockeye, and in the lakes, Birkenhead, Owl and Tenquille, there are very good resident spawning populations of Rainbow Trout.

In the Gates River drainage there are heavy runs of Steelhead and Sockeye with light runs of Coho in the main river. Haylmore Creek, Blackmore Lake and Gates Lake have

populations of Rainbow and Cuttroat Trout and Dolly Varden. Gates Lake also has low numbers of Kokanee and Mountain Whitefish (Prosopium williamsoni).

In addition to maintaining various fish species, the Soo also supports numerous wildlife populations. The major factor in determining the capability of an area for an ungulate range is its ability to support that population during the winter months. Therefore in most of the cases mentioned below, the area sited will be the critical winter range (See Map III). Migratory birds, however, require summer nesting grounds, hence the areas sighted for them are those sites with capabilities in this regard.

There are large numbers of ungulates and waterfowl in the upper Squamish River region but this is not included within the Public Sustained Yield Unit. In the lower reaches of the river there are very few of the larger species due to the history of human inhabitation in the area. Stable populations of black bear, deer and grouse are found in the Cheakamus valley north of Squamish. These animals browse in the valley floor from Brohm Lake to Alta Lake. Here the lakes also support Harlequin and Merganser ducks. In Alpha Lake beavers have made extensive works at the eastern end. On the higher slopes mountain goats are found, especially in the excellent areas along Roe Creek and the upper end of Callaghan Lake. Lesser sites are along Callaghan Creek, Cheekeye River and Metal Dome Mountain.

Black bear and beaver are found throughout the Green River valley. The marshes at its mouth in the Pemberton valley provide moderately good nesting and breeding areas for migratory waterfowl. In the higher elevations, along Rutherford Creek and on the ridge across the main valley from its mouth, deer and goats find adequate wintering range.

In the upper Lillooet and Ryan River areas Grizzly bear, moose, deer, goats, black bear, beaver, ducks and geese are found. The waterfowl find suitable nesting grounds in the numerous marshes, particularly around the head of Lillooet Lake. The beaver lives in this area and on the meander scars along the main river. Black bears, goats and deer browse throughout the valley floor, while the goats and deer make particularly heavy use of the rocky knolls on the eastern side of the main valley across from Pemberton Meadows. The valley upstream from the meadows is a favoured wintering area for moose which descend from the higher alpine meadows in late autumn. There are approximately six to ten families of Grizzly bears that inhabit the upper areas along the Ryan River and Rutherford Creek (H.O. Slaymaker, personal communication).

North of the Lillooet, in the Birkenhead drainage, small populations of goats inhabit the bluffs above both the north and south ends of Birkenhead Lake. Moose can also be found at the northeast and southwest ends of that lake. Small numbers of deer utilise the available browse in the Owl Creek area.

Beyond Birkenhead Pass, in the Haylmore Creek area of the Gates River drainage, is a key wintering area for goats, again in the bluffs above the creek. Around the Gates River itself are marshy areas used by waterfowl, and general browsing areas for deer, bears and coyotes. Numerous beaver dams and lodges have been built in the river itself. There are also several cougars still to be found in this area. They descend into the lower side valleys during the winter months in search of prey.

As with the fish populations, the major values for wildlife are not commercial, but of a recreational nature. The deer, goats and waterfowl provide possibilities for hunters and all the species are valuable to the naturalist seeking to observe fauna in its natural environment. The Soo is much closer to the large population of Vancouver than are similar wilderness areas in the Cascades and Interior, which increases its recreational value.

RECREATION

The Fish and Wildlife Branch has studied the fisheries and wildlife capabilities of the Soo and has attempted to ascertained the levels of recreational use involving those animals (Fish and Wildlife Branch records). Its conclusions are offered in qualitative terms that range from "light" to "extremely heavy". However they do permit some estimation of the overall recreational value of the region (See also,

University of British Columbia, School of Community and Regional Planning, 1970).

In order to maintain continuity, it again seems advantageous to follow the drainage basin alignment when discussing recreation values. Along the lower Squamish River and the Mamquam River sport fishing is quite heavy, especially for the steelhead and salmon runs of the former and the salmon and freshwater fish of the latter. Of the lakes, Mamquam and Lovely Water are used by hiking anglers and Alice is heavily used by vehicular travelers. There is very little hunting in the lower Squamish because the larger ungulates have left the area, but the mountains provide numerous possibilities for outdoors activity. The most notable and popular hiking and backpacking areas are Petgill Lake, Stawamus Chief, Cloudburst Mountain, Alice and Brohm ridges and the Diamondhead area. The latter three are in Garibaldi Provincial Park but their approaches are within the Public Sustained Yield Unit. In the Squamish/Brackendale area there are numerous small farms that board horses, which seem to be used mainly for pleasure riding by the local inhabitants and people from Vancouver. For the more commercial recreationists there are no facilities at present, but in the past, both Alice and Brohm Ridges have been considered for ski developements. This area is considered by the Parks Branch to have very high recreation potential principally because of its varied natural settings and its proximity to the Lower Mainland.

In the Cheakamus drainage, the Cheakamus River and Brandywine Creek are heavily used by anglers. The other streams, except Cheekeye and Brchm Rivers which are closed to fishing, experience only light use. None of the lakes have much use, but Nita and Daisy Lakes are beginning to become more popular. On Alta and Alpha Lakes access is a major problem due to private lakeshore property. There is very little hunting activity in the entire drainage, with the exception of some limited goat hunting in the Roe Creek area despite the relatively poor access. In sharp contrast is the very heavy hiking/packing use that is made of this area. Again, Brandywine Creek, Cheakamus Lake and The Black Tusk are all within Garibaldi Park with their approaches in the Public Sustained Yield Unit. Extremely heavy use is made of the latter area. There are nc permanent commercial facilities in the drainage except the lodges that form part of the Whistler Mountain development. The area of this drainage above the Canyon is considered to have extremely high recreation values by the Parks Branch. Varied natural terrain, proximity to the metropole and previous prestige are seen as the outstanding characteristics.

With respect to recreational capabilities and use, the Green River area is basically an extension of the Cheakamus drainage. The Alta Lake recreation area encompasses the upper reaches of both the Cheakamus and Green River watersheds. Its merits were those attributed to the upper Cheakamus in the

preceeding paragraph. This area provides many more opportunities than do the lower reaches of the Green River drainage. The angling pressure is low on all of the streams and lakes as is the hunting pressure despite the relatively good potential for both. The only exception is the hunting of the waterfowl at the river's mouth, which according to the Fish and Wildlife Branch, is moderate and increasing (Personal communication, 1975). Again, much hiking and packing is done in the Park, on Whistler Mountain, Wedge Mountain and Singing Pass, to which the Public Sustained Yield Unit lends access. Moderate use is also made of Rainbow Lake which is high above the valley across from Whistler Mountain. Whistler Mountain has been developed as a ski resort by the Garibaldi Lift Company and the Alta Lake area has attendant lodging facilities. Both the quality and quantity of the skiing are high .

Access to Lillooet River and Lake has been limited in the past due to the poor condition of powerline and logging access roads, but it has been improved since 1970. Correspondingly, angling has been low in this drainage but is now increasing, particularly around the lake. Since the last war, hunting for deer, goats and waterfowl has been quite heavy along the Ryan River and the upper Lillooet. Moose hunting in the Lillooet is restricted by statute. With the increased access, the lake area is also experiencing more hunting. However, in contrast to the Cheakamus and Green River areas which adjoin the western

flank of the Park, the Lillcoet drainage is not extensively used by hikers or packers. Tenquille, Lizzie and Glacier Lakes are the only sites that have any consistent use. The entire eastern flank of the Park is virtually unknown and unused. This is so in spite of the fact that the Parks Branch rates the lower valley as having high recreational and historical values. Access has been the major limiting factor. Here again there are no commercial recreation ventures, but in the valley there are numerous horses that seem to be mainly for pleasure riding purposes. The valley is also used as a winter range for horses from adjacent areas (Fish and Wildlife Branch, pers. comm.).

In the Birkenhead drainage angling is very heavy and increasing along Birkenhead River and Lake. Once more it seems to be a function of access, which in this valley is adequate. Hunting, however, is comparatively low. The goats and deer do not seem to attract the hunters and restrictions have been placed upon the shooting of moose. Birkenhead Park is the only area in the drainage that is used by hikers and packers, it is moderate to heavy, seemingly in conjunction with the angling. There are no commercial ventures in this drainage basin.

Beyond Pemberton Pass in the Gates drainage, sport fishing is limited, reaching moderate levels only on the Gates itself. Unlike the Birkenhead, hunting pressure is quite high. In the Haylmore Creek area, mountain goats are heavily sought after. Hiking and packing are limited in this drainage and there are

no commercial establishments in operation. These two latter drainages are viewed by the Parks Branch as having high recreation potential. Distance from Vancouver has been the principal limiting factor, though in 15 years time, as access improves, it may become a significant area.

In the sphere of organized recreation, only Whistler Mountain is developed for downhill skiing. There have been proposals for similar developments on several other suitable mountains in the area, but nothing has, as yet, come of them. Ski touring has recently become much more popular than in the past, but it is at its best in areas with more open terrain, which is somewhat limited in the Soo. Nevertheless, some of the side valleys between Squamish and Alta Lake are used quite frequently, particularly Callaghan Creek. Finally, there is a fair amount of equestrian activity on the lower slopes adjacent to Squamish and Pemberton.

SUMMARY

The capabilities for the Soo region are varied. There are possibilities for new mining developments in the near future (e.g. gold extraction on Callaghan Creek, and geothermal power on Meager Creek), but mineral values are highly localized. Agriculture is limited to the Pemberton and Squamish areas. Grazing values are low with the only use being made in conjunction with the agricultural enterprises noted. Timber

values are moderately high in relation to the entire Province, but because of climatic differences are only fair in comparison with those of the Vancouver Forest District in general. Thus, intensive development of the timber resouce was held back until the prime stands elsewhere along the coast were cut. Fish and wildlife values are moderately high in terms of habitat capability, although this has been altered in many cases by other activities. For example, agriculture and/or recreation causing reductions in habitat ranges and logging operations causing siltations of important spawning grounds. Recreation values depend upon accessibility and therefore are increasing throughout the region as trails and roads are improved. The large population of the Lower Mainland is the key factor in this increase. This has received special consideration from the Provincial Government which established the Alta Lake Resort Municipality in 1975.

CHAPTER 5

LAND USE ACTIVITIES IN THE SOO

To ascertain the human influence upon the forests of the Soo it seems desireable tc retain the historical time periods that have developed through the examination of institutions, policies and practices. In this manner each set of actions will be grouped with the other trends of the period, allowing one to view the overall impact. From this may be determined the extent to which each specific group of decisions and actions was capable of achieving the goals desired in its initial viewpoint.

THE EARLY PERIODS, 1786-1907

The initial European utilization of the Soo forest landscape commenced with the arrival of the trappers. They pursued their activities throughout the region but in general, their impact was light. The exceptions were the animals that they trapped; deer, beaver, otter, sheep, etc. Their numbers were severely reduced by the hunters which must have caused considerable readjustment in the faunal community. Otherwise, the principle effect of the trapper's presence was that the land had to provide shelter and nourishment for a few more human beings, and in this respect the trappers life style was

not appreciably different from that of the indigenous Indians. The primal forces of generation and regeneration, degradation and aggradation were left intact.

The Gold Rush days saw the forging of the Douglas Trail up the eastern valley of the Soo and over Birkenhead Pass to D'Arcy and Lillooet. The trail was served by steamers on the four large lakes; Harrison, Lillooet, Anderson and Seaton. At the heads of the lakes, small communities of perhaps 50-100 people quickly established themselves; e.g. Douglas on Harrison Lake and D'Arcy on Anderson Lake. Some clearing of cover for the trails and felling of timber for construction of the settlements were the principle actions of the Royal Engineers and their helpers in establishing the route.

When the Douglas Trail was supplanted by the newer Fraser Canyon route, the small transit communities and steamers died rapidly, leaving behind only a few hearty settlers; e.g. John Currie at the foot of the mountain which bears his name, and the Paynter family near D'Arcy. Activity during this period was thus limited to the thin ribbon of the Trail and to the years between 1858 and 1864. Following the Rushes, as the route reverted to a simple Indian track, there were no more Europeans in the Soo than there had been trappers a few decades before.

From Confederation until just after the turn of the century very little European activity took place in the Soo's forests. What is now the Pemberton area was not wholly inaccessible, rather it was off the beaten track from the coast to the interior, a minor back eddy in the new flow of society to the west coast.

Another attempt was made between 1873 and 1877 to use the region as an access route to the Interior when the Squamish Trail was cut from Lillooet down to Mount Currie and then down to Squamish and over the mountains to North Vancouver. The Trail was intended for the use of ranchers to drive their herds to market wihtout clogging the Cariboo Highway through the Fraser Canyon. Unfortunately, due to careless construction and almost complete lack of feeding opportunities along the way, the trail was used only once, in 1877. After that, it too returned to being a track for the Mount Currie Indians to use between the coast and their reserve at the head of Lillooet Lake.

A number of pioneer settlers entered the region and forged niches for themselves along the corridor. They included Thomas Bracken (hence Brackendale), Cheakamus Charlie, Johnny Miller, the Phillips, the Cottons and the Neills (Ronayne, 1971). However, they were few and far between. These people came to fashion homes out of the wilds. They hunted and fished to help themselves along.

To supply a small mill in Squamish (nee Newport) some logging took place on a very small scale during this period, 1880-1907. It was carried cut on the valley floor around the Squamish and Mamquam rivers. In the final two years of this expansion period, 1905-1907, the rush to secure Timber Licenses spread through the Soo's forests.' There were no immediate developments because the issuance of a license was an administrative transfer of cutting rights. Direct realization was to be felt when the licenses were finally cut.

For the Soo, the activities of this period were not much greater than those of the Gold Rushes. The territory had been explored more completely, placing it within the realm of society, tentatively at least. By and large though, the area was still a wilderness.

THE DEVELOPMENTAL PERIOD, 1908-1938

The major contributions of the developmental period were inclined to limit rather than alter the forests of the Soo. Land was withdrawn from the forest resource by settlement, farming, mining and recreational interests (as had logging interests had done earlier) leaving the remainder for the Forest Service to administer. Some forest alteration was caused by a number of wild fires and some logging, but their effects were usually of moderate intensity and on a local scale. The impact from these events was some forest disruption

and retardation through erosion, siltation and fertility loss. The limited number of such events seems to be the sole reason for less widespread damage. (Refer to Maps V and VI for the placement of all clearance and reforestation activities mentioned in this chapter.)

While the Provincial Government was deciding what it would like to do next with the Crown Forests, after the "give-away" of Timber Licenses was halted in 1907, it once again hit upon the idea of a North-South railway for the province. The idea had been bandied about since the completion of the Canadian Pacific Railway in 1886, but no group had undertaken it. In 1912 the government contracted the Grand Truck Pacific Company to build the line, which was completed from Squamish to Lillooet two years later and named the Pacific Great Eastern Railway. This third attempt to use the low land corridors of the Soo for Interior access was at last a success when the line was pushed on to Fort George in 1921.

Along almost its entire length through the Soo, the railway travels adjacent to a body of water. Running north from Squamish it borders the Squamish, Cheakamus and Green Rivers. It then crosses the Lillooet River, heads up the Birkenhead River and down the Gates River to D'Arcy. It also runs along the shores of some of the lakes; Alta , Green and Gates, and over a few swamps near Squamish, Alta Lake and Pemberton. More importantly, it runs through the forests all

the way. During the lines construction some siltation must have occurred from debris falling or being pushed into the streams and lakes. Unless subsequent washouts resulted, this most likely had only a temporary impact in that it was a one shot affair. In conjunction with the removal of streamside cover and concurrent nutrient loss, the siltation may have caused some reduction of fish populations. Overall, the direct effects of the railway were relatively light.

The after effects seem to have been much more serious. Between the years 1925 and 1933 there were ten wild fires along the railway line that burned a total of 1943 hectares of forest. The largest of these was a 660 hectare blaze on the western slopes of the Cheakamus Canyon below Cloudburst Mountain. Though the fires are not documented in detail, it is presumed, due to their very close proximity to the rail line that they were caused by sparks which flew from the steam engine's stacks. The loss of forest cover and erosion from these fires undoubtedly were quite significant. Subsequent siltation, mainly along the Cheakamus River where seven of the fires occurred, could have been heavy and detrimental to the fish of that river. Such effects remain unrecorded and can only be inferred.

However, site observations show a marked difference in the regeneration after the varicus fires. The largest area below Cloudburst Mountain, which is generally below 800 meters and on

varied slopes between 10 percent and 50 percent, has grown back to a relatively even stand of 10 meter conifers. The other large fires, above Daisy Lake on 25 percent to 60 percent slopes between 600 meters and 1300 meters, have regrown to a patchy stand of alder and fir, five meters in height. With the climate, energy and soil characteristics of these sites being roughly equal, the influences of altitude and slope are evident in their effects upon the regenerative ability of a burned area.

A second major outcome of the railway was the catalytic effect it had upon the settlement of the region, especially in the Pemberton valley. In addition to the small settlements along the line (D'Arcy, Birken, etc.) numerous settlers anticipating its opening, moved into the Lillooet valley to homestead the fertile though somewhat soggy plain. The major impact of this human activity was upon the faunal community whose range was restricted to the more distant reaches of the valley. Ramifications may have been quite significant in the cases of moose, beaver, waterfowl and predators that previously inhabited the plain. They were more moderate for deer, bear and smaller animals, because of their easier adaptibility to man. The goats, prefering the rocky knolls to the flats, were the least disturbed. The vegetal effects may have been relatively less important because, due to the drainage conditions, much of the alluvial plain was not heavily forested. Those areas that were cleared were most likely of a

mixed deciduous/coniferous type, located on old pointbar deposits or the margins of the floodplain. These sites would not have been critical, in that climatic, slope and alititude factors favoured a speedy readjustment. The major consideration was probably the disruption of the hydromorphic soil formation processes in the sedge marshes. The areas concerned, whether forested or not, were of much higher value for agrarian pursuits than for commercial timber production.

The Pacific Great Eastern also brought the Soo into the realm of commercial logging by providing a realistic means of transporting timber from the valleys to Squamish. Between the time of the line's completion and the Second World War (1914-1939) little use was in fact made of this potential. Some logging took place in the Twenties along the rail route in the Birkenhead valley. The timber, being across the river from the line, had to be yarded back across the stream. Though the cuts were less than 20 hectares, local erosion could have been quite significant due to this procedure. On a macro scale, the salmon that frequented the Birkenhead probably were not greatly effected. In 1933 below Paul Ridge, east of Brackendale, more logging took place. This cut was of 160 hectares on a 25 percent slope below 600 meters. Rails were not used in this operation, however, which indicates that after cat or highlead yarding, tractors were used to drag the logs to the Mamquam River, upon which they could be floated down to Squamish for milling. On-site observation shows that the area has

regenerated completely to an intermediate level when compared with the burned sectors along the Cheakamus. This indicates that environmental damage was moderate to heavy, with a fair amount of erosion and compaction. Siltation may have been a problem at that time but its effects have passed away. Today Mashiter Creek supports stable resident and transient fish populations.

Other developments took place, in addition to the railway. In 1912 (when the Forest Act was implemented) Anaconda Copper Company commenced production at its mine at Brittania Beach, on Howe Sound. This mine was a large scale operation which continued production until 1974 when the company ceased its operation and part of the mine site was converted into a museum. While most of the surrounding mountain slopes were left forested, the area around the mineral claims was effectively withdrawn from the forest resource.(22) Those claims extend for five kilometers along the Sound and up to ten kilometers inland to the east. Over the years the trees have been logged off, but the relative value of the area for timber production was much less than for mining.

Beyond the Brittania site, intermittent prospecting took place on numerous other claims during this period. In the northern Soo, the chief areas of prospecting were the Owl Creek, Boulder Creek, Tenquille Creek, Crown Mountain, and Copper Mountain The chief ores sought were copper, silver and

gold. Just beyond the Soo's boundaries at Anderson Lake, along McGillvary Creek, gold was hydraulicly placer mined in the early Twenties, but none of this type of mining took place in the Soo itself. In the south western Soo prospecting was also active east of Green Lake, along Fitzsimmons Creek, around Mons, Alpha Lake and Daisy Lake for the same ores. In the south eastern sector, the only major prospecting was along the Lillooet River and at Fire Mountain. Those areas that were actually mined were Owl Creek, Copper Mountain, Fitzsimmons Creek and Fire Mountain (Camsell, 1917; Cairnes, 1925). These claims are all active at the present time though extraction has ceased. Within the Soo, then, mining during the first four decades of this century was a relatively small scale operation. Its effects upon the landscape were to extend the human influence further into the wilderness without seriously disrupting many of its natural processes.

In 1927, after many years of talk, the Provincial Government created Garibaldi Park. Convenient access had been gained to the western "park" region with the establishment of the Pacific Great Eastern railway, and "out-of-doors recreationists" had begun to explore the area. By 1927, their

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22. In fact, when the Public Working Circle boundaries were drawn up the area around the mine was excluded from either the Soo Public Working Circle or the Vancouver Public Working Circle and listed as the Furry Creek Special Sales Area, i.e. a private cutting ground for Anaconda.

arguments in favour of formally recognising the park had become strong enough to outweigh antagonistic views concerned about the hydro-electric potential of Cheakamus Lake, Cheakamus River and Garibaldi Lake. (As mentioned above, the commencement of the Bridge River project in that year was instrumental in persuading the legislators.) Even though the Park was expanded in 1928, the "death" of Garibaldi hydro was prolonged until 1933 when a report produced by Mayor L. D. Taylor showed it to be uneconomical due to subterranean water loss.

The establishment of the Park set aside the entire area as a recreational reserve for the people of British Columbia. Recreational use at that time was light such that detrimental effects were minimal. Far more important was the fact that large areas of forest were placed into a single use category. Effectively, those forested regions were withdrawn from the realm of useable forest lands except for the one particular type, recreation. The potential boundaries of the Provincial Forests and the Soo Public Sustained Yield Unit were delineated in advance by the Park. In this, the delineation of the Park was akin to the major actions of the era.

THE WAR YEARS, 1939-1945

Forest activities during the war were confined to the effects of forest clearance, which were of two types. The first involved areas along the railway line with small cuttings

and low levels of impact. The second consisted of several large sites away from the railway that had high level of detrimental impact. the area of the latter set was more than twice that of the former. These actions were the first instances of large scale cutting activity in the Soo and therefore evinced for the first time the potential for immense change and degradation that logging held.

With the outbreak of the war in 1939 the need for forest products increased appreciably. The upsurge was matched by a proportionate decrease in the availability of the factors of production; labour, materials and capital. Accordingly, during the war years the Soo underwent very little development. Economic activities were constrained to some logging and a few of the previously mentioned mining areas, e.g. Britannia and Fitzsimmons Creek. Characteristically, logging over these six years was undertaken in small cuttings at various valley sites along the five major drainage courses. Most of them were within the 500 to 700 meter elevation range, though some, to the east and west of Alta Lake, extended above 1100 meters. All of these cuttings were adjacent to streams and several spanned the water courses. Throughout the period, the yearly cut was always less than one section, i.e. 260 hectares, with the except of 1943 and 1945. While in 1945 the cut was only 274 hectares, 1943 was the year in which the previously mentioned extensive cutting took place (See Table. 5, for the annual cuts described in this chapter).

TABLE 5

FOREST CLEARANCE STATISTICS FOR THE SOO REGION (1913-1974)
(IN HECTARES)

YEAR	ANNUAL LOGGING CLEARANCE	TIMBER LICENSE CLEARANCE	PERCENTAGE OF ANNUAL CUT	WILDFIRE CLEARANCE
1920	19			
1925				12
1930				660
1931				294
1932				417
1933	167			569
1913-1938	186			1952
1940	109	45	41%	
1941	81	81	100%	
1942	223	223	100%	
1943	1468	1279	87%	407
1944	167	81	48%	
1945	275	275	100%	108
1939-1945	2323	1984	85%	517
1946	19			
1947	168	168	100%	
1948	230	130	56%	
1949	71			
1950	468	292	62%	536
1951	131	61	46%	
1952	181	16	9%	625
1953	113	93	82%	
1946-1953	1381	760	55%	1161
1954	2059	648	31%	57
1955	2387	1419	59%	
1956	1780	732	41%	200
1957	1133	648	57%	
1958	2337	1678	72%	1054
1959	1919	747	39%	
1960	1748	635	37%	177
1961	1365	653	47%	558
1962	2069	1010	49%	
1963	1247	549	45%	227
1964	1577	619	39%	
1954-1964	19,621	9338	48%	2273
1965	1071	551	51%	
1966	1067	758	71%	
1967	1265	700	55%	
1968	1465	639	44%	
1969	2042	738	36%	
1970	1355	675	50%	
1971	1485	841	57%	
1972	1302	682	52%	184
1973	1349	622	46%	
1965-1973	12,401	6206	50%	184
TOTAL	35,912	18,288	51%	6087

Source: B.C. Dept. of Forests, Forest Service Inventory Div. Forest Inventory Statistics of British Columbia. 1975.

Of all the hectarage cut, at least 85 percent was taken from Timber Licenses. Most of it was undertaken at a close proximity to the railway such that highlead yarding with rail transport was the rule. The areas on the east side of Alta Lake and along the Lillooet River were too far from the line to employ highlead exclusively. Most likely, tractor yarding was substituted. Slash burning was employed to reduce debris at the Alta Lake sites. The slash fire on the west side of the lake escaped and consumed 405 hectares of uncut forest on the slopes north of the site. This wild fire burned from the valley floor, at approximately 650 meters, up the mountain side above Green Lake to the 1400 meter level.

The impact of these logging activities was of two kinds. The cuts around Alta Lake heavily disturbed the environment through employment of tractors and slash burning and through logging at excessive altitude. The effects upon the landscape were heavy; erosion and siltation, loss of nutrients, interruption of food chains and disruption of fish habitats all reached high levels. This was compounded and extended by the extensive fire which was a direct result. The areas have regenerated forest cover but it is generally broken and less than five meters in height. In all other areas, the effects of the cutting were relatively low, being small enough, low enough and clean enough to have only localized impacts and temporary regressions.

Nineteen Forty-three was an anomalous year. It featured the fire mentioned earlier and also witnessed the first truly large scale cutting in the Soo. Quite large cuts were made on the lava flow between the Mamquam River and Ring Creek and also in the area immediately north of Cat Lake, at elevations between 400 and 600 meters. Similar activities took place on Paul Ridge which extended into Garibaldi Park at altitudes of 1100 meters. Each of the three cuts was over 400 hectares in extent, totalling 1460 hectares, of which 85 percent was taken from Timber Licenses. All three of the areas were at a considerable distance from the railway, greater than 2 kilometers. Forest Cover Maps show that roads were laid out into these areas making the use of tractors and/or trucks for transportation of logs to the mill at Squamish inevitable.

In contrast to the general mode of operation during the war, these three 1943 sites produced quite heavy impacts upon their environments. The combinations of size, proximity to water, slope, altitude and logging methods eliminated any tempering factors that may have been present. Soil disturbance, erosion, subsequent siltation and fertility loss were all severe and effected surrounding areas as well as the sites. Today, while salmon runs in the area have fully recovered, Cheekeye River and Cat Lake have only returned to moderate fish capabilities. Regeneration of these three areas has been so unsuccessful that after thirty years deer still prefer the two southern areas for winter browsing grounds. The

northern area was reseeding so slowly that it was finally replanted by the Forest Service in the early 1960's.

THE MODERN PERIOD, 1946-1964

This period, from 1946 to 1964, may be called the modern period because it saw the growth of large, corporate structures, and modern economic and technologic methods (Lawrence, 1957; Hardwick, 1963). The provincial trend was mirrored by the lumber industry, particularly in the Soo region. Initial development moved slowly but gave way to a decade of economic boom.

Timber production during this period may be subdivided into two categories, 1946-1953 and 1954-1964. The former was a period of low annual cutting, under 260 hectares per annum (with the exception of 1950 at 1156) while the latter was a period of high annual cutting, over 1200 hectares per annum (with the exception of 1957 at 1132 hectares.) During the earlier period only 1375 hectares of the Soo's forests were cleared. Most of the cutting took place along the two southern corridors between Squamish and Pemberton and Harrison Lake. Generally the cuts were small, from 40 to 80 hectares, with only three over 200 hectares; 1946 north of Harrison Lake, 1946-1948 east of Alta Lake and 1950 west of Lillooet Lake. All of the cuts around Squamish,, along the Green River and at Lillooet and Harrison Lakes were all quite low, generally below

500 meters. The exceptions tc this trend of valley sites were two medium/large sized cuts, along the Birkenhead River, approximately 160 hectares each, and the larger set of cuttings at Alta Lake, all of which were between 500 and 1000 meters. All of the areas felled during this period were situated on relatively gentle slopes , below 40 percent. The only exceptions to this were the upper portions of the Alta Lake cuttings and a few small regions south and east of Squamish. All of the clearings bordered water courses, either creeks, rivers or lakes, except the high elevation sites at Alta Lake and Squamish. All of thcse water courses supported moderate to high fish populations, though none of the areas were concerned with significant wildlife ranges.

The logging methods employed for these operations were entirely mechanical. It can be assumed that mechanical saws were used to fell and buck the timber and that nonmobile highlead systems were used to yard it. The topographic conditions indicate that yarding took place in a down slope direction. Transport from the Birkenhead, Gates and Alta Lake sites was most likely by rail, though for the latter, some overland transport would have been necessary. At Harrison Lake and around Squamish, the transport was definitely by truck, as the roads on Forest Service maps indicate. Along Lillooet Lake, the transport was initially by water and then by rail from the north end of the lake. During this period, at least 49 percent of the 1375 hectares cut were located within Timber Licenses.

In all cases some erosion and siltation must have taken place but it is estimated that due to the other factors involved, principally the small size and low elevations this was localized. Alta Lake may have been an exception. Here the conditions of size, slope and altitude were sufficiently adverse to cause delta aggradation into the lake.

In addition to the cutting of this period there were two fires of major proportions. The first took place in 1950 on the rocky ridge between the Cheakamus River, Cheekeye River and Brohm Creek and the second in 1952 on similar knolls immediately east of Squamish. The former was a 525 hectare blaze while the latter consumed 600 hectares of timber. Some of the physical factors involved had ameliorating effects; both areas were below 250 meters in elevation, had gentle slopes, less than 25 percent, and were in the mild, moist conditions which enhance regrowth. Adversely, however, they both abutted major fish streams and covered areas of poorly structured rocky soils. More importantly, size may have magnified these unfavourable factors.

The causes of the fires are a mystery because no historical records of the blazes can be found. While the former blaze adjoins the tracks of the Pacific Great Eastern and the engines it used were steam engines, they were the oil buring type and thus could not have started a fire. Also, no slash burning was going on at the time they started.

During this period, forestry was not intensive in the Soo. Less timber was cut in eight years than had been cut in the one year of 1943. Nearly as much forest was consumed by wild fires as by the woodsman's axe. In general, the cuts were small and relatively well situated for recovery. Of the three larger cuts which which were more seriously effected due to their size, the Alta Lake site seems to be the worst. Some of its areas have not regenerated well because of elevation and/or poor soil structures. Other parcels, with favourable aspect and soils, have regenerated better than some of the 1930's fires. The two wild fires near Squamish appear to have caused the most damage; the salmon still frequent the streams concerned, but forest cover has not abundantly returned. Poor soil conditions were the major limiting factors enhanced by the fires. After more than 20 years, the forest cover is now scattered, uneven and in places entirely missing. Generally, effects of logging in this period were light to moderate in comparison with the heavy damage created by the fires.

During the second part of the modern period, 1954-1964, the cuttings across the entire Soo were very numerous. Accordingly, they will be discussed collectively by areas. The six areas which present themselves are: a) the Birkenhead River and Gates River drainages; b) the Mount Currie area; c) the upper Lillooet River; d) the lower Lillooet River; e) the Alta Lake-Green River area and f) the Squamish area. (See Map V for the placement of these sub-regions.)

In the Gates-Birkenhead area felling was heaviest between 1954 and 1959 but was significant throughout the period. The majority of the cuts were in the 100 to 200 hectare range, only two were any larger. Most of the sites (60 percent) were on Crown Grant land rather than Timber Licenses of which there were perhaps ten. (It is possible that not all of the Timber Licenses were active at the time of cutting which means that felling would have taken place under the authority of the Forest Service. This seems most likely, given the small average size of cut relative to concurrent cuts elsewhere.) The elevation boundaries for these sites were between 400 and 900 meters with most lying between 500 and 800 meters. Only three sites reached above 900 meters to an altitude of 1300 meters, but they were all less than 80 hectares in extent.

Most all of the cutting in this area took place along water courses which had good stocks of fish. In these positions, the cuts were on relatively gentle slopes, less than 25 percent, but almost invariably extended up the valley walls into areas in excess of 35 percent. In several cases slope reached above 50 percent, e.g. west of D'Arcy, south of Birken and one of the higher elevation sites. The only critical wildlife habitat to be altered was the moose wintering range at the northeast end of Birkenhead Lake. The logging in this area was within the park but as shrub growth resulted, the area was probably enhanced as far as the moose were concerned. The Interior type climate region, with extreme temperatures and lower precipitation, may also have hindered recovery.

The operations themselves were of the modern mobilized mechanical type. Felling and bucking used chainsaws and yarding was with highlead systems, down slope into the valleys. Half of the clearing took place directly adjacent to the Pacific Great Eastern. The line could have been used to transport the logs, although that might have been unlikely in lieu of the other operations. Forest Service and National Topographic Series maps show that roads were laid out into the other half of the operations, making it inevitable that trucks were used to remove the logs. The roads were invariably on the valley floors adjacent to streams and had spurs extending up the walls. Subsequent soil disturbance and erosion must have been heavy. There were no significant fires during this period.

In the Mount Currie area, clearing was constant and at a significant level throughout the period. The normal size of cut was between 100 and 200 hectares, again with the majority (60 percent) on Crown Grant land and the remainder equally divided between Indian Reserves and Forest Service lands. The range in elevation for the area was between 200 and 900 meters with the distribution being towards the upper end. The ridge between Owl Creek and the Lillooet was a major exception, where the cutting extended up to 1200 meters. Similar to the Gates River drainage, the valleys were gently sloped (less than 25 percent) while the walls where more steep (greater than 35 percent). The previously mentioned ridge was again an

exception. There extensive areas (300 hectares) were cut above 50 percent slope. In ccntrast to the Gates, most of the logging in this area did not take place along streams, rather, it was upon the slopes that run down to the plain of the Lillooet River. The single major wildlife habitat that was altered was the deer range which was also on the ridge near Owl Creek. The impact of the clearing was more likely to have extended the wintering range than limit it. The climate of this area is represented by the Pemberton Meadows meteorological station as a transitional one with moderate extremes and harshness; this may have partially inhibited regeneration.

Forest Service maps shcw rcad networks for all of the logging sites in this area. It is evident that these operations used modern mechanical methods including trucks and tractors to transport the timber. In addition, there was one significant fire during this period, near Spetch. It consumed 80 hectares along an unnamed creek above the main river. The slopes were not excessive and it can be viewed as simply another minor cut.

In summary, the logging in this area had moderate to light impact due to the combination of favourable slopes, altitudes, moderate sizes and climate. Only the removal methods were unfavourable. The exception was the ridge above Owl Creek was heavily effected due to the high altitude and steep slopes.

In the upper Lillcoet area, between 1959 and 1964, clearing took place on a moderate scale. The normal size of cut was again between 100 and 200 hectares but with the trend towards the lower end. Most timber (70 percent) was again taken from Crown Grant land, with the rest from two Timber Licenses and some Forest Service land. The elevations involved were between 300 and 700 meters with most below 500 meters. Most site were on the valley margins and therefore the slopes were low (less than 25 percent). Only in one instance, on the margin of a clearing along the Ryan River, did a cut reach 50 percent slope. Half of the cuts adjoined streams, most commonly the Ryan River, making downstream siltation of its waters a high probability. The only wildlife habitats effected were the two deer ranges, one to the east of the Lillooet and the other between the two rivers. These two wintering areas were probably enhanced because at present, the former experiences extremely heavy use by deer. The climate of the area is represented by the Pemberton Meadows climatic station as a transition zone.

The Lillooet was logged entirely with modern methods. Roads and bridges were built to gain access to the entire area. Due to the poor soil structures and unstable glacio-fluvial banks, extra difficulties may have been caused in certain areas, though Forest Service records make no note of any mishap. Yarding was down slope and transportation exclusively by truck. There were no significant fires during this period.

The logging impact of this area may be summarized as light due to the favourable size, slope and altitude characteristics. Regeneration has been observed to be steadily and evenly progressing, though the alders and firs are still quite small (less than three meters).

The lower Lillooet, in contrast, was an area of massive clearance. From Little Lillooet Lake to Harrison Lake, all cuts were larger than 120 hectares, with only a few exceptions. Various cuts were in the 400 hectare range, a few in the 800 hectare range. The largest, in the Sloquet valley, was close to 2400 hectares. The majority (65 percent) of these cuts were from Timber Licenses with the remainder coming from Indian reserves and Crown Grants. The distribution of cutting was roughly constant throughout the period. The elevation range of the sites was from near sea level at Harrison Lake to 900 meters, though 1000 meters was reached upon occasion. The slopes were slight on the valley floors but in most cases reached above 50 percent on the valley walls, which were cut extensively. In all cases, the clearing was on the margin of a stream, either on the Lillocet or one of its tributaries. In the cases of Tipella, Fire and Sloquet Creeks, the entire valleys were laid bare. All of these creeks supported fish populations, and in the three cases mentioned, those populations were quite large. Conversely there were no significant wildlife habitats in the area. The area is a transition zone with a climate that is milder than that of the

upper Lillooet, especially further to the south. Recovery would be neither particularly hampered nor aided by these climatic factors.

The logging methods for the area were modern ones, employing roads, trucks and highlead yarding. In most cases, Forest Service maps show the roads to extend well up the valley slopes and completely cover a logged area. Fewer major bridges were used in this area than in the upper Lillooet but minor courses were crossed more frequently. There were two fires; the first in 1954 covering 57 hectares near Harrison Lake and the second in 1960, an escaped slash fire in the Sloquet valley effecting 90 hectares.

The impact of logging in this region was extremely heavy. While altitude and climate were favourable, the slopes, sizes and methods involved would have completely negated any positive influences. An example of the impact is Sloquet Creek where erosion snd siltation from the cut-over Timber Licenses was so heavy that previously strong salmon runs were entirely destroyed.

The Alta Lake area had long been an area of logging activity. However, in the late 1950's those activities were stepped up considerably. Extensive areas were cleared to the south and east of the lake, and on Fitzsimmons Creek to its east. Five years of cutting laid bare areas that were greater

than 200 hectares. In the Fitzsimmons area some cuts were greater than 400 hectares. The tenures of the cut lands were spread more or less equally among Timber Licenses, Crown Grants and Forest Service lands. Their elevations were generally between the corridor's floor at 650 meters and 1000 meters, though on Mount Sproat and Sixteen Mile Creek, they reached 1100 meters. On Twenty-one Mile Creek and Fitzsimmons Creek they extended to 1200 meters. All areas other than the corridor's floor were sloped such that the large majority of the cuts (greater than 75 percent) were on slopes greater than 35 percent. At least half were above 50 percent, particularly on Whistler Mountain and the four higher sites. Roughly half of the sites bordered streams though the only significant ones were the three creeks previously mentioned. Wildlife habitats were left more or less intact. Black Bears, who may have felt a pinch in their natural environment, found a consolation of sorts in the garbage dump. The climate of the area is indicated by the Alta Lake station as moderately harsh, having heavy precipitation and extreme temperatures, due mainly to altitude. These factors combine to produce heavy snow, which evinces the hampering effect they have upon recovery. High precipitation would also have fostered erosion of disturbed soil cover.

The logging operations in this area were analogous to all other areas discussed so far. Many roads extend high up the mountain slopes, even to 1200 meters. The region had no

significant fires during this period. The impact from forest clearance could therefore be described as very heavy, due to the adverse combination of size, slope, altitude, climate and methods. The sites concerned have not regenerated any adequate forest cover though alder and some scattered fir and hemlock have begun to take hold.

The Squamish area, like the lower Lillooet, experienced massive cutting during this period. More clearing took place in the late 50's than in the early 60's but the size of cut seems to have remained constantly within the 120 to 240 hectare range, though, a few earlier ones approached 400 hectares. At least 60 percent of this timber was withdrawn from Timber Licenses, with the remainder being equally spread among Crown Grants, Indian reserves and Forest Service lands. The elevation range for the western and southern portions of the area was from near sea level on the valley floor up to 800 meters. In the eastern portions, adjacent to Garibaldi Park, the range was much higher; generally between 500 meters and 1200 meters. In two cases, on Paul Ridge and slightly to the north it reached 1400 meters. Here again, the glaciated valleys have walls that are quite steep, from 35 percent slope to well above 50 percent. Numerous sites on all sides of Squamish reach onto the slopes above 50 percent, while only the ridge between the Cheakamus and Squamish Rivers has slopes that remain below 35 percent. The majority of creeks in the area that had not already been logged were effected by the

operations in this period. However, the only valleys in which clearing was complete were those of Fries and Stawamus Creeks. Every major creek in the area supported native and migratory fish populations which were effected by the clearing operations. There were numerous deer browsing ranges in the Squamish-Cheakamus valley and nearly all of them were effected to some degree by the cutting. Once again, from the faunal point of view, this was probably beneficial. The Squamish meteorological station represents this area climatically, as one of high precipitation and small temperature extremes. The environment is mild with altitude being the most limiting factor. Regeneration, therefore, has been highly favoured by the climatic conditions.

The logging methods of the area were identical to those elsewhere, as evinced by the many roads stretching to the tops of the cuts at 1400 meters. Here however, fire played a more important role. There were three major blazes that adjoined one another in the years 1958, 1961 and 1963, whose causes are unknown. They consumed respectively 1054, 558 and 227 hectares of the mountainsides above the east bank of the Cheakamus Canyon. The maximum elevations were only 900 meters but many of the slopes were above 50 percent and the parent soils were very low quality, rocky Podsols. While roads were absent, the effects of size, aspect and soil conditions combined to produce quite severe damage. This is the region through which Highway 99 travels, north of Brackendale. It is still quite desolate,

although alder, birch, fir and hemlock have begun to regenerate more rapidly in the last five years (See Illustrations 1 and 2). As can be seen in the illustrations, regeneration is quite random. Both the deciducus alders and birches and the coniferous firs and hemlccks seem to group themselves around eachother to the exclusion of the other type of species. This seems to be due to the restricted availability of seeds caused by the extensive nature of the fires. The commercial nature of the sites will probably be quite low after the first regeneration due to the poor species-mix and the imperfect nutrient structure of the environment.

The impact of clearing in this area could also be considered extremely heavy. This was due primarily to the adverse effects of large area sizes, steep slopes, high altitudes, logging methods and proximity of animal populations to cutting areas. Numerous streams have exhibited a marked drop-off in fish populaticns, particularly in Fries and Stawamus Creeks, and regeneration on the high ridges has been very slow.

Forestry at this time was intensive in the Soo. During this eleven year time span, approximately 19,650 hectares of forest were felled. This is an area equivalent in size to all of Burnaby, New Westminster, Vancouver and the Endowment Lands. Cutting was fairly continuous over the entire region throughout the time period. The first big ventures were made into the

ILLUSTRATION 1

REGROWTH OF A BURN ALONG HIGHWAY 99 (1970)

ILLUSTRATION 2

SAME SITE (1976)

upper Lillooet bringing the entire region within the sphere of commercial forestry. While numerous cuts were smaller, the average size for the whole area was between 100 and 200 hectares, placing it above the level of moderate impact. In addition, most sectors had cuts that exceeded this range, if not in a single year, then over a span of a few years. The largest of these was taken from Timber Licenses in the Sloquet Creek from 1954 to 1959. It was approximately 2,350 hectares in extent. The cuts that exceeded 200 hectares were almost always taken from Timber Licenses.

The cuts of this period had more widespread and heavy impacts upon the forests of the Soo than had those of any previous period, due particularly to their greater size. Only now, ten, fifteen, or twenty years later are some of the areas beginning to return to a scattered nascent tree cover. This is particularly true of the Squamish, Mamquam, upper Cheakamus, Alta Lake, lower Lillooet and Sloquet drainages. Other areas have returned to a more complete cover but nowhere has there been a spontaneous and easy recovery. In most cases, streams were involved. With the combined multiple effects of the cuts, there has been a drastic reduction in resident and migratory fish populations. As mentioned, in some cases this has lead to virtual extinction, the Sloquet drainage having suffered most severely. Conversely, because of the new shrub growth that followed, the ungulate populations have thrived since these areas were cut.

The three major fires during the period were quite extensive. Their size and intensity put them on par with the large clearings of the time. Erosion and nutrient loss were quite heavy such that they have regrown only sparsely. The overall impact of forest clearance during this period was extremely heavy. It is likely that full environmental recovery will require a period much longer than the time it will take to grow a new stand of trees, and this in itself may take a long time. The retardation was generally quite severe and some areas may never fully recover.

Governmental Projects

Forest clearance between 1946 and 1964, especially 1954 to 1964, was by far the most extensive series of actions taken during that period. There were, however, numerous other actions that were significant. In 1946 the Water Development Branch of the Prairie Farm Rehabilitation Act administration commenced a drainage project in the Pemberton Valley.(23) The major features of this project were 1) the digging of a dyked canal to channel the waters of the Lillooet River along the east side of the meadows; and 2) the widening of the river's channel between Lillooet Lake and Little Lillooet Lake in order

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23. This administration was a Federal agency set during the Depression to provide public works for agriculture. It used a cost sharing scheme between Federal and Provincial governments to defray the costs of its operations.(Faulkner, 1951)

to lower the former by three meters. By reducing the lake's level, the gradient of the river above could be steepened, thus allowing a straight channel, as opposed to its natural meanders. In addition, numerous smaller channels were dug to drain the excess waters of the meadows and swamps into the main rivers. The combined effects of these operations greatly increased the agricultural potential of the lands in the valley (Faulkner, 1951). The immediate external effects of the project were to spur further settlement and development of the valley's meadows, to bring on increased growth in Pemberton and to cause more clearing of cottonwood stands along the river and its old meander belt. While the channelling and dyking systems were intended to lower the flood hazard of the area, the increased run-off and sediment load which resulted from these and the other land use changes have caused a greater frequency of flooding, particularly in the delta area (Slaymaker and Gilbert, 1972).

The Bridge River Hydro Project was completed in 1951. While the dams and power stations were outside of the Soo, the major markets for the generated electricity were the Lower Mainland, Vancouver Island and Washington State. The easiest transmission line routes to those areas lay down the corridors from Pemberton to Squamish or Harrison Lake. For the completion of the first generating station, high tension powerlines were erected along the western corridor. When further generating capacity was inaugurated in 1961, a new

transmission line had to be placed down the Lillooet to Harrison Lake with a second line down to Squamish. The chief effects of the powerlines were that 1) they removed from Forest Service control the rights-of-way over which they ran and permanently removed the timber from those areas; and 2) their construction required the establishment of loose surface access roads. Access was thus provided to other users as well. The fact that the strips were narrow limited their environmental effects, but the effects of access have been widespread.

In conjunction with the second phase of powerline construction Highway 99 was extended north from West Vancouver, roughly parallel to the British Columbia Railway tracks. The tracks had previously been extended down Howe Sound to North Vancouver during the earlier phase of powerline construction in 1951. The highway was laid in its present course through Squamish, Pemberton, Mt. Currie and D'Arcy. Many of the old access road beds were utilised for the new highway. The major impacts therefore were not the immediate effects of environmental disruption nor the alienation of forest land but rather the long term effects of increased accessibility to the region. This has become evident in the last ten years with the great increase in recreational use of the area.

As previously noted, the increased standard of living and greater leisure time that accompanied a burgeoning economy allowed the metropolitan populace to more freely transport

itself to the less civilized areas of the Soo. Garibaldi Park in particular experienced greatly increased hiker and packer usage as the whole region saw more activity. Hunting and fishing increased accordingly throughout the region. The main effects of this trend were threefold: a) it increased the human presense in many previously wild areas, thus restricting wildlife habitats to more remote areas; b) it increased the amount of waste and pollution left behind by the recreationists; and c) it intensified the conflict between the various forest users. The overall landscape manifestations of the post-war period in the Soo were dominated by the ten year boom in forest clearance from the mid-fifties to the mid-sixties. With the large areas concerned the environmental degradation caused by the increased use of mobile, mechanized equipment far outweighed any advantage gained by its efficiency. Numerous areas were adversely effected by large scale erosion and nutrient loss which subsequently decimated a number of salmon and trout streams. The most heavily damaged areas and streams have not presently regenerated to any significant degree. Size of operation, which was directly linked to tenure arrangements, reliance upon road type vehicles, adverse climate, soil, slope and altitude factors and the overall number of users were the major determining factors in the level of impact.

THE CONTEMPORARY PERIOD, 1965-1974

The most recent pericd of forestry development in the Soo extends from 1965 to 1974. This ten year period was marked by intensive though somewhat diminished timber activities. Comparison of the average annual cut with that of the previous eleven year period shows a reduction in output of 25 percent. Never-the-less, yearly cutting totals ranged from 1200 to 1450 hectares, with exceptions in 1965 and 1966, which were close to 1050 hectares, and in 1969, nearly 2025 hectares. It is evident that all of the modern technologic, economic and leisure trends that developed in the post war period carried over into this contemporary period. The major distinguishing factor between the two therefore has been the emergence of an ecological consciousness which has further shaped our use of the forests. This may best be illustrated through discussion of forest activities and their impacts.

The most obvious and continuous activity was, of course, that of forest clearance. Once again the division into six sub-areas will be employed to simplify the generalizations of characteristic procedures. The Gates-Birkenhead area experienced a marked drop-off in clearing activity. There were only ten clearings made during the entire period with the largest being approximately 80 hectares in extent. These few cuts were along, though nct adjacent to, the major water courses of the area. Their elevations were therefore fairly

low, below 800 meters, and their slopes fairly gentle (25 percent), with only one exception, which approached 50 percent slope. The moose herd that frequents the north end of Birkenhead Lake was the only faunal species effected by these operations, and results may well have been beneficial.

This area also experienced the period's only wild fire. It was a 184 hectare blaze high on the slopes above the upper reaches of Spruce Creek. Its altitude was between 1200 and 1900 meters on slopes well above 50 percent. The land was not heavily wooded but the burn was complete. Subsequent erosion and siltation from such totally adverse circumstances were heavy.

As with all other operations in the Soo during the recent period, the loggers in this region were heavily dependent upon modern methodology and technique, employing large earthmoving machines, hydraulic systems, trucks and generally energy intensive devices. The level of production here would have mitigated against any great damage, even though these devices were used. The logging impact on this area was light, principally due to the small number and size of the cuts. In spite of the hindering climatic conditions, regeneration should prove to be rapid.

To the south, in the Mount Currie area, clearing operations also experienced a drop-off from the previous period

but they continued at a moderate level. Clearings were made on both valley floor and valley wall sites throughout the area. The Mount Currie Indian band continued to sell timber from parcels of its reservation, while numerous cottonwood stands were also taken from the meander islands in the Lillooet plain. The use of these sites contributed to keeping the size of cuts small; most were less than 40 hectares and all were less than 80 hectares. The elevations involved were, once again, low. Most sections were below 700 meters while a few reached 1000 meters and one, 1200 meters. This latter cut was also the only one to be taken from a slope greater than 50 percent; the rest were spread evenly between the level valley floor and 50 percent slope. The fauna of the area were disturbed in only a few cases. The deer north of Pemberton may have benefitted from the clearing because the available browse was increased. South of Pemberton, the goats on the flanks of Mount Currie may have been mildly disturbed by the cutting immediately below their favourite rocky knoll. The fish of the area should not have been greatly disrupted as most of the cutting was not directly adjacent to streams.

In this region, the impact of the operations could be considered moderate, even though modern techniques were employed. The size of the operations was small and the other factors, of slope, altitude climate, animal habitats, etc., were not adverse. There was one exception where the slopes and elevations were high, but its effects were localized.

Regeneration in this area is progressing at a moderate rate, as can be observed on Miller Creek, which was cut in 1965 (See Illustration 3). In this instance the cover that has sprouted is a relatively even, low stand of mixed coniferous/deciduous type (principly fir, hemlock and alder).

Illustration 4 shows the pattern of human use in the Mt. Currie area. (Pemberton is in the top centre of the photograph, while the Lillocet River flows from right to left.) The principal features are the numerous areas which have been logged, e.g. Miller Creek (upper right corner), the ridge between Owl Creek and the Lillooet (centre), the hills and slopes by the Indian Reservation (left centre) and along the birkenhead River (bottom centre). The transition from orange to light green and then dark green illustrates the different stages of regeneration for cuts of varying ages. (See also Map V for the comparison between regeneration rates and age of cut.) In addition, the cultivated fields in the main valley are clearly evident, as are the rights-of-way for the various power transmission lines. Also of note is the straightening of the Lillooet above Pemberton (right centre).

The upper Lillooet area, which was opened up by a new road that will be discussed in detail below, seems to have taken up the slack created by the slowing down of operations in the two adjacent areas. During the recent years, it has experienced increasingly heavy clearing operations. Most of this activity

ILLUSTRATION 3

REGROWTH ON MILLER CREEK (1973)

ILLUSTRATION 4

AERIAL PHOTO OF MT. CURRIE AREA (1972)

SCALE 1 : 125,000

took place on the hitherto inaccessible timber licenses beyond the Meadows. The sizes of the cuts involved are correspondingly much larger. In one case, over a four year period a 200 hectare patch was cut, while in anctner three year period, from 1970 to 1973, a 600 hectare area which encompassed two adjacent creeks was cleared. The upper elevations of these timber licenses were usually at the 1000 or 1100 meter level while the previously mentioned large cut reached 1300 meters. The slopes involved generally were from 25 percent to slightly over 50 percent. Numercus new roads in this region are shown on Forest Service maps.

The Lillooet and Ryan Rivers and numerous tributary creeks were involved in these operations. The fishery values for these streams were in the moderate range for both indigenous trout and transient salmon. In addition, numerous deer and moose grounds were disturbed, including one particularly important deer territory east of Pemberton Meadows.

The impact of logging in this area was heavy. The adverse factors of size, proximity to fish populations, harsh climate, in some cases altitude and in particular numerous roads, caused much erosion, siltation and loss of habitat capability. Recovery from these operaticns can be expected to be fairly slow.

Illustration 5 shows the pattern of human activities in the Pemberton Meadows-Ryan River area of the upper Lillooet River. Logging activities are most evident on the slopes of the main valley (far right), the Ryan River Timber Licenses (low right centre), the Rail Road Creek Timber Lincenses (upper left centre) and the timber sales on the south bank of the Lillooet (centre and centre left). Once again, the rehabilitation of these sites is indicated by their colours. The two logging roads that service the abcve mentioned areas are seen as they run along the north and south banks of the main river (from centre to left). The significance of these roads will be discussed later in this chapter. Also of note are the cultivated fields in the main river valley.

In the lower Lillcoet area, the level of clearing operations was reduced frcm its earlier extremely heavy stage but it still remained moderately heavy. A switch was made from logging the valleys of major tributaries to clearing patches on the slopes of the main river. Initially, because they were taken from Timber licenses, the average size of clearings were still moderately large, 120 to 160 hectares. Progressively, however, they diminished to leave the most recent cuts well under 80 hectares. The elevations were consistently low, below 600 meters. The slopes however, were steep whenever the mountainsides were invclved, and in more than half the cases they exceeded 50 percent. No wildlife habitats were disturbed, but the good trout and salmcn spawning grounds in the Lillooet

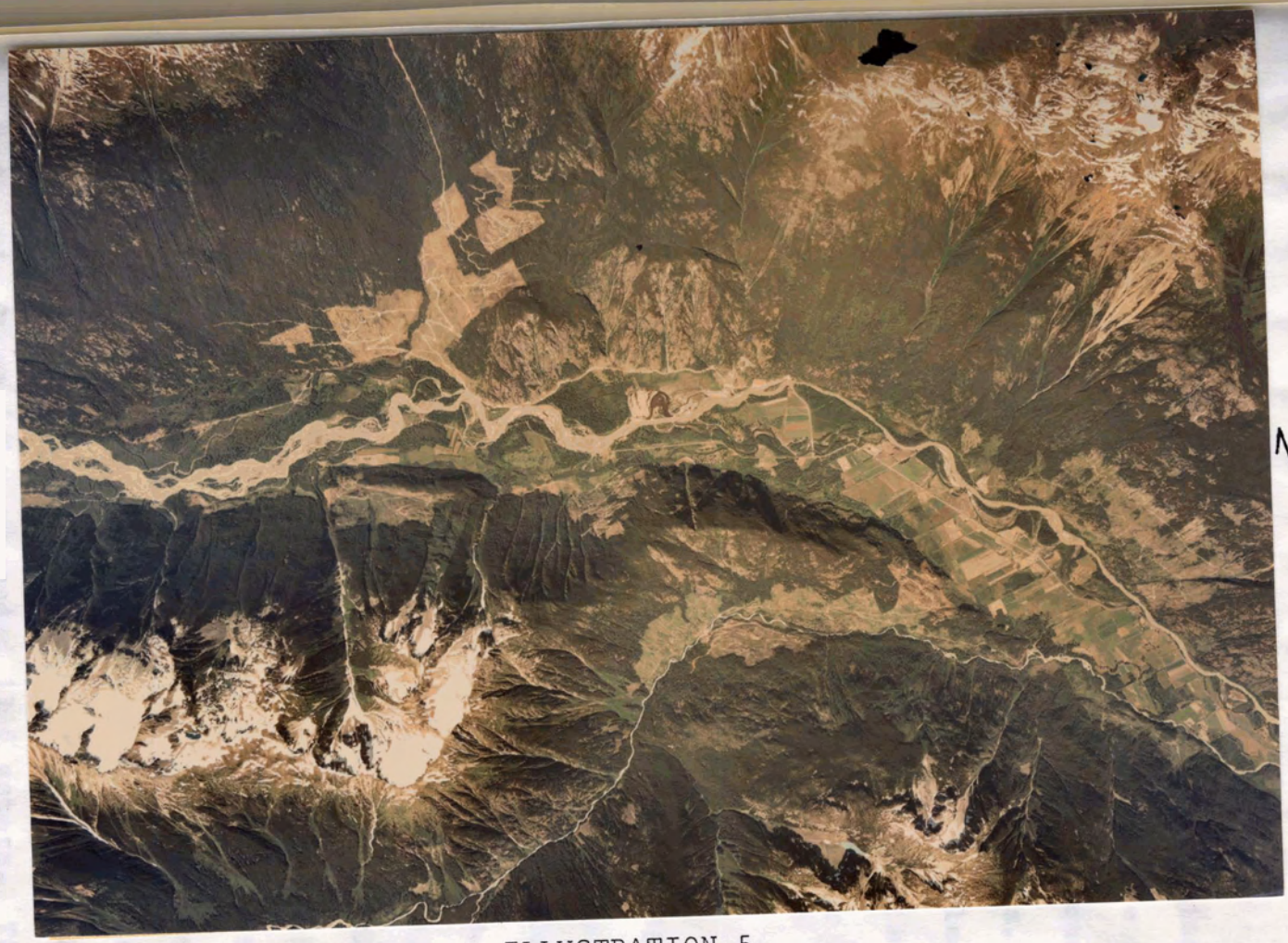

ILLUSTRATION 5

AERIAL PHOTO OF PEMBERTON MEADOWS AREA (1972)

SCALE 1 : 125,000

and its side streams were degraded by the majority of the cuts which abutted them.

Once again, this area shows numerous new logging roads on Government maps, which indicates a heavy reliance upon trucks and modern technology. The environmental impact could thus be described as moderately heavy due to the methods, slopes and proximity to streams. The factors of climate, elevation and smaller size may have ameliorated the effects to some degree. Recovery of both spawning grounds and forest cover should be fairly rapid.

South west of Pemberton, the Alta Lake area experienced a similar situation to that of the lower Lillooet. Logging was reduced but still maintained at a moderate level, with Callaghan Creek experiencing most of the activity. Likewise, due to the existence of the timber licenses, some of the cuts were moderately large. In a four year period clearing amounted to a 160 hectare parcel, and in nine years, to a 200 hectare parcel. Generally however, the clearings on other tenure lands were less than 60 hectares. The timber licenses extended up the valley walls along small side creeks. Therefore, many of the cuts reached 1000 meters in altitude and the highest, to the west of Green Lake, exceeded 1300 meters. The slopes of these higher areas were also often above 50 percent. As it happened, the larger cuts were also the higher, steeper ones, while the opposite was true of the smaller ones taken from

Forest Service lands. The only habitat disturbance involved the trout creeks of the area which were quite numerous. In addition to new logging roads being placed into all of these sites, Northair Mines built an access road up Callaghan Creek to their Brandywine Properties. The impact of some operations in this area was heavy due to the adverse factors of size, slope, altitude, climate, methods and habitat proximity. This was not uniform due to the variation in different sites, particularly between the Timber Licenses and the Forest Service timber sales.

Illustration 6 provides an oblique view of the slopes immediately north of Whistler Town (which is partially seen in the centre). The clearings (which extend from the centre of the photograph to its left margin) have been made sequentially during the past twenty years (See Map V). While those in the centre have been replanted, their visual disruption of the scenic quality of the area is heavy. These cuts were made primarily on timber sales. Their slopes are generally close to 50 percent and their elevation ranges from 800 to 1300 meters. Also evident (faintly, from centre to right) are the areas that were burned by escaped slash fires during the Second World War. These have regrown, though the cover is still discontinuous.

The sixth sub-area, around Squamish, experienced a step-up in operations during the past decade, as the large numbers of timber licenses in the Mamquam valley were logged off. Because

ILLUSTRATION 6

VIEW OF CUTTINGS NORTH OF ALTA LAKE (1973)

of the lengthy sequence of logging in this area, the only untouched slopes were at higher elevations. In the northern sector, all the clearings were on valley slope areas of up to 900 meters. In the southern part, they were situated in the small side valleys or on mountain slopes reaching above 1300 meters, the highest being 1400 meters. Since all clearings were on mountain slope areas, aspects were greater than 50 percent. Surprisingly, approximately half of the cuts were small, less than 40 hectares, regardless of whether they were situated in timber licenses or not. The other half, however, were quite large. Most were greater than 200 hectares, with the largest two in the Mamquam valley, at 600 hectares (over a four year period) and 1400 hectares (over a five year period). Numerous roads were placed into all the areas concerned indicating a heavy reliance upon modern technology. As mentioned, due to the proximity of this area to the ocean, the stated critical elevation of 1100 meters may be somewhat higher, though not more than 100 or 150 meters. In the Mamquam and elsewhere, numerous deer ranges were effected, but more than likely to their benefit unless erosion was excessive. In addition, the goat herds of the area were infringed upon, for although their favoured bluffs were not traversed, the forests immediately below were cleared away. Many streams in the area had high trout and salmon capabilities, particularly the Mamquam and Pillchuck which were quite heavily logged. Heavy siltation must have occurred following those operations. The landscape impact of this periods logging was heavy. Size,

altitude, slope, methods and proximity to important habitats completely negated the pcsitive effects of climate and precipitation, which then combined to cause even greater erosion, siltation and nutrient loss. Regeneration and return of fish populations may be expected to require a long period of time.

During this contemporary period, 12,350 hectares of forest were cut in the Soo. While operations overall were somewhat abated, certain areas, the upper Lillooet and Squamish, maintained the scale that had characterized the previous eleven years. Of the total acreage, at least 50 percent was taken from Timber Licenses with approximately an additional 10 to 15 percent coming from Crown Grants and Indian reserves. It is evident that the logging companies continued to depend heavily upon the low rent, high quality stands at their disposal rather than upon Provincial Crown Forests. Consolidation of holdings from 1907 to 1974 resulted in the 108 Timber Timber Licenses in the Soo being controlled by only eight firms. Three of those firms, Canada Trust, MacMillan Bloedel and Pacific Logging Co., presently control 90 of the Licenses (See Table 6). Canada Trust's holdings are concentrated in the upper Lillooet, which is now being logged. MacMillan Bloedel's concentrated holdings are in the Mamquam River valley, where they have been logging in the past ten years. Pacific Logging Co. controls the 26 Licenses in and around Callaghan Creek, Daisy Lake and Alta Lake, which have likewise been logged in the last decade.

TABLE 6

OWNERSHIP OF STANDING TIMBER LICENSES IN THE SOO (1974)

NUMBER	HOLDER
1407,1408	ROYAL TRUST
1419	ROYAL TRUST
1847	PETTY'S LUMBER CO.
2109	ROYAL TRUST
2683	MACMILLAN, BLOEDEL
2685,2686	CANADA TRUST
2876	ROYAL TRUST
3064-3070	MACMILLAN, BLOEDEL
3111,3112	MACMILLAN, BLOEDEL
3284-3290	MACMILLAN, BLOEDEL
4600	MACMILLAN, BLOEDEL
4781	ROYAL TRUST
4792-4794	MACMILLAN, BLOEDEL
4796,4797	MACMILLAN, BLOEDEL
4799	MACMILLAN, BLOEDEL
5139,5140	WELDWOOD CANADA
7649-7674	CANADA TRUST
8080-8105	PACIFIC LOGGING CO.
8930-8932	SQUAMISH MILLS
8954	MACMILLAN, BLOEDEL
9160	MACMILLAN, BLOEDEL
9316	CANADIAN FOREST PRODUCTS
9317	CANADA TRUST
9319,9320	CANADA TRUST
9432,9433	L&K LUMBER LTD.
12944-12947	ROYAL TRUST
13256	MACMILLAN, BLOEDEL
STL 3286	MACMILLAN, BLOEDEL
STL 3291	MACMILLAN, BLOEDEL
STL 3292	MACMILLAN, BLOEDEL
STL 4600	MACMILLAN, BLOEDEL

Source: B.C. Department of Forests, Vancouver Forest District records.

Unfortunately the Timber Licenses that produced the logging in Sloquet and Fire Creeks during the 1950's and early 1960's, have reverted to the Crown and are no longer shown on Forest Service records.

The techniques employed in these operations were capital and energy intensive, but labour extensive. This necessitated a rougher, less personal dealing with the forests (Walsh, 1975). Automotive transport remained a key factor in the system, as shown by the numerous new roads in all areas which preceded their exploitation. In that modern methods were used throughout, the size of operation seems to have been the principal factor in determining levels of impact, with slightly lesser but equal importance to slope, altitude, climate and soils. Operations carried cut solely by lumber firms, e.g. on Timber Licenses, continued to be large scale single interest ventures. Those that were under the guidance of the Forest Service were reduced greatly in size and caused much less environmental disruption. Forest regeneration has only just begun except for those areas that have been replanted, of which there are a fair number. The fish streams will have to wait until the forest cover adequately returns before completing their recovery.

Other sectors of forest uses also continued their previous trends. Agriculture and grazing maintained themselves in the Pemberton valley while mining continued at a low level. In

1974, Britannia mine was closed by Anaconda, for economic reasons. At the same time, old properties were reconsidered and new claims staked because of the rising price of gold. Much of this activity centered around Callaghan Creek at the same time that logging roads were opened up in that drainage. After much testing, Northair Mines planned to commence operation in early 1976 at its Brandywine Properties. (Production of gold, silver, copper, lead and zinc was projected at 300 tons per day.) At the same time, some geothermal exploration was carried out by British Columbia Hydro and by the Geological Survey of Canada in the upper Lillooet drainage. B.C. Hydro is currently conducting exploratory drilling in the area.

The trend towards increased real incomes and leisure time, with concurrent greater outdoors participation, caused a marked increase in recreational activities. The greater access to the Soo brought on by Highway 99 and the gravel roads along the Lillooet, spurred usage and development of the region. Angling and hunting experienced a renaissance when sportsmen could move their vehicles into the eastern and northern portions of the Sco to pursue their quarry. While hikers and packers seemed to shun long treks in all terrain vehicles, they jumped at the chance to motor to the foot of a mountain or valley for an excursion into the semi-wilderness. For all of them, Garibaldi became increasingly attactive. Each year greater and greater numbers of enthusiasts have frequented Black Tusk, Singing Pass, Cheakamus Lake, Diamond Head, etc.

The major development in recreation, beyond the Park Branch's improvements to campsites and trails, was the establishment of Garibaldi Lift Co. at Whistler Mountain in 1965. For this development lifts and trails were cut through the forests both within and along side the park. Since 1965 a series of new lifts and trails have been cut to facilitate more skiers. Each following year sets new attendance records which indicates the croissance in outdoor sports. Paralleling the increased popularity of downhill skiing, though to a lesser extent, have been dramatic increases in cross country skiing and snowshoeing. The expansion of these sports indicates the desire of urban dwellers to escape their everyday life and experience a less hectic environment in the semi-wilderness.

In 1973, the Parks Branch returned to the Lands Branch, for its administration, the 1000 hectares of Park upon which the Lift Co. operated. The rationale behind this move was that a commercial development and the activities it entailed (e.g. blasting of avalanches, etc.) were not compatible with normal Park policy, and therefore, should be handled by the Lands Branch (British Columbia Dept. of Recreation and Conservation, Parks Branch, 1974). Through the Forest Service, all of the ski area is now accessible for logging. This situation immediately points out the possibility of conflict between industrial ventures and recreationists.

The large majority of visitors and property owners of Whistler Town are from Metropolitan Vancouver and use the area for recreational purposes. These people strongly oppose logging on the mountains around the Town (whether on Timber Licenses or timber sales) because it degrades the scenic splendor of the area, which they wish to enjoy. At the same time, many of the Town's permanent residents find employment with the various timber firms that operate in the area. While the prospect of logging within sight of their homes may not please this group of citizens, they sympathize with its purpose and usefulness. Thus, there is a dichotomy among the residents of the area over the path its future resource uses should adopt.

The overall landscape manifestations of the contemporary period in the Soo were once again dominated by forest clearance activities, though their influence was greatly diminished with respect to the increase in recreational activity. As before, access to the areas concerned critically effected the level of all of these activities. The other key factor was the type of sanction or tenure under which the activity took place. The amount of environmental dislocation and damage caused during this time span diminished, but never the less, in some localities was extreme. The process of increased human control of the forest, through clearing and/or frequent visitation continued and extended itself further into the wilds of the region.

THE CASE OF THE LILLOOET FOREST DEVELOPMENT ROAD

The recent series of events which has surrounded the construction of the Forest Development Road into the upper Lillooet valley may be used to illustrate more clearly the effects of resource develcpment upon the environment, and the manner in which resultant ccnflicts have been and will be dealt with. Because Forest Service policies regarding road construction have heavily influenced the development of many areas, it is best to explain their evolution before recounting the specific events that tock place in the upper Lillooet.

Following the Second World War, the Forest Service adopted a policy of direct contrcl over road construction. The Engineering Division of the Service began by surveying the area concerned and then drew up plans for the future road site. These plans were maintained and periodically updated until construction of each road segment tock place. Building was usually undertaken in twc to three mile sections, as needed, with the work being carried out either directly by a Forest Service crew, an independent firm or timber company contractor. In any case, the Service retained control of the road upon its completion.

In the mid 1960's a shift in policy put the impetus to construct any Forest Road into the hands of the timber firms. The Forest Service still surveyed and established the tentative

route for the major access roads. The individual operator then had to submit an application for a "Permit to Construct Works" in order to build any length of that road, in addition to the roads in his own cuts. Thus the risk and expense involved in construction were transferred to the company, for which it received a reduction in royalties on the timber it cut. Though the Service "owned" the road the company controlled it. Instead of roads continuously and automatically being pushed into watersheds by the Forest Service, they began to proceed at a rate at which the timber firms felt that they could profitably justify them.

A further shift took place in 1973 when the Service and other governmental agencies, e.g. the Provincial Parks and Fish and Wildlife Branches, Federal Fisheries Service, and the Geologic and Soils Surveys of Canada, decided to move towards the Folio system of integrated resource use. The system requires explicit and complete information on all resource uses to be inventoried before any development takes place. In this manner, all constraints upon road building (as well as any other use) are known in advance of even tentative site selection. All the operator needs to do is make the best fit possible. With this shift, the Forest Service has withdrawn completely from the road building business. It only checks to see that the firms abide by the restrictions contained in their final Permit to Construct. The company manages the road, but the Service can place any regulations it deems necessary, i.e. as regards closure, etc.

The upper Lillooet Forest Development Road was initiated in the second set of regulations. In 1966 and 1968 the Forest Service Engineers surveyed the north bank of the upper Lillooet, in two thirteen mile sections, for an access road and then drew up plans for its location. Revisions and relocations were made to those plans in 1969. Construction of the road began in 1966 with the erection of a bridge across the Lillooet at the north end of Pemberton Meadows, roughly below Wolverine Creek. From the bridge head, mile zero, construction progressed to mile 4, at the base of Timber Licenses 9318, 7672 and 7673, which are on the banks of Rail Road Creek, by 1969. Thence it progressed to mile 13, though Timber Licenses 7671 and 9317 and the first part of Timber Sale Harvesting License A03272, by 1973. All of this construction was undertaken by a private contractor, who in addition to controlling the Timber Sale Harvesting License, received half interest in the Timber Licenses. The cutting of which he undertook for the owner, Canada Trust. The Forest Service was thus fostering the development of an area that was primarily of benefit to the owner of the old Licenses which stemmed from 1905-1907. Most of the cutting (greater than 60 percent) that has taken place in the area has been on the old Licenses, rather than on Forest Service lands. The Service could have more closely controlled the development of the entire area but chose in stead to follow the old pattern. Construction of the road was carried out solely according to the plans and under the guidance of the Forest Service. There was no additional input.

Late in 1973 the intra-agency Referral system (the immediate predecessor of the Folio system) was established. The Forest Service informed the Fish and Wildlife Branch of a petition to construct the forest road to mile 15.5 for the following season. The Branch protested that they were unhappy with the tentative location of practically the entire road from mile 13 to its scheduled end at mile 27. It cited water quality of the Lillooet and a critical moose range as the key concerns. However, no figures or quantitative evidence to support its claims could be provided. The Forest Service replied that, due to topographic constraints, the road would necessarily have to be constructed on the flats as originally planned. The Service also noted that because Fish and Wildlife could not make any differentiation between high and low value sites, it was difficult to determine how a reassessment of location should be undertaken. A copy of the Permit to Construct Works, illustrating the regulations to be imposed upon the development, was also provided to the Branch. These regulations, though not obtainable for reasons of confidentiality, may be expected to have closely followed those outlined in the Guidelines for Coastal Logging Operations. (Although the Guidelines are general rather than specific, they point out the orientation that the engineering regulations would have followed.) During the 1974-1975 season, the road was thus built to mile 15.5, which is the beginning of the second and larger portion of Timber Sale Harvesting License A03272.

In mid 1975, the Service informed the Fish and Wildlife Branch that they had been requested to permit construction up to mile 19.5, the middle of Timber License 7670. They pointed out that the road was again topographically constrained to its intended position up to mile 18.2 and would the Branch please examine that portion. Once again, and for the same reasons, the Branch, after investigation, objected to the prospective placement. It requested relocation and/or strict controls of the road. The Service made explicit its requirements for construction (assumed to be those in the Guidelines) in granting the permit for the original location, to which the road has accordingly been built. Again the Service noted that it was difficult for it to incorporate the Branch's desires when they were expressed as broad qualitative statements.

Early in 1975, aware of the mutual desire to establish a Polio for the upper Lillooet, the Fish and Wildlife Branch began work to compile their necessary inventory information. This inventory was completed in January 1976 and will be incorporated in a Polio for the Pebble Creek-North Creek area. In the future additional Polios will be produced for Meager Creek and the rest of the upper Lillooet to guide the development of those areas. In most of the area, the critical values are forestry, water quality, fisheries and wildlife. In addition, there are specific sites of particular interest, including geothermal activity on Meager Creek and the scenic-recreational value of the splendid falls on the Lillooet just

beyond mile 27. Urgency was added to the Branch's desire to complete its surveying with the knowledge that, soon after their final completion, Forest Development Roads have often become full-fledged, paved public roads.(24) Acknowledgement of all values in the upper Lillooet is therefore more important than it would normally appear.

In addition, over the same period of time and particularly 1969-1975, a second road was placed into the upper Lillooet along the south bank. This road pushed forward to reach a series of timber sales that were offered by the Forest Service on that side of the river. The road is not a Forest Development Road and as such, was not initially laid out by the Service's Engineers. It has been constructed by an operator who has successively requested and received permission to construct it piece by piece. The only restrictions placed upon the building of this road were those placed in its Permit by the Forest Service. No other agency or formal group had any input concerning the other values of the area .

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24. A constant complaint thoughout the years has come from the Fish and Wildlife Branch that it has never had the staff, resources nor funds to adequately provide the information concerning the numbers, habitats, whereabouts, etc. of the animals that comprise its jurisdiction. It has continually had to cut inventories short, leave them incomplete or take much more time in compiling them simply because of insufficient personnel. This has led to the circumstances where objections and/or recommendations could only be expressed in qualitative terms, which always seems to carry less weight than quantitative data. Hence many of pleas, while not being ignored out of hand, have not been duly heeded and acted upon. If the present desire for accurate Polios is to be realized, much greater aid will have to be given to support all sectors of the inventories.

The implications of this series of events are significant because they took place during a period of change. Following the War, because multiple-use was interpreted in a strictly economic manner, forestry turned heavily towards timber management. Within this frame of reference, the Forest Service developed the forests for timber purposes. Roads were built to access timber, after which they might be used by others for various purposes, e.g. recreation, hunting etc.

When the body of public and legislative opinion opposing such a one-sided outlook became strong enough, moves were made to incorporate other criteria into the development scheme. The Forest Service welcomed, even solicited, input from other agencies and groups. However, the terms of reference remained unchanged. They were still highly economic. If other agencies could not provide quantitative information, the Service had difficulty incorporating their input into its plans because it had no tools to evaluate other types of information.

To find a common ground upon which to work it was much easier for other agencies and activist groups to adopt the Service's forms rather than for them all to find some new format. Hence, the urgency of the Fish and Wildlife Branch's attempt to adequately define its values for the upper Lillooet. The crucial point is that other agencies must be easily able to deal with those terms of reference. In some cases this may be a function of inadequate personnel, while in others it seems to

be a function of technique. Agencies that have years of experience with only qualitative techniques often find it equally as difficult to broaden their perspective (as did the Forest Service). Perhaps some of the funds derived from timber royalties and/or Park fees should be transferred to other agencies in order to allow them to uphold their equally important parts of the forest inventory bargain.

The following chapter is a full interpretation of the events that have transpired in the Soo, nevertheless a partial summation of these events and their importance is necessary at this juncture. The Soo Unit forms part of the Coastal forest region whose large, old stands of timber are a result of the high precipitation of the West Coast Maritime climate and the light acidic soils of the youthful mountains and valleys. The cutting of the Soo's forest has been extensive, especially since the Second World War when modern forms of energy and transport became fully functional. The Soo, however, is distinctive in that it is adjacent to the urban metropole. It is one of the few remaining natural forests in close proximity to Vancouver, and therefore, has experienced the brunt of the outdoors recreation demand from the Lower Mainland. Resource use conflicts have been more intense and have provided the first opportunities for decision-makers to reconcile two highly often incompatible resource appraisals of the same area. In this the Soo is unique.

The most recent attempt at reconciling differing appraisals of the area has been the Folio system. As yet, only those areas that are undeveloped are slated for folio appraisal, e.g. North Creek, Meagre Creek, the upper Lillooet. This excludes those areas in which development has already begun and which are now experiencing heightened conflict of interests, particularly Alta Lake. For reasons of insufficient finances and personnel many areas will never be included within folios. Even where full coverage is possible, the complete effectiveness of the planning may be in doubt. While conflict between agencies may be minimized, environmental damage can still take place due to the developmental bias of the current system. Adverse external opinions may well be muted by incorporation into the system. And, even if the system is not a true re-orientation of forestry decision-making, in order for it to have any positive effect upon those decisions the financial and personnel constraints of all the agencies concerned will have to be overcome.

All of the activities in the Soo, and the management policies and practices devised to control them have contained implicit assumptions concerning man's control of nature. Development, control, utilization and subjugation of nature's riches has always been accepted as an inevitable, desireable occurrance. (Pearse, 1975) Except in the case of parks, preservation or protection, in the sense of a positive decision not to develop, has rarely been considered as an alternative.

CHAPTER 6

DECISIONS OF THE PAST AND TRENDS FOR THE FUTURE

The previous chapters have illustrated some of the factors involved in the structuring of a landscape. The relationship between changing land values and the body of laws, institutions, policies and practices has been outlined. The objective of this concluding chapter is to make a final assessment of how the Soo landscape has evolved, to pinpoint the critical decisions that have shaped its evolution, and to suggest what may be gained from an understanding of the trends that have developed.

The Northwest Company and the Hudson's Bay Company were the original bounty hunters of the Northwest. Their ideas of endless riches spurred them to ruthlessly trap out first the seal and otter, and then the beaver. For these species such actions were devastating, but the impact upon the rest of the wilderness forest environment was minimal. Very few changes occurred other than the appearance of the rudimentary beginnings of society: the forts and trails. The view of the Northwest as a storehouse of natural riches, however, was to have far greater and more lasting effects.

The gold miners held this same viewpoint and they just as carelessly ripped the land apart in search of their yellow treasure. Heed and forethought were words for sedentary folk who did not mind waiting while others got rich. While little mining took place in the Soc, the Douglas Trail was the first major thrust into the region, though it was short lived. In more fortunate locations there were others who did wish to establish a lasting rapport with the land, rather than to scalp it. In the main, these people intended to establish a permanent society by tilling the land and setting up an infrastructure of settlements. Though few settlers came to the Soo, those who did viewed the land not as a storehouse waiting to be tapped, but rather as raw clay that could be worked into a kiln hardened homeland. Except in the case of individual homesteading, Crown ownership with private development of natural resources was adopted at this early stage. In light of their homesteading tendencies, the ever present trees were, for the settlers, a pestilence which they gladly razed to get at the fertile, tillable soil beneath. While this was a widespread technique that must have caused very considerable environmental damage, it was very well accepted as an expedient means to a perfectly justifiable end.

The period from the 1880's to 1907 was one in which British Columbian mercantilism blossomed forth. The woods and minerals of the Province were viewed as holding the promise of a great commercial economy based upon their extraction,

processing and exportation. The Soo also held great promise but it was too inaccessible to be well used during that time. The various forms of temporary timber tenures went largely unnoticed in its wilds, while the forests of the Fraser Valley and Vancouver Island were cleared away to be shipped to market and open up the land.

It was not until 1905 when the terms of tenure were made considerably more lenient that timber merchants ventured forth into the Soo to stake their claims in its forests. The 1961 Forest Cover Series Maps indicate that approximately 300 Timber Licenses (of 261 hectares each) were taken out in the Soo, which was not even a prime area. However, the initial rush seemed to be in response to the need for wood by the prairie pioneers rather than to the expedient move of the Legislature. The boom that kicked off the 1910's took place on Timber License and Timber Berth lands of the eastern mountain valleys and Vancouver Island where railroad logging was most profitable. While devastation was common in those areas, the Soo was spared once again. Its activities centered upon opening up the land and exploring the wilds. The Pacific Great Eastern Railway, in addition to causing a number of fires, spurred settlement in Pemberton Valley and provided access to Garibaldi, which lead to its establishment as a Park. It was not until 1943 that large scale clearing took place in the Soo, around Squamish. The fact that other areas appeared much more profitable and closer at hand seems to be responsible for the benevolence up to that point.

After Second World War the Soo experienced a period of large scale development. The Prairie Farm Rehabilitation Administration drainage project catalyzed settlement and agriculture on Pemberton Meadows and the Bridge River Project required transmission lines in the Soo's other valleys. After the post-war recovery period logging moved into large-scale production. After 1954, at least 1000 hectares have been cut annually. Since over 50 percent of this cut was from Timber Licenses, where operators were at liberty to log carelessly, environmental disruption and degradation was heavy. Sloquet Creek was an example of such single-minded practices. Its once heavy salmon runs were decimated by sedimentation from massive clearcuts. Since the early Sixties logging activities have been reduced somewhat, but during the last ten years they have still cleared over 1000 hectares per annum.

As old drainages are logged bare, a pattern has emerged of constructing roads into new valleys that are generally controlled by Timber Licenses, in order to maintain an adequate supply of low cost timber. The lower Lillooet was the principle focus in the late Fifties, it then shifted to Squamish and Alta Lake in the Sixties, then to Callaghan Creek and the Mamquam River and finally to the upper Lillooet in the past five years.

The importance of motorized access is also evident with regards to recreation. When the hard surface Highway 99 was

finally completed into the Pemberton Valley in the late 1950's, motorized urban recreationists gained easy access to the heart of the region. Since that time all types of recreational forest activities have increased greatly in the Soo. This trend has centered on the Squamish and Alta Lake areas, with the Whistler Mountain skiing development being a particularly heavy focus. The croiscance of recreation has caused considerable conflict over the direction that resource use of the area should take.

KEY DECISIONS OF THE PAST

Thoughout the evolution of the Soo landscape there have been certain key decisions which have carried great import for the forests. The initial, fundamental step taken by the Colonial Legislature was to reserve Crown ownership of resources. To this day 90 percent of the Soo forest lands are owned by the Crown (compared to 85 percent in the Coastal sector in general and 90 percent Province wide). In contrast, in Scandinavia and the United States the government owns is roughly 25 percent (B.C. Commisssion on Forest Resources, 1956). Thus the Crown established its authority over private interests in resource development, while Scandinavia, through historical trends, and the United States, through choice, allowed private enterprise to own the raw materials.

It is ironical, however, that the Crown has not chosen to fully exercise its authority. To allow for development of the Province's resources by private entrepreneurs, the government initiated the railway grants and the various temporary tenures, (e.g. Timber Leases, Timber Licenses, etc.) Due principally to the massive issuance of Timber Licenses between 1905 and 1907 the Crown presently exercises effective control over approximately 73 percent of the Soo's mature timber, while in 1913 it controlled only 44 percent (B.C. Dept. of Forests, 1975). In comparison, the Crown controls 51 percent of the mature timber in the Coastal sector and 75 percent province wide. However, on a volume basis its control is even less, 39 percent on the Coast and 57 percent provincially (B.C. Commission on Forest Resources, 1956). In 1913 Crown control over both area and volume would have been considerably less, although no records are kept of the reversion of Timber Licenses. The breakdown by volume on the Coast is 39% Crown, 47% Timber Licenses, and 14% other. Therefore, public ownership of resources does not necessarily equate with their control.

Private exploitation of resources within essentially capitalist systems is the means of development British Columbia, Scandinavia and the United States. British Columbia chose to retain ownership of natural resources and then induce their private development by offering non-constraining temporary leases for the resources. Scandinavia and the United States induced development by allowing private ownership of the

resources and then firmly controlled that development through governmental legislation. It is significant that newer and better practices are brought into production much sooner in the latter two cases than they are in British Columbia. Environmental protection has been a motive there much longer than it has here (H. Waehlti, B.C. Dept. of Forests, personal communication). The irony is that the honourable intention of public ownership of resources has given rise to systems that forfeit so much control over resource use.

The temporary tenures were an expedient means of inducing development. However, the major problem that has arisen since their passage is that no one has dared turn in the face of their precedence and drastically change or abolish them. Thus today, there are over 100 Timber Licenses in the Soo, upon which timber firms are permitted to log without restriction. When they have taken what they desire from the forest it is left to the Crown to rehabilitate the plots.

The response to overextension was a more controlled, thoughtful approach embodied in the Forest Act and the Forest Service. Development necessitated regulation and the public interest needed an official administrative arm. The Act was a first attempt to recoup some of the control that the Timber Licenses had lost. It was thwarted in that endeavour because private interests held sway over more than enough timber to

supply their needs for many years. Since 1913 the Service has always attempted to maintain its resource in the condition that was determined by its experts, its ministers and the legislature as being optimal. In performing this task it has followed orders and has fashioned the landscape it was instructed to produce. Large clearcuts, though not particularly aesthetic, were the signs of prosperity and employment that were desired by the government.

The next major decisions came after the Second World War and gave forestry a long term perspective through the introduction of Tree Farm Licenses, Public Sustained Yield Units and Sustained Yield techniques. These policies and mechanisms established a firm base for forestry which was tuned to the economic feeling of the times. They offered stability to industry by advancing large reserves of timber, which could be depended upon over the long term. The Crown thus recouped some of its forfeited control by issuing contracts which explicitly covered the operation of the Tree Farm Licenses. In the Public Sustained Yield Units and railway lands, however, the new techniques still faced the precedent of the old temporary tenures upon which "good" forest practices always seemed to get lost in the slash and sediment.

Efficient organization of the forest into Tree Farms and Public Units realized considerable gains in stability and

security, but the rigidity of economic criteria perpetuated certain problems. Tunnel-vision and overspecialization were obvious outcomes, however the over-all application of economic criteria to timber harvesting and market fluctuations has now come into question. Adequate solutions will have to be found to both overspecialization and inflexibility. They will have to retain the long term perspective of the economic procedures while also allowing for short range market fluctuations and at the same time incorporate environmental values into the decision-making process.

It is under the post-war systems that the Soo is run as a Public Sustained Yield Unit by the Forest Service. It is since the inception of the unit that timber harvesting has become the major agent of change in the Soo. On an annual average, however, half of the timber extracted from the Soo has come from Timber Licenses, which are not governmentally regulated. Therefore, despite sustained yield management, considerable environmental damage has occurred. The use of the Soo forest in the post-war period has been shaped as much by the decisions of 1905 as by those that came after 1945. Their combined effects, along with the various governmental projects (e.g. drainage, dams, powerlines and highways) have increasingly brought the Soo forest away from its wilderness state and into the socialized realm of man.

The final key decisions concern the shift towards more fully integrated resource use. With the shift in multiple-use from an economic to an advocate orientation, as evinced by the Planning Guidelines, Referral and Polio systems, forestry has moved to accept a much broader perspective. The Guidelines were the major official policy statement of the Forest Service, in which it recognised the importance of incorporating new values into forestry decisions. The two new systems are the results of inter-agency attempts to effect the shift in emphasis. While these new systems allow for new sources of input into the forestry decision-making process, they essentially carry forwards the same developmental ideals of bringing nature completely under man's control. However, it does seem that forestry has come to recognise the difference between timber and forest.

TRENDS FOR THE FUTURE

Certain trends have crystallized from these key policy decisions that should be conscientiously watched. The first, and perhaps most critical, is the temptation to adopt a short-term perspective in order to realize a quick gain. This temptation is especially dangerous in the case of renewable resources because they may be treated in a manner that will greatly diminish their future productivity and usefulness. While most fiscal planning is done on a five year basis, complete resource development should project much further

ahead, 25 years or more, to anticipate future contingencies and to deploy the resources in the best overall manner. The greater the present investment, in terms of investigation, understanding and planning, the greater will be the future return, in terms of protection, production and utilization. This is the greatest merit of the Tree Farm Licenses and Sustained Yield: they permanently set the forestry perspective at eighty years or more.

The second trend is actually a permutation of the first: the idea of not locking oneself into a situation that can not be altered as external conditions change. Undue reliance on precedence can only hinder the progress of resource development as it seeks to continually upgrade its use and reap optimal benefit. Contracts should never be endorsed if they can not be changed through negotiable agreement. This is the greatest failing of provincial forestry in allowing the abuses of the "out-of-time" Timber Licenses to continue unabated in the face of current knowledge.

A third pitfall that should be avoided is the disenfranchizement of sources of input into the decision making process. Though undesired, this may occur inadvertently. For example, the absence of non-forest specialists and public inputs contributed to the zealous adoption of economic tools as the criteria for resource allocation. The greatest assets of the Guidelines and the Folic system are that they guard against

such a fault. Though the Guidelines are basically a statement of principle and contain no precise specifications, they outline the new importance that the Forest Service wishes to attach to environmental quality. They make specific mention of protecting water quality, scenic, fish and wildlife values. If the Service can uphold these principles, tunnel vision will be a thing of the past. As the principal vehicle of this emphasis, the Folio system shows promise. Because it draws on such a broad base of agencies, with their various talents and perspectives, it should prove capable of comprehensively planning forest landscapes to match our environmental goals. In bringing these groups together at the initial planning stages, the Folio system allows for the early recognition of conflicts and thus will arrive at more equitable solutions.

The fourth trend is less easy to identify specifically but lies in the realm of less than critical adoption of implicit assumptions concerning resource development. This shows up in the ease with which the early forms of sustained yield and multiple-use were accepted, without detailed examination by decision makers. It is also entailed in the continued acquiescence to the doctrine that development is a given, "good" thing. As implied in previous arguments, the possibility of neither logging a valley nor calling it a park is rarely entertained. This situation is exemplified by the placement of a road into the upper Lillooet. No one concerned has seriously questioned the idea that the valley should have a

road, or two, should be logged, or that its wildlife should be protected. The implicit assumptions are the Judaeo-Christian beliefs that man is apart from Nature, that he must conquer Her wilds and that he must bring Her within his organized sphere (White, 1961; Neff, 1961; and Nash, 1967). But it is not given that man must go everywhere. We do not have to put a road into every valley, cut its trees and mine its ores. We may, if we wish, leave it alone. This is not to say that one must or should always leave things untouched for the sake of doing so. On the other hand, it shculd not be unthinkable to conduct a detailed investigation of an area and, having done so, decide not to develop it at all.

At present, the future of the Soo is uncertain. The new referal and folio systems face quite a task; the legacy of the past is hard to overccme. It seems certain that logging operations will continue to expand in the drainages of the Mamquam, Cheakamus, Soo, Ryan, Lillooet, and Birkenhead Rivers. It can only be hoped that closer regulation and an emphasis on cooperation will lead to the reduction of heated conflicts in most areas. Undoubtedly there will need to be compromise on all sides and not everyone will be completely satisfied.

At present the most critical area is the Squamish-Alta Lake corridor. (In the near future the lower Lillooet, because of its high recreation potential and historical resource, may become equally important.) In addition to having high timber

values, this area provides the key recreational hinterland for Vancouver. Hence, its scenic, fish and wildlife values are critical. The principal logging activities are now centered upon the Soo River valley, and Rutherford and Callaghan Creeks. The principal focus of intensive recreational demand is the Daisy Lake-Alta Lake area around Whistler Town site. Working out a fit between the two values may be difficult, but the most plausible solution seems to be for each to forego the use of certain areas in favour of the other use. Thus the corridor and Whistler Town might be spared the visual disamenity of logging, while clearing operations could continue in the less immediately noticeable sectors of Rutherford Creek and the Soo River. Regardless of the solution adopted, all activities must be carried out in such a manner that they maximally protect the future values of other users.

Elsewhere in the region (e.g. the upper Lillooet, Meager Creek, eastern Garibaldi Park) there are equally as important decisions to be made. The Meager Creek area will likely be developed in the near future, and as yet, no concrete moves have been made to comprehensively plan its future. The various Provincial Government departments (e.g. Parks Branch, Fish and Wildlife Branch and Forest Service) consider the area's timber, scenic, fish and wildlife potentials to be high. The complexity of the situation is increased by certain natural hazards, including avalanches, unstable glacial soils that are prone to slumping, and flooding, and the potential

development of geothermal power. In spite of the fact that planning is more effective if done before development, this area and others not receiving the attention that is afforded the better known partially developed sites.

However, if we in British Columbia decide that we wish to subdue the wilderness, we should do so with open eyes and in the full knowledge of the implications. When access is granted to an area it must be realized that it is being turned into a human place and brought into society. If it is determined that development is the correct course of action, then subsequently we must to decide upon the best means in which to proceed. Hopefully this study points out the preferable manner for going about making the second set of decisions and the need for consciously making the first.

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