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THE POLITICAL - TECHNICAL INTERFACE IN PEST MANAGEMENT: A HISTORICAL ANALYSIS OF THE PROPOSED 1977 FRASER CANYON BUDWORM SPRAY PROGRAM

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The Political - Technical Interface in Pest Management: A Historical Analysis of the Proposed 1977 Fraser Canyon Budworm Spray Program

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ABSTRACT

The British Columbia Forest Service plan to control an infestation of western spruce budworm, Choristoneura occidentalis Freeman (Lepidoptera:Tortricidae), in the Fraser Canyon in 1977 by means of an aerial insecticide spray program generated a major public controversy. This paper documents the background and development of that controversy. The review process preceding approval of the program by responsible government agencies is also described. Information available to the decision-makers of the time regarding biology of the western spruce budworm and its impact on the forest resource is summarized, as are two benefit/cost analyses of the proposed spray program.

Lack of citizen involvement in the decison-making process, along with the existence of a significant segment of the public skeptical about pesticide safety, set the stage for the controversy. The decision to undertake the spray program was considered by government agencies with forestry, environmental protection and health protection mandates. Although it was approved by these agencies, the program met with strong objections from a group of local residents. In order to block its implementation, this group attempted to transform the decision to spray the Fraser Canyon from a technical one to a political one. The politicization of the spray decision was greatly aided by the existence of bona fide technical questions regarding the efficacy, safety and cost-effectiveness of the

program. Considerable media coverage kept the controversy before the public. Shortly before the spray program was due to commence, it was blocked by Cabinet order.

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I. INTRODUCTION

Pest management is inescapably both a social and a technical endeavor. A "pest" is socially defined as an organism whose activities interfere with those of people. Measures taken by people to combat a pest also interfere with human activity. At best, chemical, physical, cultural and biological controls impose costs and constraints on the management of urban, agricultural and wildland systems. At worst, pesticides may cause human health problems or declining environmental quality.

Any management activity, when applied to publicly owned resources, such as forests, major lakes and waterways, can have divergent effects on different uses, such as logging, fish production, and recreation. Thus, any pest management program is likely to have both positive and negative effects.

Each effect is the concern of people. There are discrete government agencies charged with managing forests, managing fish stocks, protecting public health and the purity of food and water supplies, enforcing building codes, and promoting improved agricultural techniques. In addition, there are businesses, non-governmental organizations, and individuals with special interests in one or another of these activities. It is no wonder that pest management decisions are often controversial.

In spring, 1977, the B.C Forest Service planned to apply an aerial insecticide spray to 100,000 acres [40,500 ha] of

infested Crown forest in the Fraser Canyon area of the province. This treatment was intended to control an outbreak of western spruce budworm, Choristoneura occidentalis Freeman (Lepidoptera:Tortricidae), a defoliating insect which feeds on Douglas-fir, Pseudotsuga menziesii (Mirb.) Franco. The plan was submitted to the B.C. Interministerial Pesticide Committee; this was the normal mechanism for satisfying the provincial public health and environmental protection agencies with respect to the safety of the treatment. The Committee approved the plan, but public opposition to the spray was already considerable. The Minister of Forests strongly favoured the spray program, and operational preparations were carried out in spite of the atmosphere of controversy which prevailed. In mid-May the size of the planned treatment area was reduced by half.

Less than one week before the spraying was scheduled to begin, Cabinet announced that the program would be deferred until pending pesticide control legislation had been passed and proclaimed. This action effectively ruled out implementation of the spray program for the 1977 season, since the budworm is susceptible to insecticide treatment for only a few weeks each year.

Combined examination of political and biological aspects of major pest management decisions can be an important step in the improvement of communication between resource managers and the public, and in the rationalization of decision making processes. The aerial spray program against the western spruce budworm in

the Fraser Canyon, B.C., as recommended, reduced and then abandoned, is an excellent subject for a case study of this kind. The events are recent enough to be remembered, but enough time has passed to allow the atmosphere to cool. Many of the people who figured prominently at the time are still actively working within 100 miles of Vancouver, and were willing to be interviewed. Several of them allowed me to review relevant correspondence, opening another window on the human interactions which influence pest management decisions. I have also been able to refer to substantial published documentation, such as reports of the Western Spruce Budworm Task Force set up by the B.C. Forest Pest Review Committee, the Hansard transcript of the technical conference convened by the Minister of Forests in April 1977, and extensive newspaper coverage of the controversy.

This study does not attempt to conclude whether or not the Fraser Canyon should have been sprayed in 1977. Rather, it documents a management decision which the B.C. Forest Service was forced to abandon in the face of determined opposition from a part of the public. Three points were crucial to the events and their outcome:

1) the decision to spray was made without public input;

2) a vocal segment of the public was pre-set to oppose any aerial pesticide application; and

3) the technical and biological information available to the B.C. Forest Service at the time was inadequate.

The moral of the story will be clear - pest management does not, and cannot, operate in a vacuum.

II. BACKGROUND

A. The Insect

Budworm Biology

The western spruce budworm is a native tortricid moth. Along with several other species, it was recognized in 1967 as distinct from Choristoneura fumiferana Clemens, the notorious spruce budworm which has devastated millions of acres of balsam fir, Abies balsamea (L.) Mill., in eastern Canada [Freeman 1967; McKnight 1968]. The larvae, or caterpillars, are defoliators, mostly attacking Douglas-fir in B.C.; occasionally they also attack the true firs, Abies species [Sutton 1977; Brown 1971]. In the Rocky Mountains of the U.S. they are also found on larch, Larix occidentalis Nutt., and on Englemann spruce, Picea engelmannii Parry [Schmidt and Fellin 1973].

The geographic range of the western spruce budworm extends from southern B.C. to California, and east to Idaho, Montana, Colorado and New Mexico. This distribution coincides with the northern part of the range of Douglas-fir [Stehr 1967]. In the coastal, montane and Columbia forest types in which the insect occurs [Brown 1971], Douglas-fir is the dominant tree species

[Stehr 1967].

Unlike the two-year-cycle budworm, Choristoneura biennis Freeman, which is found at higher elevations in B.C., C. occidentalis takes one year to complete its development. In midsummer the moths lay their green eggs in rows on the needles of host trees. Each egg mass, from one to five rows wide, may contain up to 50 or more eggs [Washburn and Brickell 1973]. The eggs hatch after about ten days into tiny caterpillars, which crawl along the twigs finding shelter among lichens, under bark scales, and in flower and needle scars [Brown 1971]. There they spin protective silken webs, called hibernacula, and molt; they spend the winter as this second larval stage, or instar. The overwintering larvae occur throughout the crown of Douglas-fir and along the branches and trunk [McKnight 1968].

The larvae become active in May; the date depends on temperature and thus varies with elevation and exposure, and from year to year. The emerging larvae begin to feed by mining inside old needles. Usually, they soon move to the buds, and feed on new foliage until they exhaust this preferred food [Sutton 1977; Johnson and Denton 1975]. Developing cones may also be damaged or destroyed [Dewey 1970; Fellin 1976]. As the larvae grow, passing through instars III through VI, they construct loosely woven shelters of silk, green needles, dead needles and bud scales [McKnight 1968]. The largest instars, V and VI, consume by far the greatest amounts of foliage [Sutton 1977].

The insects pupate in silken shelters between late June and mid-July. The moths which emerge 8 to 18 days later are mottled grey or brownish, with wingspans of about 2.5 cm. As in many other moths, the females produce a chemical attractant, or pheromone, which enables the males to find them. The females lay up to 150 eggs within seven to ten days after emerging from pupation [Sutton 1977].

Population dynamics

Periodically, C. occidentalis numbers increase dramatically. Areas of severe defoliation expand for several years before the population subsides to its usual low level. Johnson and Denton [1975] attribute budworm population fluctuations to changes in a number of environmental and population characteristics, including weather, abundance of parasites and predators, prevalence of pathogens, quantity and quality of available food, and budworm sex ratio, fecundity and egg viability. The interaction of these factors in bringing about the rise and decline of outbreaks is not clearly understood [Johnson and Denton 1975; Sutton 1977].

Whereas much attention has been devoted to constructing models of the population dynamics of eastern spruce budworm on balsam fir, relatively little experimental or theoretical work has been carried out on the western spruce budworm/Douglas-fir system. The following interpretation of the eastern spruce

budworm system was current at the time the Fraser Canyon spray program was under consideration. The presence of stands of mature balsam fir, which produce large quantities of staminate flowers, a favoured budworm food [McMnight 1968; Holling 1973], was thought to be the precondition for an outbreak. A sequence of unusually dry years, which enhance the survival of larvae, apparently triggered explosive population growth. This combination of favourable circumstances then allowed a rapid increase in budworm populations, exceeding the ability of predators and parasites to respond in kind. Budworm numbers continued to climb until poor weather, starvation, or scarcity of oviposition sites caused a collapse to pre-outbreak levels [Baskerville 1976; Holling 1973].

Insecticide spraying keeps the trees alive by greatly reducing numbers of the defoliating budworms. But it was recognized that such treatment prevented the end of an outbreak by protecting the insects' food supply, to be utilized by the surviving budworms and their offspring. Any immigration of adults or early larvae from untreated stands would help to keep populations elevated in the treated stands [Baskerville 1976].

Further computer simulation studies have since led to the development of a sophisticated and realistic model of eastern spruce budworm population dynamics. This model is based on the idea that populations have the potential to exist in more than one stable state, in which numbers remain roughly constant from year to year. The increasing food supply provided as a stand of

balsam fir matures creates the condition for a budworm population to cross the boundary between the endemic and outbreak states. Favourable weather or immigration of budworms from other stands can hasten the occurrence of an outbreak; the activities of predators and parasites may delay it. The outbreak subsides when the budworms have destroyed their food supply by killing the trees. Eventually, young balsam firs begin to grow. The cycle begins again, with an endemic state budworm population in an immature stand. In this view spraying is seen to perpetuate the stand conditions required for the outbreak state of the budworm population while preserving the forest resource for human use [Clark et al. 1979; Peterman et al. 1979].

The degree to which western spruce budworm resembles its extensively studied eastern relative is of great interest, since it would be convenient to apply conclusions drawn about one species to management of the other. Williams et al. [1960] found the survival of C. occidentalis larval instars IV to VI to be greatest in trees whose canopy form provided increased exposure to sunlight. Silver [1960] reported that the western spruce budworm outbreak which occurred in the 1950s in the Lillooet area of B.C. was preceded by two years of drought. These observations suggest that dry weather may be favourable for C. occidentalis population growth. Much further work is required to define the influence of weather on the timing of outbreaks.

Extrapolation from the eastern to the western situation must be done with care. The two closely related insects might

well display physiological and behavioural similarities, but there is no evidence that C. occidentalis requires mature Douglas-fir to reach outbreak levels. Thus the nature of outbreaks in the two species may be profoundly different.

The geographic patterns of budworm outbreaks have implications for control strategies. If an outbreak spreads outwards from a single focus, it might be controlled while it is still limited in extent by early spraying of a relatively small area. If, on the other hand, outbreaks begin at many points at once, such a strategy would not work.(1) Shepherd [1977] described western spruce budworm outbreaks as capable of spreading to adjacent stands within a particular biogeoclimatic zone, specifically the westernmost areas of the Interior Douglas-fir Zone. He considered both local population increases and immigrating individuals to be important in the growth of outbreaks, their relative contributions varying with topography, weather, and other factors.

The western spruce budworm is certainly capable of travelling long distances [Sutton 1977]. Johnson and Denton [1975] reported dispersal of adult moths over wide areas of the eastern Rocky Mountains, transported by the strong winds which are common in such terrain. First and second instar larvae are also capable of dispersal. When jostled or disturbed they may drop off twigs and hang suspended on silk threads until they are carried away by air currents [Brown 1971; McKnight 1968].

The duration and extent of outbreaks are variable. In northern Idaho and Montana, 82 outbreaks, forming five major infestation cycles, have been reported since 1922; yearly totals of defoliated areas have ranged from 278,000 acres [112,300 ha] in 1948 to 5,869,000 acres [2,371,100 ha] in 1958. Most of these outbreaks lasted five years or less, but three persisted for between eleven and fifteen years [Johnson and Denton 1975]. Eleven outbreaks have occurred in Washington and Oregon since 1943. Of the two which were not treated with insecticides, one continued for six years and the other lasted for twelve [U.S. Dept. of Agric.-Forest Service 1978; Williams 1967]. The yearly extent of defoliation had two peaks, in 1950 and 1976-77, with a period of low budworm activity from 1964 to 1970 [Dolph 1980]. Four major outbreaks previous to the current one have been recognized in southwestern B.C. since 1900. They occurred in 1916-1918, 1926-1930, 1942-1946, and 1953-1958. The longest of these persisted for six years [Sutton 1977].[2]

No systematic attempt has been made to identify the factors which cause outbreaks to subside [Carolin and Coulter 1959]. In the absence of other controlling factors, a budworm population may exceed the capacity of its food resource [Johnson and Denton 1975; Silver 1960]. Unusually cold weather, particularly in fall or spring, has occasionally been associated with reduced western spruce budworm populations [Johnson and Denton 1975; Fellin and Schmidt 1973]. McKnight [1971] described a case in which a normally rare parasitic wasp, Bracon politiventris Cushman, may

have contributed to the collapse of an outbreak in Colorado. No instances of outbreaks controlled by insect parasites appear to have been reported in either the Northern or Intermountain Regions of the U.S. Forest Service (parts of Washington, Montana, Idaho, Utah, Nevada, Colorado and Wyoming) [Johnson and Denton 1975]. There have been reports of relatively high incidences of parasitization in the latter years of outbreaks [Carolin and Coulter 1959].

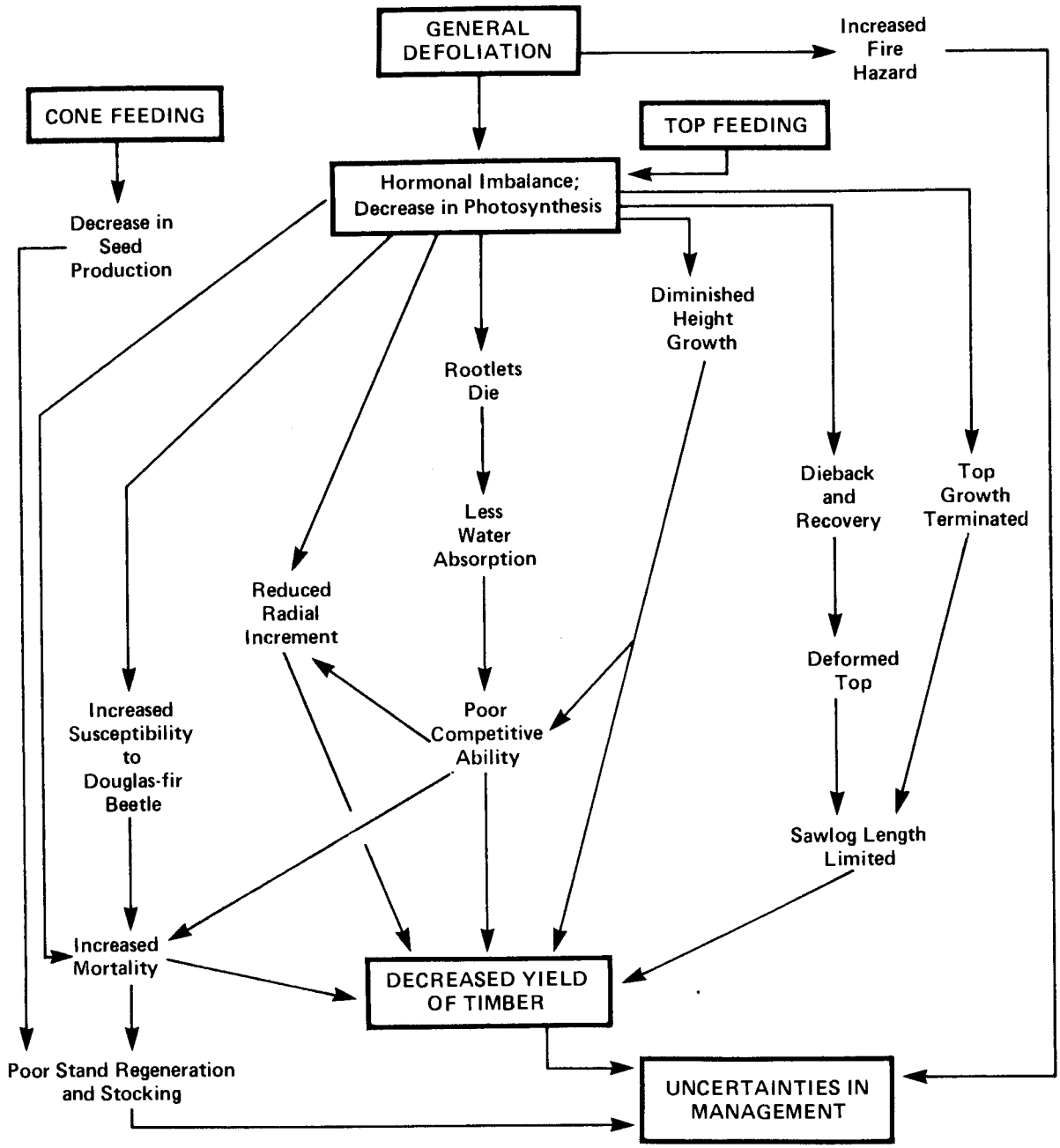
The lack of experimental and theoretical work specifically directed to understanding population dynamics of the western spruce budworm makes prediction of the occurrence and course of outbreaks very uncertain [Johnson and Denton 1975; Sutton 1977]. Development of accurate sampling methods for all life stages of the insect is an essential prerequisite for such studies. Carolin and Coulter [1972] developed sampling techniques for C. occidentalis in eastern Oregon based on those used for C. fumiferana. Forest managers need an inexpensive and convenient method for surveying pest population levels over wide areas in order to make control decisions. Carolin and Coulter [1972] recommend counting the number of current-season, hatched egg masses on one midcrown branch per tree as a reliable estimate. They present tables which can be used in their region to predict the amount of defoliation in the following summer from the egg counts. These authors emphasize that such numerical relationships must be developed independently for particular geographic areas. Silver [1960] did not find a correlation

between egg mass density and degree of defoliation. Nevertheless, the Canadian Forestry Service's Forest Insect and Disease Survey accept and use egg mass counts as indicators of western spruce budworm population trends and expected defoliation levels [e.g. Wood and Doidge 1971; Morris and Wood 1976]

Impact of defoliation

Defoliation is itself only an indicator of the statistic of real concern to the forest manager, that is, loss of lumber. The major consequences of defoliation are mortality, increased susceptibility to secondary insects and diseases, and loss of growth resulting in delayed rotation [Kulman 1971]. These negative consequences are due to general disruption of tree physiology. Photosynthesis may be greatly reduced, and hormonal imbalance or decreased water uptake may block growth even when carbohydrate reserves are high [Kozlowski and Keller 1966; Kozlowski 1969]. Fig. 1 summarizes the possible effects of western spruce budworm attacks on forest stands. The magnitude of the impact will vary with host species and the severity and duration of defoliation. Stand characteristics, such as species composition, tree maturity, soil type, elevation, exposure and climate, which together produce the environmental and competitive stresses experienced by the trees, are also important determinants of host response [Johnson and Denton

Fig. 1. Possible impacts of defolation by C. occidentalis on forest stands and their management.


GENERAL DEFOLIATION
Increased Fire Hazard
CONE FEEDING
TOP FEEDING
Hormonal Imbalance; Decrease in Photosynthesis
Decrease in Seed Production
Diminished Height Growth
Rootlets Die
Dieback and Recovery
Top Growth Terminated
Less Water Absorption
Reduced Radial Increment
Deformed Top
Increased Susceptibility to Douglas-fir Beetle
Poor Competitive Ability
Sawlog Length Limited
Increased Mortality
DECREASED YIELD OF TIMBER
Poor Stand Regeneration and Stocking
UNCERTAINTIES IN MANAGEMENT

1975; Fauss and Pierce 1969; Williams et al. 1971].

Relatively few quantitative studies have been made of the impact of western spruce budworm; of these few, even fewer were carried out in British Columbia itself. Williams [1967] examined the relationship between symptoms of crown damage, including degree of defoliation, and radial growth in Douglas-fir, Engelmann spruce and grand fir, Abies grandis (Dougl.) Lindl., attacked by western spruce budworm in eastern Oregon. As expected, radial growth was least in those trees with the greatest extent of crown damage. Several authors consider Douglas-fir to be remarkably resistant to defoliation [Sutton 1977]. Silver [1960], describing the 1953-1958 infestation in the Lilloet area of B.C., observed many trees surviving losses of more than 90% of their needles. Williams [1967] found Douglas-fir to be less damaged than either grand fir or Englemann spruce growing in mixed stands in eastern Oregon. Carolin and Coulter [1975] also found Douglas-fir to be less damaged than grand fir. However, Johnson and Denton [1975] report higher mortality for Rocky Mountain Douglas-fir growing in pure stands than for true firs in mixed stands.

The width of annual rings provides a record of the growth achieved each year, but results must be interpreted with care. Defoliation is only one of many influences on radial growth. These factors can be divided into three main groups [modified from Graham 1963, p. 177]: 1) variation among trees, due to site characteristics, stand characteristics, and place in the canopy

as dominant, suppressed or juvenile [Kozlowski and Keller 1966; Kulman 1971]; 2) variation among years, due to fluctuating weather conditions, heavy cone production [Tappeiner 1969], or insect outbreaks; and (3) variation within individual trees. Not only do these factors confound measurement, but they also influence host response to defoliation, and the budworm population itself.

The question of variation within trees requires some explanation. In any one season, radial growth will vary at different heights along the trunk. The most rapid cell division takes place in the youngest cambial layer, that is, at the top of the shoot. In addition, cambial growth generally utilizes carbohydrates produced nearby, and will therefore be greatest where the foliage area, hence photosynthesis, is greatest [Kozloswki and Keller 1966]. As the tree grows upwards and outwards, the position of each internode changes with respect to canopy structure. These changes in cambial age and carbohydrate availability are an intrinsic source of variation in ring width at any given height. Sensitivity of radial growth to environmental stresses, including defoliation, is also greatest in physiologically young cambium [Graham 1963, p 180; Kulman 1971]. Growth increment measurements taken only at "breast height," as is commonly done, therefore underestimate the impact of defoliation and fail to distinguish the effects of growth patterns on ring width [Kulman 1971].

An additional complication is introduced by the fact that the degree of defoliation is not uniform within the crown. The highest concentrations of budworm larvae, and of defoliation, occur in the upper crown [Williams 1967]. This is the area containing the highest proportion of young foliage, which is preferred by the insects [Silver 1962]. The pattern as well as the amount of radial growth thus may be changed with defoliation [Williams 1967].

Use of ring width measurements to quantify radial growth losses requires separation of these growth pattern effects from other components of variation. Methods have been developed to do so, using measurements taken at several heights along the bole [Graham 1963, pp. 176-181; Kulman 1971]. These methods have been applied by Williams [1967] in his comparison of western spruce budworm impacts on various host trees.

The points to be examined are determined by the years of the insect outbreak, in order to select internodes which were young at the time [Williams 1967]. These dates may be difficult to derive from survey records [Johnson and Denton 1975], and the dating of the rings can be obscured if severe defoliation has caused missing or incomplete rings [Kozlowski and Keller 1966; Graham 1963; Kulman 1971].

Distinguishing the effects of budworm attack from other environmental influences on growth requires comparisons with non-defoliated trees. The selection of such check populations is another difficult problem. Kulman [1971] discusses four possible

solutions. Growth rates of damage-free, non-host trees growing in mixed stands along with host trees can be measured. The host and non-host individuals are exposed to the same environment, but intrinsic growth patterns and levels of response to environmental conditions may well vary among species. The use of members of the host species which have somehow escaped defoliation is only a partial improvement. Without knowing the basis of their escape, it is risky to assume that degree of defoliation is the only significant difference between such individuals and the rest of the population. Both of these cases are further complicated by the possibility that reduced competition from their defoliated neighbors might permit improved growth of the non-defoliated trees. Comparison of pre- and post-defoliation measurements of the same trees eliminates physiological sources of variation, but introduces others, since weather fluctuates from year to year. Probably the most scientifically valid checks would be provided by using chemical or microbiological insecticides to protect randomly selected host trees from defoliation. Similar considerations apply to the selection of check plots to distinguish normal from budworm-caused mortality.

Heavy budworm feeding in the upper crown can retard height growth, or terminate it by killing the leader, i.e. the point of vertical growth [Silver 1960; Johnson and Denton 1975]. In young trees, height growth may be resumed by a nearby branch tip, which turns upward. The deformation which may result can make

the top portion of the tree unusable as timber [Johnson and Denton 1975; Sutton 1977], further reducing the yield of infested stands.

The severity of the impact of defoliation on radial growth and the incidence of mortality increase with successive seasons of severe defoliation [Johnson and Denton 1975]. Trees require several years after an outbreak subsides to reestablish their full foliage complement and resume normal growth rates [Silver 1960; Silver 1962; Sutton 1977; U.S. Dept. of Agric.-Forest Service 1977a]. The Pacific Northwest Region of the U.S. Forest Service has developed a model relating percent reduction in radial growth to infestation and recovery years for Douglas-fir, true firs and Engelmann spruce in north-central Washington. Growth loss was expected to increase from 2% in the first year of defoliation to 71% in the eighth year. Growth rates were expected to improve gradually following a natural collapse of the budworm population, reaching normal levels in the sixth year after defoliation ceased. The same study also presented estimates of mortality and topkill for two areas surveyed in the second year of budworm outbreak. Mature tree mortality represented 0.22% of the total volume of host species in the Wenatchee area and 0.44% in the Okanogan area. Topkill was reported in 12.9% and 5.8% of trees of all species in the Wenatchee and Okanogan areas respectively [U.S. Dept. of Agric.-Forest Service 1977a]. The pooling of values for the various host species made it difficult to apply the model to

forests elsewhere.

Quantitative studies of budworm impacts in British Columbia forests were begun in 1970 [Alfaro et al. 1982] but even preliminary results were not published until late in 1977 [Shepherd et al. 1977].

Understory trees are more severely affected than are the dominant trees above them. Their budworm populations tend to be greater because larvae dislodged from taller trees land in their crowns. Young trees have a greater proportion of current season needles, leading to a greater degree of defoliation than that experienced by the more mature trees. Finally, photosynthesis in understory trees is normally limited by their shaded and relatively small foliage complements. They thus have smaller carbohydrate reserves and lower levels of growth hormones. Suppressed trees also undergo greater water stress than do their dominant neighbors. Understory trees are therefore less able to withstand the further stresses caused by defoliation [Kozlowski and Keller 1966; Johnson and Denton 1975]. More than 4.5% of existing understory stands were found to be destroyed in the second year of a budworm outbreak in north-central Washington [U.S. Dept. of Agric.-Forest Service 1977a]. The authors of this study expected an additional 1.3-1.4% of understory stands to perish during each succeeding year of unchecked infestation. In stands where natural regeneration is expected to provide restocking, high mortality of understory trees produces particularly serious management problems [U.S. Dept. of

Agric.-Forest Service 1978].

Budworm infestations may cause reduced seed production, either directly by feeding on flowers and cones, or indirectly, by the physiological effects of defoliation. Reduced seed production also presents restocking problems, by decreasing both natural regeneration and seed harvest to be used in nursery production of seedlings for reforestation [Dewey 1970; Fellin 1976; Johnson and Denton 1975].

Stress induced by defoliation may predispose trees to attack by bark beetles [Graham 1963, p. 159]. These insects, unlike the budworms, frequently kill trees outright. Outbreaks of the Douglas-fir beetle, Dendroctonus pseudotsugae Hopk., have occasionally been reported in stands heavily damaged by western spruce budworm [Johnson and Denton 1975; McKnight 1968]. The causal connection does not appear to have been rigourously tested [McKnight 1968].

The undergrowth beneath defoliated stands quickly becomes desiccated in hot, dry weather. The resulting fire hazard is increased even further by dead needles left in the canopy by the insects. Any fires which occur are then more likely to "crown", i.e. move rapidly from treetop to treetop [Graham 1963, p. 11]. Johnson and Denton [1975] reported that fuel buildup was regarded as dangerous in some but not all budworm-infested stands surveyed in the Salmon and Challis U.S. National Forests in 1964 and 1965. Salvage cutting of budworm damaged stands should make use of techniques designed to minimize fuel buildup

[U.S. Dept. of Agric.-Forest Service 1977a]. The presence of budworm outbreaks may call for intensified fire management programs in some areas.

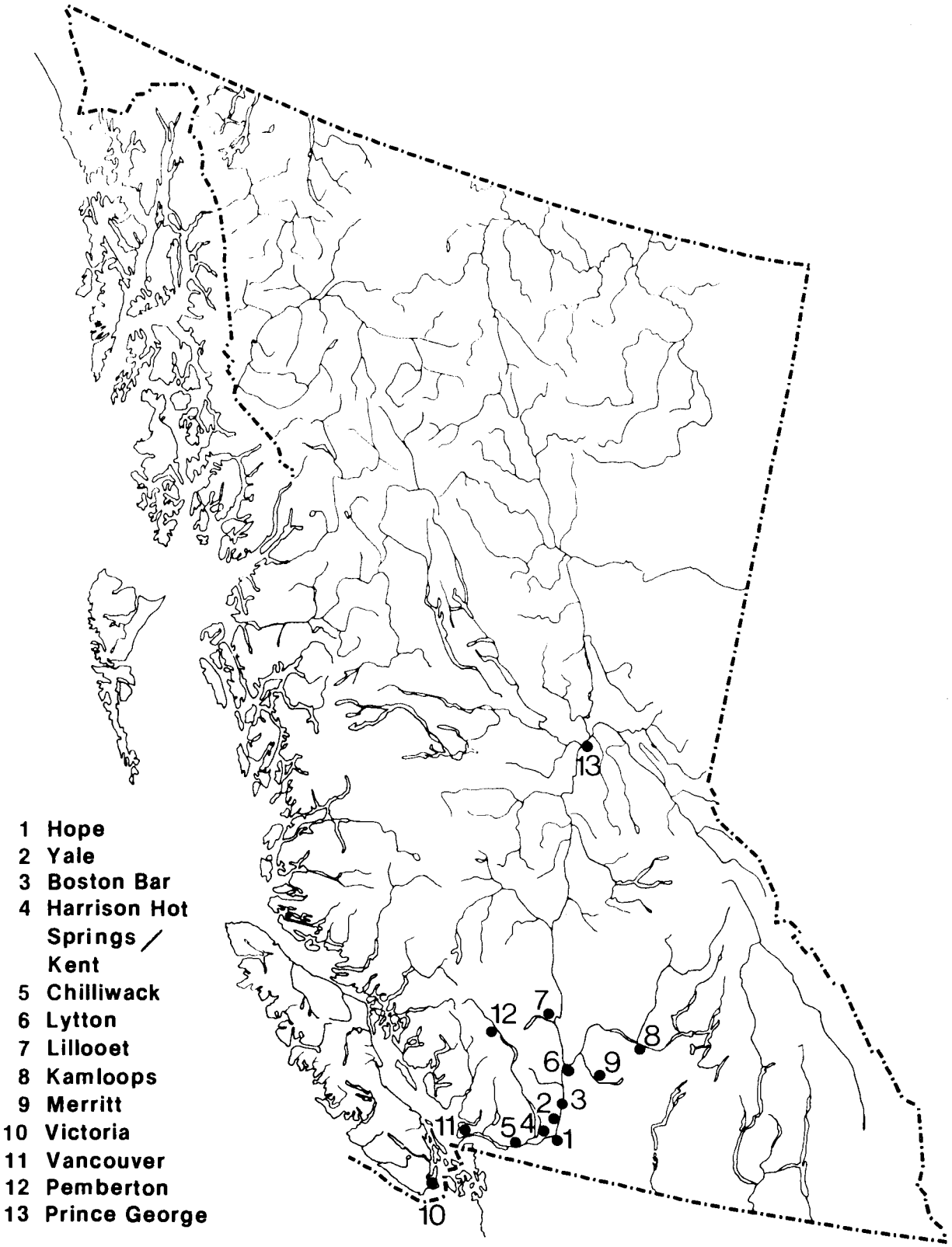
The difficulty faced by the resource manager is illustrated by this review of the information regarding western spruce budworm which was available in 1977. Even if the data collected from different locations, times and situations could have been combined, the resulting picture would have been inadequate for deriving a quantitative assessment of the impact of the insect on the forest resource.

B. The Place

The Fraser Canyon Area, as defined by the B.C. Ministry of Economic Development [1978] (Fig. 2), had a population of 7,162 in 1976. Logging is a widespread and economically important activity, and employed about 280 people in the Fraser Canyon area at that time

The major companies active in the area were B.C. Forest Products Ltd., Whonnock Lumber Division of Whonnock Industries Ltd., and Cattermole Timber Ltd. Very few small independent logging companies were still in business. Changes in the Forest Act in the 1950s had seriously hampered the ability of small operators to obtain cutting permits. Former independents now worked as contractors for the big companies, building roads and logging the less productive tracts.[3] Production in 1976

Fig. 2. Map of British Columbia indicating place-names mentioned in the text. The Fraser Canyon Area includes the region between the western corner of Manning Park, Hope and Lytton.


1 Hope
2 Yale
3 Boston Bar
4 Harrison Hot Springs / Kent
5 Chilliwack
6 Lytton
7 Lillooet
8 Kamloops
9 Merritt
10 Victoria
11 Vancouver
12 Pemberton
13 Prince George

totalled 24,610 thousand cubic feet [8,690 m^3]; two-thirds of this was processed at mills downstream [B.C. Ministry of Economic Development 1978].

The towns which figured prominently in the budworm spray affair were Hope, Yale and Boston Bar. These three communities are quite distinct in character, although they all include many people who work in some sector of the forest industry. Hope, with a population of 2,963 in 1976 [B.C. Ministry of Economic Development 1978], is located at the junction of Highways 1,3 and 7, in the path of all road and rail traffic between the Coast (Vancouver, Victoria and the lower Fraser Valley) and the Interior of the province. The restaurants, gift shops, gas stations, and motels that ring Hope and line its main street demonstrate the importance of highway travellers to its economy. Hope is also the local commercial and service centre, with medical clinics, a hospital, RCMP post, banks, movie theatre, radio station (CKGO) and newspaper (the Standard).

Boston Bar, originally set up by the Canadian National Railway to house its workers, is now a mill town. Its B.C. Forest Products sawmill is the largest single employer in the Fraser Canyon area, with jobs for about 225 workers when operating at full capacity [B.C. Ministry of Economic Development 1978].

Yale was once the upper limit of navigation on the Fraser River, and was thus the starting point for overland journeys to the gold fields of the late 1850s [B.C. Ministry of Provincial

Secretary and Government Services 1980]. It is now mainly visible as a highway stop, with gas station, restaurants and motels, but the Yale and District Historical Society proclaims the village to be the "Birthplace of B.C." because it contains the province's first church and courthouse [Yale and District Historical Society n.d.]. In addition to the Historical Society, the small community (population 224 in 1974 [B.C. Ministry of Provincial Secretary and Government Services 1980]) has its own school and water system.(4)

The Fraser Canyon area is part of the Fraser-Cheam Regional District. The Regional Board, which has its headquarters in Chilliwack, functions as the local government. Members of the Board represent the towns of Hope, Harrison Hot Springs, Kent and Chilliwack, as well as the six electoral districts into which areas outside the chartered municipalities are divided.

Most of the land in the Fraser Canyon area which is outside the actual communities is publicly owned Crown forest land. As such, it falls under the jurisdiction of the Ministry of Forests. The Regional Board does not have the authority to override Ministry of Forests management decisions affecting this land.(4)

C. The People

The Government Agencies

The decision to attempt control of the spruce budworm infestation was taken by the Protection Division of the B.C. Forest Service, in consultation with the Canadian Forestry Service. The consent of other government agencies, responsible for environmental and public health matters, was obtained; Table 1 lists these agencies, along with brief descriptions of the mandates which determined their involvement.

More than 90% of the forest land in B.C. is Crown owned [B.C. Ministry of Prov. Sec. and Travel Industry 1978]. The B.C. Ministry of Forests, through the Forest Service, was responsible for administering forestry activity on this land. Publication of the report of the Royal Commission on Forest Tenures [Pearse 1976] marked the latest stage in the development of overall forest policy. This report was a full-scale investigation of harvesting rights granted to forest companies on crown land and the fees and management obligations incurred in return. The contents of the report were to be used in the writing of a new Forest Act. This process was in its early stages at the time that the budworm control program was being planned.

Table 1. Objectives of government agencies represented on the Interministerial Pesticide and/or Forest Pest Review Committees [B.C. Ministry of the Provincial Secretary and Travel Industry 1978; Canadian Forestry Service 1978; Fisheries and Environment Canada 1978].

AGENCY	OBJECTIVES
B.C. Ministry of Forests	To develop and enforce policies which will ensure for all time the proper balance of timber supply, forage production, forest recreation, wildlife protection, and environmental preservation of the Crown forest lands of the province
B.C. Ministry of Forests, Protection Division	In addition to forest fire management, to develop and administer policies aimed at minimizing the detrimental effects of forest insects and diseases
B.C. Ministry of Recreation and Conservation, Department of Conservation, Fish and Wildlife Branch	To maintain, protect, and enhance fish and wildlife resources for the sustained benefit of the people of B.C. The basic objectives of the Branch are: 1) To maintain diversity and abundance of fish and wildlife resources within the province 2) To protect all fish, wildlife, including rare and endangered species, and their habitat from all forms of abusive and destructive practices 3) To enhance the fish and wildlife resources through habitat improvement and the encouragement of sound land use practices 4) To manage these resources for the provision of diverse public recreat-tional opportunities of high quality and for the economic use of some species
B.C. Ministry of Recreation and Conservation, Department of Conservation, Water Investigations Branch	To administer programs directed towards preservation of the water resource in areas where degradation potential is considered to be significant

Table 1. continued

AGENCY	OBJECTIVES
B.C. Ministry of Recreation and Conservation, Department of Recreation, Parks Branch	To manage and administer Parks and Recreation Areas, including dry land and water, the atmosphere above them, the flora and fauna upon and within them, and all their subsurface components
B.C. Ministry of Agriculture, Field Crops Branch	To assist and advise B.C. farmers on the most sound method of modern farm operation
B.C. Ministry of Environment, Pesticide Control Branch	To ensure that the sale and use of pesticides are carried out in a knowedgeable and responsible manner, and that where decisions are made to use pesticides that adequate consideration is given to public health and environmental concerns
B.C. Ministry of Health, Public Health Programs Branch	Each of the Province's 17 health units is a modern health department staffed by full-time public-health-trained personnel serving one or more population centres and their adjacent rural areas
B.C Ministry of Health, Bureau of Special Health Services, Division of Occupational Health	To provide investigative and consultative services for the restoration and conservation of health in relation to work and the working environment
Environment Canada, Canadian Forestry Service	To provide a national overview on forestry matters, carry out forestry research and forest surveys, aid the provinces in improving forest protection, management, and public education regarding forests
Environment Canada, Canadian Forestry Service, Forest Insect and Disease Survey	To monitor the general pattern of occurrence of forest pests in each province

Table 1. continued

AGENCY	OBJECTIVES
Environment Canada, Environmental Protection Service	To implement integrated environmental protection programs and to serve as a focal point with other government departments, the Provincial Government and industry on matters dealing with environmental protection
Environment Canada, Environmental Protection Service Aquatic Programs and Contaminants Control Group	To prevent pollution of Canadian waters inhabited by fish

The objectives of B.C. Forest Service (Table 1) clearly included the concept of multiple-use of forest land; timber supply is only one of the forest attributes to be preserved. This concept implied that the management of these lands was not solely the responsibility of the Ministry of Forests. Accordingly, the Forest Pest Review Committee was set up to broaden the input into pest management decisions. In 1976 the Committee was a group of technical experts (Table 2) drawn from the B.C. Forest Service and from other interested government agencies, such as Health, Recreation and Conservation, and Environment. The Council of Forest Industries of B.C. and the Interior Lumber Manufacturer's Association were also represented. The meetings were open to other selected technical personnel, who attended on a more casual basis.

The objectives of the Forest Pest Review Committee, adopted in September 1976, included: discussion of the current status of forest pests and of management options, initiation of control activities, lobbying for pest management funds, and assistance with public information programs.[5] When the Committee considered a particular infestation to be reaching a critical level, a task force or subcommittee was appointed to investigate the situtation and report back to the full Committee.

The Canadian Forestry Service was was one of the primary information sources for the Forest Pest Review Committee. This agency of the federal government is charged with providing a national overview on forestry matters, carrying out forestry

Table 2. Membership of the B.C. Forest Pest Review Committee in 1976.

Position	Name	Affiliation
Chairman	Mr. D.H. Owen	Forester In Charge Protection Division B.C. Forest Service
Secretary	Mr. J.M. Finnis	Forester In Charge, Forest Pest Management Protection Division B.C. Forest Service
Members	Mr. R.L. Morley	Biologist Habitat Protection Fish and Wildlife Branch B.C. Ministry of Recreation and Conservation
	Dr. P. Warrington	Biologist Environmental Studies Division Water Investigations Branch B.C. Ministry of Environment
	Mr. D. Ross	Planning Officer Parks Branch B.C. Ministry of Recreation and Conservation
	Mr. R. Kussat	Manager Aquatic Programs and Contaminants Control Group Environmental Protection Service Environment Canada
	Dr. L.J. Kornder	Director Division of Occupational Health B.C. Ministry of Health
	Mr. D. McCloud	B.C. Council of Forest Industries
	Mr. S. Tolnai	Interior Lumber Manufacturers Association

research and forest surveys, aiding the provinces in improving forest protection and management, and public education regarding forests [Environment Canada, Canadian Forestry Service 1978]. The Forest Insect and Disease Survey is a unit of the Canadian Forestry Service which monitors the general pattern of occurence of forest pests in each province. It acts in an advisory capacity, informing the provincial Forest Services of problems noted by its survey teams. Its Western headquarters is at the Pacific Forest Research Centre in Victoria. Thus the provincial Forest Service sets policy and manages the forest resource, while the federal Forestry Service provides information and technical support.

Because insecticides are toxic chemicals, potential side effects of their use are the concern of several government agencies charged with protecting the environment and public health. These mandates are in effect constraints on pesticide programs designed to meet other agencies' objectives, such as mosquito control or forest protection. Fisheries are particularly vulnerable to spraying: chemicals entering streams may kill fish directly or affect them by reducing the numbers of the insects they feed upon.

In 1976 the B.C. Ministry of Environment was formed, combining existing governmental programs concerned with land and water resource allocations and regulation, environmental studies, and pollution control into one administrative unit with its own voice in Cabinet. This reorganization proceeded in

stages over several years. In 1976 and 1977, the Fish and Wildlife Branch was still part of the Ministry of Recreation and Conservation. In April, 1977, the one-year old Pesticide Control Branch was transferred from the Ministry of Agriculture, which has a pesticide-using constituency, to the Ministry of Environment, an agency less likely to be pro-pesticide. At the same time, a new Pesticide Control Act was being written to replace provisions of the Pharmacy Act which had governed pesticide sale and use.

The Interministerial Pesticide Committee existed as a mechanism for coping with possible agency conflicts stemming from overlapping mandates. Prior to proclaimation of the Pesticide Act in 1978, this committee took its authority from Section 6 of the Pharmacy Act [Statutes of B.C. 1974, pp. 349-379]. The Interministerial Pesticide Committee was chaired by the head of the Pesticide Control Branch, with members from the Ministries of Environment, Agriculture, Health, and Recreation and Conservation (Table 3). The federal Environmental Protection Service also sent a representative, who participated in discussions but did not vote. The Interministerial Pesticide Committee was responsible for ensuring that pesticide applications were carried out with due regard for the safety of the project crew, local residents and other members of the public, and with minimal accidental contamination of water or soil. It is interesting to note that the memberships of the Forest Pest Review Committee and

Table 3. Membership of the B.C. Interministerial Pesticide Committee in 1976.

Position	Name	Affiliation
Chairman	Mr. B.F. Vance	Head Pesticide Control Branch B.C. Ministry of Environment
Secretary	Mr. S. Craig	Pesticide Control Officer Pesticide Control Branch B.C. Ministry of Environment
Members	Mr. E.C. Hughes	Assistant Branch Head Field Crops Branch B.C. Ministry of Agriculture
	Ms. P.S. Lim	Biologist Environmental Studies Division Water Investigations Branch B.C. Ministry of Environment
	Dr. L.J. Kornder	Director Division of Occupational Health B.C. Ministry of Health
	Mr. R.L. Morley	Biologist Habitat Protection Fish and Wildlife Branch B.C. Ministry of Recreation and Conservation
	Mr. R.H. Kussat	Manager Aquatic Programs and Contaminants Control Group Environmental Protection Service Environment Canada

Interministerial Pesticide Committee may overlap. In 1977 the same people from the provincial Ministry of Health, the Fish and Wildlife Branch and the federal Environmental Protection Service sat on both committees.

Any large-scale pesticide program required approval by the Interministerial Pesticide Committee, which had the power to impose operational conditions on the program. The request for a permit to spray a particular area specified the amount and type of chemical to be applied. The Committee's reply detailed its requirements as to the facilities for preparing spray mixtures, handling of toxic chemicals, closure of the spray area to public access, leaving of unsprayed buffers along streams and inhabited areas, monitoring of both spray efficacy and impact on non-target organisms, and other operational matters. The proponent agency could raise objections to these conditions; the Committee might discuss these and revise its requirements, but in the end it had the final say. Agreement between the Interministerial Pesticide Committee and the agency planning the pesticide treatment constituted formal approval of the program for implementation.

Other Actors

Discussion of the Fraser Canyon spray program did not remain confined within the government agencies which participated in the formal approval process. Once the plan was known publicly, many individuals became involved. Fig. 3

indicates the links between the most important groups of actors in the controversy which developed; Table 4 lists some of the individuals which represented them.

Fig. 3. Flow diagram illustrating the principal interactions between the various "actors" in the Fraser Canyon spray controversy, 1976-1977.

Abbreviations used:

BCMA	B.C. Medical Association
CFS	Canadian Forestry Service
COFI	Council of Forest Industries of B.C.
IWA	International Woodworkers of America, Local 1-367
SPEC	Society for Pollution and Environmental Control

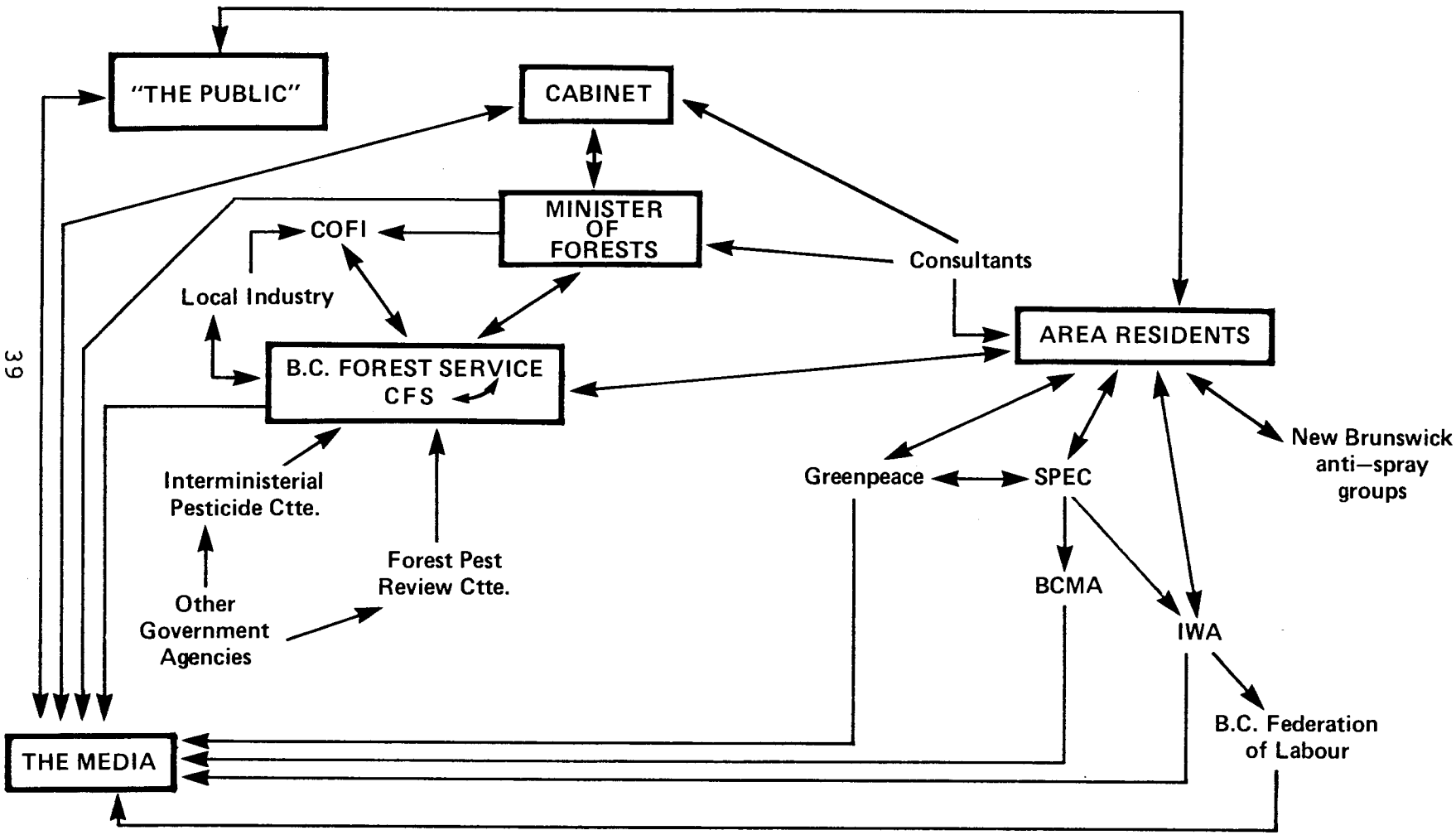

"THE PUBLIC"
CABINET
MINISTER OF FORESTS
COFI
Local Industry
Consultants
AREA RESIDENTS
B.C. FOREST SERVICE CFS
Interministerial Pesticide Ctte.
Forest Pest Review Ctte.
Other Government Agencies
Greenpeace
SPEC
New Brunswick anti–spray groups
BCMA
IWA
B.C. Federation of Labour
THE MEDIA

Table 4. Persons of importance in the Fraser Canyon Spray controversy, 1976-1977. Asterisks denote persons interviewed during the present study.

Name	Position
*Mr. Douglas E. Adderly	Information Officer Information Division B.C Forest Service Victoria, B.C.
Mr. John Bailey	Member Yale Ratepayers Association Yale, B.C.
*Ms. Sharon Baker	Resident Hope, B.C.
Mr. David Barrett	M.L.A., Vancouver East Leader of the Opposition B.C. Legislative Assembly Victoria, B.C.
*Dr. Bryan P. Beirne	Professor of Pest Management Director of Pestology Centre Simon Fraser University Burnaby, B.C.
*Mr. Glen D. Bertram	Ranger, B.C. Forest Service Hope, B.C.
Ms. Sandra C. Bourque	Technical Supervisor of Monitoring Non-Target Organisms Monitoring Program Anderson Budworm Control Block
Mr. John Braddock	Reporter Vancouver Province Vancouver, B.C.
*Mr. Roy H. Corbett	Mayor Hope, B.C.
*Mrs. Susan Davis	Member Yale Budworm Committee Yale, B.C.
*Mr. Thomas Davis	Member Yale Budworm Committee Yale, B.C.

Table 4. continued

Name	Position
*Dr. Robert F. DeBoo	Research Scientist Chemical Control Research Institute Canadian Forestry Service Ottawa, Ontario
Mr. Robert E. Dolph	Forest Insect and Disease Management State and Private Forestry Pacific Northwest Region U.S. Dept. of Agriculture--Forest Service Portland, Oregon
*Mrs. Merriam Doucet	Chairman Pesticide and Chemical Resource Committee SPEC Vancouver, B.C.
Ms. Moira Farrow	Reporter Vancouver Sun Vancouver, B.C.
*Mr. J. Michael Finnis	Forester In Charge, Forest Pest Management Protection Division B.C. Ministry of Forests Victoria, B.C.
Ms. Sharon Gazzola	Secretary Yale Ratepayers Association Member Yale Budworm Committee Yale, B.C.
*Mr. William Gilpin	Whonnock Lumber Division Whonnock Industries Ltd. Hope, B.C.
*Dr. Kenneth Graham	Professor of Forest Entomology Faculty of Forestry University of British Columbia Vancouver, B.C.

Table 4. continued

Name	Position
*Dr. John W.E. Harris	Research Scientist Pacific Forest Research Station Canadian Forestry Service Victoria, B.C.
Dr. Robert M. Heffelfinger	Chairman Environmental and Occupational Health Subcommittee Health Planning Council B.C. Medical Association Vancouver, B.C.
Mr. D.R. Hurn	Assistant Director Development, Management and Habitat Protection, Fish and Wildlife Branch B.C. Ministry of Recreation and Conservation Victoria, B.C
*Mrs. Sophie Kassian	Member Yale Budworm Committee Yale, B.C.
*Mr. Walter Kassian	Vice-Chairman Regional Board Fraser-Cheam Regional District Chilliwack, B.C.
*Dr. Lee J. Kornder	Director Division of Occupational Health Bureau of Special Health Services B.C. Ministry of Health Vancouver, B.C.
*Mr. Richard H. Kussat	Manager Aquatic Programs and Contaminants Control Group Environmental Protection Service Canada Department of Fisheries and Environment North Vancouver, B.C.

Table 4. continued

Name	Position
*Mr. Otto E. Langer	Biologist Aquatic Programs and Contaminants Control Group Environmental Protection Service Canada Department of Fisheries and Environment North Vancouver, B.C.
Ms. Heather Leader	Member Yale Budworm Committee Yale, B.C.
Mr. Hall Leiren	Reporter Vancouver Sun Vancouver, B.C.
Mr. Richard Lemm	Member Yale Budworm Committee Yale, B.C.
*Mr. E. Hugh Lyons	Forester In Charge, Information Division B.C. Ministry of Forests Victoria, B.C.
*Mr. Clive Lytle	Assistant Secretary-Treasurer B.C. Federation of Labour Vancouver, B.C.
Mr. Edward J. McArthur	Project Manager, Budworm Control Project Technical Forest Officer Vancouver Forest District Vancouver, B.C.
*Mr. D. Ross Macdonald	Deputy Director Program Manager, Forest Protection Pacific Forest Research Station Canadian Forestry Service Victoria, B.C.
*Dr. William O.H. McInnes	Director Medical Health Officer Upper Fraser Valley Health Unit B.C. Ministry of Health Chilliwack, B.C.

Table 4. continued

Name	Position
Dr. L.H. McMullen	Research Scientist Pacific Forest Research Centre Canadian Forestry Service Victoria, B.C.
Ms. Andrea Maitland	Reporter Vancouver Sun Vancouver, B.C.
Mr. Alex C. Molnar	Consultant Coordinator Non-Target Organisms Monitoring Program Victoria, B.C.
*Mr. Fred H. Moonen	Vice President - Communications B.C. Council of Forest Industries Victoria, B.C.
*Dr. Patrick A. Moore	President Greenpeace Foundation Vancouver, B.C.
*Mr. Richard L. Morley	Biologist Habitat Protection Fish and Wildlife Branch B.C. Ministry of Recreation and Conservation Victoria, B.C.
Ms. Gloria Morse	Member Yale Budworm Committee Yale, B.C.
*Dr. George S. Nagle	President Nawitka Renewable Resources Ltd. Victoria, B.C.
Hon. James A. Nielson	M.L.A., Richmond Minister of Health Province of B.C. Victoria, B.C.
Dr. Peter C. Oloffs	Professor Biological Sciences Department Simon Fraser University Burnaby, B.C.

Table 4. continued

Name	Position
*Mr. William J. Otway	Executive Director B.C. Wildlife Federation Surrey, B.C.
Mr. Don H. Owen	Forester In Charge Protection Division B.C. Forest Service Victoria, B.C.
*Mr. John Reid	Editor Hope Standard Hope, B.C.
*Mr. Barry Richardson	Cattermole Timber Ltd. Chilliwack, B.C.
*Mr. Hector A. Richmond	Consulting entomologist Nanaimo, B.C.
Mr. Donald J. Robinson	Acting Director Fish and Wildlife Branch B.C. Ministry of Recreation and Conservation Victoria. B.C.
*Mrs. Ann Schudeleit	Resident Boston Bar, B.C.
*Dr. Roy F. Shepherd	Research Scientist Pacific Forest Research Station Canadian Forestry Service Victoria, B.C.
Ms. Suzie Sims	Member Yale Budworm Committee Yale, B.C.
*Mr. Robert E. Skelly	M.L.A., Alberni Environment Critic B.C. Legislative Assembly Victoria, B.C.
*Mr. Peter Slack	Station Manager CKGO Radio (1240 AM) Hope, B.C.

Table 4. continued

Name	Position
*Mr. Robert C. Sutton	Forester In Charge, Planning and Development Protection Division B.C. Ministry of Forests Victoria, B.C.
Mrs. Janet Taylor	Plant Products Division Agriculture Canada Ottawa, Ont.
*Mr. Greg Templeman	Divisional Forester B.C. Forest Products Ltd. Boston Bar, B.C.
Mr. Howard A. Tripp	Head, Forest Insect and Disease Survey Pacific Forest Research Station Canadian Forestry Service Victoria, B.C.
Mr. Bayne F. Vance	Chairman Interministerial Pesticide Committee; Head Pesticide Control Branch B.C. Ministry of Environment Surrey, B.C.
*Dr. G. Alan Van Sickle	Research Scientist Forest Insect and Disease Survey Pacific Forest Research Station Canadian Forestry Service Victoria, B.C.
Mr. E.H. Vernon	Assistant Deputy Minister Department of Conservation B.C. Ministry of Recreation and Conservation Victoria, B.C.
*Mr. Winston Wai	Economic Analyst Special Studies Division B.C. Forest Service Victoria, B.C.

Table 4. continued

Name	Position
*Dr. Pat Warrington	Environmental Studies Division Water Investigations Branch B.C. Ministry of Environment Victoria, B.C.
*Hon. Thomas M. Waterland	M.L.A., Yale-Lillooet Minister of Forests Province of B.C. Victoria, B.C.
Mr. Erik Wood	Financial Secretary Local 1-367 International Woodworkers of America Maple Ridge, B.C.
Mr. Robert S. Wood	Consulting Forester Nanaimo, B.C.
*Mr. Edward L. Young	Chief Forester and Chief Executive Officer B.C. Forest Service Victoria, B.C.
*Mr. William Young	Assistant Chief Forester-Resource Management B.C. Forest Service Victoria, B.C.

D. The Infestation

Development of the Infestation, 1969-1976

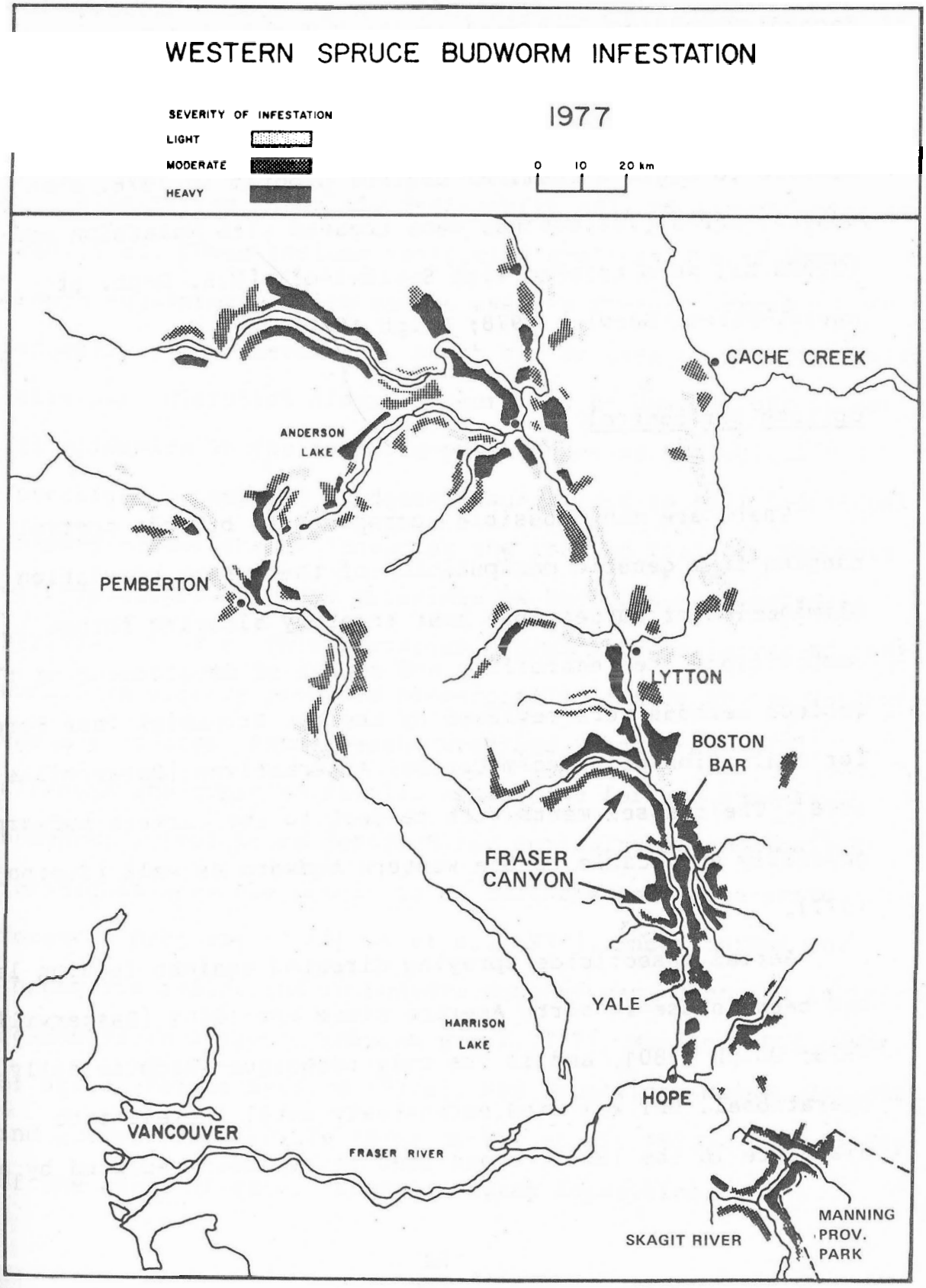
The western spruce budworm infestation in B.C. was first noted in 1969. As in previous outbreaks, attack has been concentrated in the Pemberton-Lillooet and Boston Bar-Lytton regions [Sutton 1977]. The western arm of Manning Park and the Skagit River drainage southeast of Hope have become an additional area of concern.[6][7] The total extent of defoliation increased steadily from 1969 to 1976 (Table 5), causing considerable concern among foresters.[7][8][9] Maps published yearly by the Forest Insect and Disease Survey depicted the widening area of defoliation, which reached extensive proportions by 1977 (Fig. 4).

During the same period, outbreak level western spruce budworm populations were also expanding in the U.S. Infestations in the northern areas of the U.S. Rocky Mountains have fluctuated in extent since the mid-1960s [Bousefield et al. 1974; Tunnock 1977]. Defoliation in north-central Washington expanded from 18,000 acres [7,300 ha] in 1970 [U.S. Dept. of Agric.-Forest Service 1977a] to 532,000 acres [214,900 ha] in 1975 [U.S. Dept. of Agric.-Forest Service 1978] and more than 1,000,000 acres [404,000 ha] in 1977 [U.S. Dept. of

Table 5. Number of budworm infested hectares in the Vancouver and Kamloops Forest Districts, 1969-1976 [Sutton 1977].[10]

	Fraser River Block				
	Vancouver Forest District	Kamloops Forest District	Total	Adams-Shuswap Block	Provincial Total
1969	-	-	160	-	160
1970	4,800	1,600	6,400	-	6,400
1971	11,300	4,400	15,700	-	15,700
1972	21,800	18,200	40,000	-	40,000
1973	54,100	19,000	73,100	-	73,100
1974	78,400	33,900	112,300	650	112,950
1975	81,200	34,300	115,500	3,800	119,300
1976	71,100	83,200	154,300	37,600	191,900

Fig. 4. Map showing the extent of the C. occidentalis infestation in the Fraser Canyon area of B.C., 1977.[11]


WESTERN SPRUCE BUDWORM INFESTATION
SEVERITY OF INFESTATION
LIGHT
MODERATE
HEAVY
1977
0 10 20 km
CACHE CREEK
ANDERSON LAKE
PEMBERTON
LYTTON
BOSTON BAR
FRASER CANYON
YALE
HARRISON LAKE
HOPE
VANCOUVER
FRASER RIVER
SKAGIT RIVER
MANNING PROV. PARK

Agric.-Forest Service 1977a]. The infestation extended as far south as the town of Ellensberg, west to the crest of the Cascade Mountains, and east to the Columbia and Okanogan Rivers [U.S. Dept. of Agric.-Forest Service 1978]. Concern with the continuing spread of the infestation lead the U.S. Forest Service to begin a chemical control program in 1976, when 358,039 acres [144,648 ha] were treated with Malathion and 7,663 [3,096 ha] were treated with Sevin-4-oil [U.S. Dept. of Agric.-Forest Service 1978; Dolph 1980].

Options for control

There are many possible approaches to budworm control, ranging from genetic manipulation of the insect population to elimination of susceptible host trees by altering forest composition. The feasibility and degree of development of the various methods were reviewed by the New Brunswick Task Force for evaluation of Budworm Control Alternatives [Baskerville 1976]. Their assessments with respect to the eastern budworm are generally applicable to the western budworm as well [Sutton 1977].

Aerial insecticide spraying directed against feeding larvae has been in use in North America since the 1940s [Baskerville 1976; Dolph 1980], and is the only technique which is fully operational. DDT was used extensively until it fell into disrepute in the 1960s. Since then it has been replaced by a

variety of other chemicals, notably fenitrothion, phosphamidon and carbaryl [Blais et al. 1975; Hildahl 1975; Howse and Sippel 1975; Johnson and Denton 1975; Miller and Kettela 1975; Baskerville 1976; U.S. Dept. of Agric.-Forest Service 1977a; U.S. Dept. of Agric.-Forest Service 1977b]

Alternative materials destructive only to insects have been identified. These include artificial applications of insect growth regulators, which can be used to disrupt normal maturation, and pheromones, which can be used to disrupt mating behaviour. Microbial disease agents can be used either to set off epidemics in the insect population or as biological insecticides, applied at dosages sufficient to kill individual insects contacting or consuming the treated foliage. The most well-developed of these materials is Bacillus thuringiensis Berliner, or B.t. This bacterium, which infects larvae of many moths, is already produced commercially, and is in use against a variety of crop pests [Weatherston and Retnakaran 1975]. Although the organism is also registered for use against budworm, formulations designed for agricultural application techniques have not proven to be suitable for large-scale forestry programs [Thompson et al. 1977]. Inconsistent and inadequate reductions in budworm numbers were reported in trials conducted in Oregon [Thompson et al.1977], Montana [U.S. Dept. of Agric.-Forest Service 1977a], New Brunswick, Maine, Ontario and Quebec [Baskerville 1976; Morris et al. 1975]. Instability of the spray mixture, irregular spray deposition, and

inactivation by sunlight of the bacterial spores were among the problems encountered. B.t. is more limited than are chemical insecticides with respect to the range of budworm densities and life cycle stages over which treatment is effective. B.t. is also considerably more costly than are the available chemicals [Blais 1976]. Efforts to improve the performance of B.t. continue, but the bacterium is not yet an adequate replacement for conventional insecticides in budworm control. [Sutton 1977].

Although more biologically sophisticated and environmentally acceptable methods may well be developed in the future, there are only two currently available options: spray or do nothing [Baskerville 1976]. Choosing between them is not a simple matter. The preceding discussion of budworm biology and impact demonstrates that the consequences of taking no action are difficult to evaluate quantitatively. Neither the future course of the infestation nor the timber growth loss it will cause can be predicted with certainty.

The consequences of spraying are not completely apparent either. An insecticide program can readily be shown to be effective in killing budworm larvae, but this does not necessarily mean that it is effective in controlling an outbreak. Populations of forest defoliators often decline precipitously in the absence of treatment [Prebble 1975]. Examples of this behaviour reported in the literature include: the green-striped forest looper, Melanolophia imitator Walker, the phantom hemlock looper, Nepytia phantasmaria Stkr., the

saddle backed looper, Ectropis crepuscularis Schiff., the western false hemlock looper, Nepytia freemani Munroe, the western hemlock looper, Lambdina fiscellaria lugubrosa Hulst. [Prebble 1975]; the western blackheaded budworm, Acleris gloverana Wlshm. [Carrow 1974; Prebble 1975]; and the Douglas-fir tussock moth, Orgyia pseudotsugata, [Wright 1977; Canadian Forestry Service 1980]. A spray program which happens to coincide with such a natural decline may then be erroneously credited with producing it [Prebble 1975].

Insecticide treatment might adversely affect populations of the budworm's natural enemies, particularly parasitic insects. In agricultural systems, notably cotton, rapid recovery in numbers of pest insects after insecticide treatments have been halted has been attributed to disruption of predator and parasite populations [Bartlett 1964; van den Bosch et al. 1971; DeBach 1974]. Several forest entomologists have expressed concern regarding the possibility of such resurgence by forest pests [Graham 1963, p. 248; Williams et al. 1969; Turnock et al. 1976]. Vite [1971] reported a correlation between efficacy of insecticide control of the Southern pine beetle, Dendroctonus frontalis Zimmerman, and the severity and extent of subsequent outbreaks in Texas. Williams et al. [1969] have demonstrated changed rates of parasitism in western spruce budworm populations in sprayed plots in Montana. Some parasite species increased, whereas others declined; the results differed between Zectran and Naled, the two insecticides tested. The risk

associated with possible effects of spraying on parasite populations is difficult to assess, since the contribution of parasites to natural outbreak decline has not been ascertained.

Yet another concern is the creation of a new pest problem by the attempt to solve the original one. Sudden and very damaging increases in populations of the spruce spider mite, Oligonychus ununguis Jacobi, occurred in 1957, following DDT treatment of western spruce budworm infested forests in Idaho and Montana. This outbreak was attributed to high mortality of the predators of the DDT-resistant spider mite [Johnson 1958; Johnson and Denton 1975].

In recent years considerable effort has been directed to investigating the impact of insecticide programs on non-target organisms. Although field trials and laboratory toxicity tests on birds and fish are required for insecticide registration, extrapolation from such work is made difficult by the variety and complexity of forest ecosystems. Some degree of uncertainty must inevitably remain.

Even if one were to exclude political and sociological factors, a considerable exercise of judgement would be required to make a control decision in the face of these uncertainties regarding the efficacy, safety and necessity of a spray program.

E. The Role of Pressure Groups in Decision-Making

Cancellation of the spray program was a remarkable achievement in terms of the resources of the small group of local residents which originally opposed it. The Budworm Committee of the Yale Ratepayers Association was an organization "whose members act[ed] together to influence public policy in order to promote their common interest [Pross 1975]," i.e. a "pressure group." Pross [1975], who has written extensively about pressure groups in Canadian politics, describes such groups in terms of the degree to which they have become institutionalized into long-lived, highly structured organizations with broadly defined goals and considerable financial resources. The Council of Forest Industries of B.C.(COFI), a lobbying organization which promotes the interests of timber producers to buyers, government, and the public at large, is a classic example of the fully institutionalized pressure group. It has a staff of more than 130, as well as supervisory committees made up of representatives from member companies. COFI has a close working relationship with government, particularly with the Ministry of Forests and with the provincial legislature, where it maintains a full-time observer [B.C. Council of Forest Industries 1976].

The Yale Budworm Committee fit into Pross' least institutionalized category, the "single interest group" of unpaid volunteers pursuing one narrowly defined goal. The

interactions of such groups with government representatives typically take the form of confrontations. They have nothing to offer, no base of power from which to negotiate. They can only threaten to create bad publicity. The Yale residents were true to type.

Non-institutionalized pressure groups lack access to decision-making. Presthus [1973, 1974] conducted a major field study based on what he calls the "elite accomodation" model of political structure. According to this model, government works by communication, negotiation and compromise among the members of three elite groups: politicians (MP's or MLA's and, especially, cabinet ministers), senior bureaucrats, and the leaders of "interest groups." (Presthus uses the term "interest group" to avoid the pejorative connotations of Pross' [1975] "pressure group.") Presthus' extensive survey of members of these elites in Ottawa, Ontario, Quebec and British Columbia was designed to test the applicability of this model to Canadian government. The importance of this work herein lies in its demonstration of the closed nature of Canadian decision making.

The function of Presthus' interest groups is to "refine and synthesize the claims of vast numbers of individuals for presentation to government," providing both technical and political information for government to use in deciding how to allocate society's resources. The interest groups whose directors make up Presthus' third elite are highly institutionalized ones, but even so, their effectiveness in

influencing decisions varies according to how well integrated their leaders are with the other two elites. In essence, Presthus is documenting the importance of the "old boys club" in directing Canadian affairs. He emphasizes "the conclusion of the vast majority of senior civil servants that it is very difficult for unorganized groups and those not directly affected by an ongoing issue to gain access into the decision-making process" [Presthus 1973, p. 205]. The B.C. Forest Service style of decision making, in which other agencies, such as the Fish and Wildlife Branch, had to be included, but the general public, even Fraser Canyon residents, did not, was completely typical of Canadian government.

Hartle [1976], an economist who has analyzed the negotiations involved in allocating the Federal expenditure budget each year, describes the interactions among members of Presthus' elites as a series of "games," in which each player strives to maximize "subjective net worth," a function of present and future wealth, status, influence and self-esteem. "The players within each of the political and bureaucratic games are interdependent" [Hartle 1976, p. 76], as are the games themselves, and continuation of the games is in the interests of all the individuals who have managed to enter and succeed in them.

Ad hoc grass roots organizations like the Yale Budworm Committee are not regular players in any game. How then could they affect the outcome?

The only game really open to outsiders is the media game: journalists need news, and grass roots groups can make news by organizing public protests. Because governments are eventually accountable to the electorate, they are sensitive to bad publicity. From the standpoint of the outsider, success in the media game is participation in the political game.

While the games metaphor is useful, it presumes a very cynical view of human motivation. To those engaged in it, the conflict over the Fraser Canyon spray program was not just a playing out of positions, but the expression of an underlying conflict about the nature of the public good. Nevertheless, the Yale Budworm Committee's exclusion from everyday decision-making processes limited the strategies available to them: they could only attempt to obtain the support of members of the elites and carry out activities designed to attract media attention. The narrative which follows describes the Budworm Committee's application of these strategies.

III. THE EVENTS

A chronology of the events that transpired from spring of 1976 through late fall of 1977 is given in Appendix A.

A. The B.C. Forest Service Decides to Spray

A western spruce budworm infestation was first noted in the Fraser Canyon in 1970 at Tsileuh Creek, which drains into the west side of the Fraser River close to Hell's Gate.[8][12] Over the next few years, ranger staff of the Hope office of the Forest Service, Vancouver District, and field personnel of B.C. Forest Products Ltd. in the area watched the spread of defoliation.[7] By 1976, 223,000 acres [71,000 ha] of the Fraser River drainage were infested [Sutton 1977]; both industry and B.C. Forest Service personnel were concerned, because there was no sign of the decline they had expected to see by this time.[7][8] But when Mr. Glen D. Bertram, the B.C. Forest Service's Forest Ranger for Hope, suggested the possibility of a control program that summer, he was told by the Victoria head office of the Protection Branch that they were already planning to spray for Douglas-fir tussock moth, and did not have the resources to do both.[13]

The federal Forestry Service (Canadian Forestry Service), through its Forest Insect and Disease Survey, was also keeping

track of the expanding spruce budworm infestation. On September 10, 1976, the forest protection experts at the Canadian Forestry Service's Pacific Forest Research Centre met to discuss control options. Their evaluation of the situation emphasized the danger of secondary infestation of stands weakened by budworm. The scientists were concerned about the "risk of Douglas-fir beetle spreading to adjacent areas and continuing indefinitely,"[14] building up to populations which threatened to kill healthy trees as well as defoliated ones. Accordingly, if the Douglas-fir beetle was found coincident with much of the spruce budworm infestation, the Canadian Forestry Service group advised chemical control of budworm to allow the trees to recover enough to resist attack by the beetle. Their conclusions "given no Douglas-fir beetle" were ambiguous. They felt that damage had "never been serious enough to warrant cost" of treatment; but, noting that the U.S. Forest Service was "not prepared to accept top loss or volume reduction," they wanted to know if the B.C. Forest Service was willing to accept such losses.[14]

This discussion was reported by Mr. Howard Tripp of the Canadian Forestry Service to the next meeting of the Forest Pest Review Committee, which moved to strike a task force (Table 6) to study the spruce budworm problem.[5]

All the task force members favoured harvesting severely damaged mature stands wherever economically feasible. For other stands, they devised a series of four control options ranging from no action through chemical treatment of individual stands

Table 6. Members of the Spruce Budworm Task Force struck by the Forest Pest Review Committee of B.C. in September, 1976.[15]

Name	Affiliation
Dr. Roy F. Shepherd, Chairman	Canadian Forestry Service Victoria, B.C.
Mr. Howard A. Tripp	Canadian Forestry Service Victoria, B.C.
Mr. Vern Craig	B.C. Forest Service Kamloops, B.C.
Mr. J. Michael Finnis	B.C. Forest Service Protection Division Victoria, B.C.
Mr. Edward J. McArthur	B.C. Forest Service Vancouver, B.C.
Mr. Otto E. Langer	Environment Canada Environmental Protection Service West Vancouver, B.C.
Mr. Richard L. Morley	B.C. Ministry of Recreation and Conservation Fish and Wildlife Branch Victoria, B.C.
Mr. Douglas Ross	B.C. Ministry of Recreation and Conservation Parks Branch Victoria, B.C.
Mr. Herb N. Stavens	B.C. Forest Products Ltd. Vancouver, B.C.
Mr. Hans Thur	Evans Products Ltd. Lillooet, B.C.
Mr. I. Steven Tolnai	Weyerhauser Canada Ltd. Kamloops, B.C.

to treatment of a large block. A list of these options was sent on November 1, 1976 to all task force members with a request for written positions to be sent to the Chairman, Dr. Roy F. Shepherd of the Canadian Forestry Service.[16]

The replies received by Dr. Shepherd were illustrative of the points of view of the different groups represented on the task force. The B.C. Forest Service personnel all chose the option of block spraying. The Chief Forester, Mr. Edward L. Young, summed up the Forest Service position as follows: "Spruce budworm is causing unacceptable damage and the Forest Service has a duty to control it... The benefits of a control operation surpass the adverse effects, and the adverse effects of doing nothing could be far worse."[17] In his letter he cited section 123 of the Forest Act [Revised Statutes of B.C. 1960, Chap. 153] as obligating the Forest Service to protect the forests against "the destructive effects of fire, insects, and disease." This letter also revealed the attitude of the B.C. Forest Service towards public involvement in management decisions: "We are also very aware that pesticide use is a controversial matter and none more so than spruce budworm spraying. Therefore, it will be very necessary that we engage in a public information campaign to explain what we are doing and why we are doing it."[17]

The official Canadian Forestry Service position, expressed by Mr. D. Ross Macdonald, Deputy Director of the Pacific Forest Research Centre, and Program Manager of its Forest Protection Group, was that the choice must be made by "the forest

management agency in charge of the resource," i.e. the B.C. Forest Service. If treatment was to be undertaken, the Canadian Forestry Service recommended spraying large blocks "to minimize the risk of reinvasion from adjacent infested stands...[to] reduce the possible necessity to respray in the succeeding year."[18]

Mr. Macdonald's rendering of the Canadian Forestry Service general stand regarding chemical spraying emphasized, (1) that it should be a last resort, (2) "aimed at controlling major pest outbreaks at an early stage in their development," and (3) undertaken where the infestation has a major economic impact and the benefit/cost ratio of spraying is favourable. It is interesting that ultimately the Canadian Forestry Service was to provide substantial material support to the Fraser Canyon project (Appendix B), which was far from meeting the second and third of these conditions.

Representatives of industry likewise chose block spraying. They considered no treatment to be a gamble on an unpredictable collapse of the infestation, and individual stand treatment to be ineffective.[19][20][21] But environmental protection personnel, representing the provincial Fish and Wildlife Branch and the federal Environmental Protection Service, did not feel that spraying was justified. They thought that the history of other western spruce budworm outbreaks indicated that the current infestation was likely to collapse before the whole area could be sprayed.[22][23]

The provincial Parks Branch position reflected that agency's involvement with the concerns of both environmental protection and forest management. They agreed with the Fish and Wildlife Branch expectation of a natural collapse of the budworm population, and would have preferred no treatment within park boundaries, except for those few sites, such as developed campgrounds, whose high value dictated special protection. But Parks Branch would have been willing to re-examine this position "in light of its responsibility to other participating forest land management agencies, should the consensus of this subcommittee be for large scale block treatments."(24)

The task force met on November 18 to discuss its members' positions and produce a series of recommendations for submission to the B.C. Forest Service Protection Branch and to the full Forest Pest Review Committee. The minority opinion against spraying was duly noted, but "the majority of the [sub]committee members recommended undertaking a direct spray program."(25) The key policy features of the recommendations were:

a. block rather than site specific treatment,

b. an objective of spruce budworm population control rather than foliage protection,

c. provision of funds for monitoring effects on non-target organisms,

d. completion of "a full c/b [cost/benefit] analysis to provide justification for funding and accountability to the public,"(25) and

e. preparation of "an information program for local citizens in the spray area and the people of B.C. in general."[25]

Dr. Shepherd presented the report of the Spruce Budworm Task Force to the December 7-8 meeting of the Forest Pest Review Committee, suggesting that "our only management option is to spray to control insect populations."[26] It is interesting that he was so positive about spraying, even though earlier in the same meeting Dr. L.H. McMullen of the Canadian Forestry Service had reported that "stands defoliated by spruce budworm... appear to have little damage from the [Douglas-fir] beetle."[26][27] The original Canadian Forestry Service analysis of the situation had unequivocally supported spruce budworm control only if the Douglas-fir beetle was a significant threat over much of the defoliated area.

The minutes of the December meeting indicate some differences of opinion regarding acceptance of the Task Force's recommendations, which were accordingly rewritten to emphasize the Committee's aversion to annual respraying. The status of the benefit/cost analysis of the project was changed from merely part of the project itself to a condition for recommending spraying:

> Where c/b studies... indicate action is desirable and other resource constraints are satisfied, we recommend that a spray application be considered within a limited area which can be handled efficiently with the available resources.[26]

The minutes record that "the resolution was subsequently

presented with general concurrence in discussion and with unanimous support in a vote by the Committee."[26] (The Fish and Wildlife Branch later expressed strong dissatisfaction with the procedures leading up to this vote.[28]) The Forest Pest Review Committee's resolution proposing a block spray program against spruce budworm in 1977 was passed on to the Chief Forester for approval and implementation.

Since the B.C. Forest Service estimated that it had the capacity to spray about 100,000 acres [40,400 ha] in a given season, a portion of the infestation had to be chosen for treatment. The dispersal ability of the insect made it preferable to treat one large block, rather than several smaller blocks, which would be more subject to reinvasion from surrounding areas. The Budworm Task Force had outlined several selection criteria:

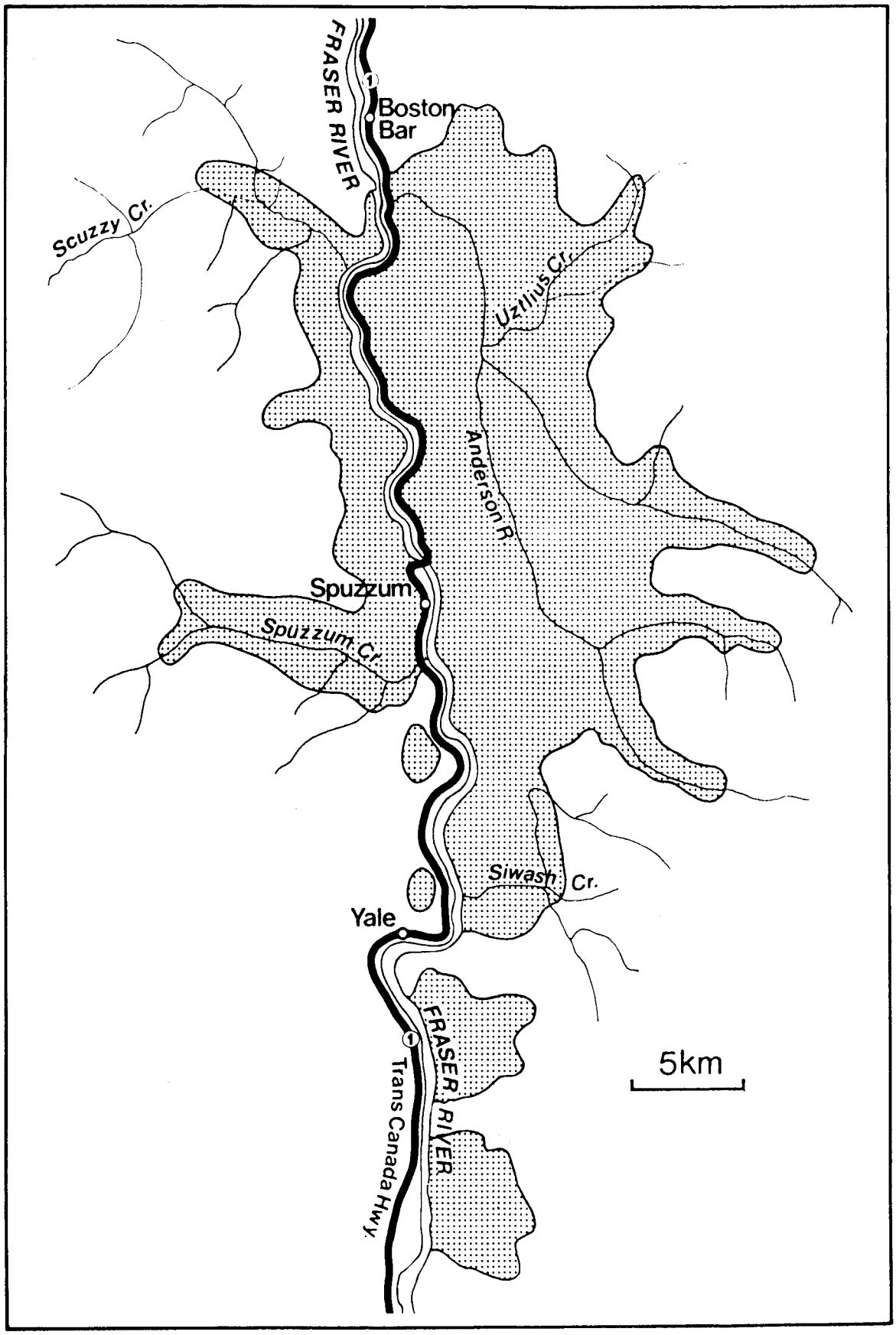
1. Areas with a large current volume of high timber values suffering the most damage
2. a large area of young growth on high [productivity] sites because future values will be affected most in these stands
3. the greatest potential for die-back and mortality to begin within two years
4. the likelihood of stands being sources of dispersing adults with priority given to areas of rapid spread
5. dry sites where selective cutting is practiced and loss of understory trees makes future regeneration difficult
6. recently infested areas where probability of natural population decline may be less than in older infestations
7. environmental sensitivity areas [sic] receiving low priority[25]

The area around the Anderson River, which runs parallel to the Fraser Canyon on its eastern side, and a smaller area west of the Fraser River, were selected for the spray program (Fig. 5). This was primarily a block of Crown Land in the Dewdney Public Sustained Yield Unit,[29] with harvesting rights held largely by B.C. Forest Products Ltd.[7] It was singled out for its high proportion of immature timber, which was just beginning to be seriously damaged by several successive years of heavy defoliation [B.C. Ministry of Forests 1977, pp. 7, 59].[8][9]

Locating an available economist who could quickly produce a benefit/cost study of the proposed spray program was a difficult problem [B.C. Ministry of Forests 1977, p. 60].[26][30] Dr. George S. Nagle, a former Canadian Forestry Service staff economist who had moved into independent consulting as "Nawitka Renewable Resources Consultants Ltd.," was retained at the end of January, 1977. He was asked to estimate and compare costs and benefits of three possible courses of action: a spray program, a salvage cutting operation, and no treatment. The original terms of reference included study of two portions of the infestation, the Anderson River block, which was eventually chosen for treatment, and an alternate area around the Skagit River. It proved to be impossible to consider both blocks in the time available, so Dr. Nagle concentrated his attention on the Anderson Block.

Having relatively little experience with large scale insecticide treatments,[31] the B.C. Forest Service looked for

Fig. 5. Map of Anderson River spray block.[32]


FRASER RIVER
Boston Bar
Scuzzy Cr.
Uzzlius Cr.
Anderson R.
Spuzzum
Spuzzum Cr.
Siwash Cr.
Yale
FRASER RIVER
Trans Canada Hwy.
5km

advice about what chemical to use. In 1976, the U.S. Forest Service had used the insecticide Malathion in an extensive budworm control program in Washington and Oregon. In the same year they also tested four other chemicals in pilot programs in Montana and Washington. Mr. Robert E. Dolph of the U.S. Forest Service office in Portland presented the results of these treatments to the Budworm Task Force on October 28, 1976 (Table 7).[16] The highest budworm mortalities had been achieved with two relatively new materials, Sevin-4-oil[33] and Orthene.[34]

In a letter addressed to Mr. Owen,[35] Mr. Macdonald reviewed the nine insecticides registered for use against eastern spruce budworm, since Zectran, the only material registered in Canada for use against the western budworm, was no longer being produced. The microbial insecticide Bacillus thuringiensis was rejected on grounds of inconsistent results, as were several chemicals. Based on effectiveness and cost, the Canadian Forestry Service concurred with the U.S. Forest Service in recommending Sevin-4-oil, even though it was known to be highly toxic to aquatic organisms and to bees. Because of its lower toxicity to these "non-target organisms" (Table 8), Mr. Macdonald suggested that the more expensive and somewhat less effective Orthene be used instead of Sevin near streams.[35]

Since pesticide registration in Canada is specific to a particular target, temporary use permits for these chemicals would have to be obtained from the Control Products Section of Agriculture Canada, the federal agency responsible for pesticide

Table 7. Results of 1976 budworm control sprays in Washington, Oregon and Montana as presented to the B.C. Forest Pest Review Committee Budworm Task Force [U.S. Dept. of Agric.-Forest Service 1977a].[16][25]

Material*	Application Rate per acre [per ha]	Budworm Mortality %	Residual Budworm Population per 100 buds
Sevin-4-oil	1 lb in 1/2 gal [1.11 kg in 4.67 l]	96	1.1
Orthene	1 lb in 1 gal [1.11 kg in 9.34 l]	89	0.8
Malathion	13 oz [0.91 kg]	85	5.9
Dylox	unknown due to difficulties in application	68	2.5
Combined Untreated Checks**			20.5

*Fenitrothion was also tested, but results were below acceptable levels.
**Malathion operational spray plus Sevin test spray.

Table 8. Characteristics of the insecticides chosen for use in the 1977 western spruce budworm control program [data from Spencer 1973; McEwen and Stephenson 1979; Zinkle et al. 1981; Atkins 1975].

CHARACTERISTIC	SEVIN-4-OIL	ORTHENE
GENERIC NAME	Carbaryl	Acephate
CHEMICAL NAME	1-Napthyl methyl carbamate	O,S-Dimethyl acetylphosphoro-amido thioate
TYPE	Carbamate	Organophosphate
ACUTE TOXICITIES:*		
Rat (Oral LD50)	500 mg/kg	female: 866 mg/kg male: 945 mg/kg
Rabbit (Dermal LD50)	>2000 mg/kg	>2000 mg/kg
Bluegill (96 hr exposure LC50)	13 ppm	2050 ppm
Bees (LD50, micrograms/bee)	1.34	1.20
Birds (Oral LD50)	Mallard: 2170 mg/kg	Dark-eyed junco: 106 mg/kg

*LD50=dosage required to kill 50% of test population
LC50=concentration of pesticide in water required to kill 50% of test population of aquatic organisms

registration.[35] This requirement involved yet another government agency in the approval process for the spray program.

The Vancouver Forest District incorporated Mr. Macdonald's recommendations into its application for a permit to spray the Anderson Block, submitted to the Chairman of the Interministerial Pesticide Committee on February 18, 1977. The original plan called for use of Sevin over most of the treatment area, with Orthene to be substituted near streams. In early March, the B.C. Forest Service decided to treat the whole area with Orthene, in response to a public controversy in Nova Scotia over the environmental safety of Sevin. The permit application included a map of the target area, specified the chemical and spray technique to be used, and outlined the precautions to be taken to minimize aquatic contamination.[36] It was distributed to all committee members for their review.

Since large doses of Orthene or Sevin could definitely be poisonous to humans, precautions were taken to protect staff who would be working directly with the chemicals. The Pesticide Control Branch agreed to provide a training course on safe handling and disposal of the pesticides before spraying was to commence.[37][38] Dr. Peter C. Oloffs, a pesticide toxicologist from Simon Fraser University, developed an employee monitoring program in cooperation with Lee J. Kornder, M.D. and William O.H. McInnes, M.D. of the Provincial Ministry of Health. A nurse-practitioner was hired to carry out the series of blood tests required to detect subclinical effects of pesticide

exposure.[39][40]

The B.C. Forest Service was also in need of help with spraying techniques. The director of the Pacific Forest Research Centre wrote to the acting director of the Canadian Forestry Service's Chemical Control Research Institute in Ottawa on their behalf, requesting assistance in calibrating spray equipment and carrying out the monitoring of spray effects on non-target organisms. The use of helicopters for spraying, necessitated by the mountainous terrain of the Anderson block, was relatively new in 1977; the Chemical Control Research Institute was also asked to give the B.C. Forest Service the benefit of its experience in the difficult problem of predicting spray cloud drift under these conditions.[31] The lack of in-house expertise regarding pesticides and spraying would prove most troublesome when the Fraser Canyon spray program became a matter of public controversy.

The Canadian Forestry Service provided more than advice to the spray program. Dr. Shepherd, whose speciality was the study of defoliating insects, was appointed project coordinator for the Canadian Forestry Service. Dr. John W.E. Harris, also of the Canadian Forestry Service, was to be the entomologist who determined when the spruce budworm had reached the correct stage of development for spraying to begin. He was also assigned responsibility for assessing the impact of the insecticide treatment on both the spruce budworm population itself and on its parasites. Two full time and two part time technicians were

to be seconded from other assignments to help them with the project during the field season.[41][42] Through the winter and spring of 1977 both these scientists devoted much time to consultation with B.C. Forest Service personnel and to planning their own contributions to the spray program.[43] Dr. Shepherd was also involved in the program designed by the B.C. Forest Service to inform the public about the spray operation.

Although the Forest Pest Review Committee had agreed that a favourable benefit/cost ratio for the project was to be a requirement for its final approval, the B.C. Forest Service could not afford to sit back until the economic study had been completed.[13] Existing information on western spruce budworm biology indicated that the larvae would be in the fifth instar, the stage most vulnerable to insecticide treatment, by mid-June. This prediction gave the B.C. Forest Service a scant six months to put together the largest spray program they had ever attempted.

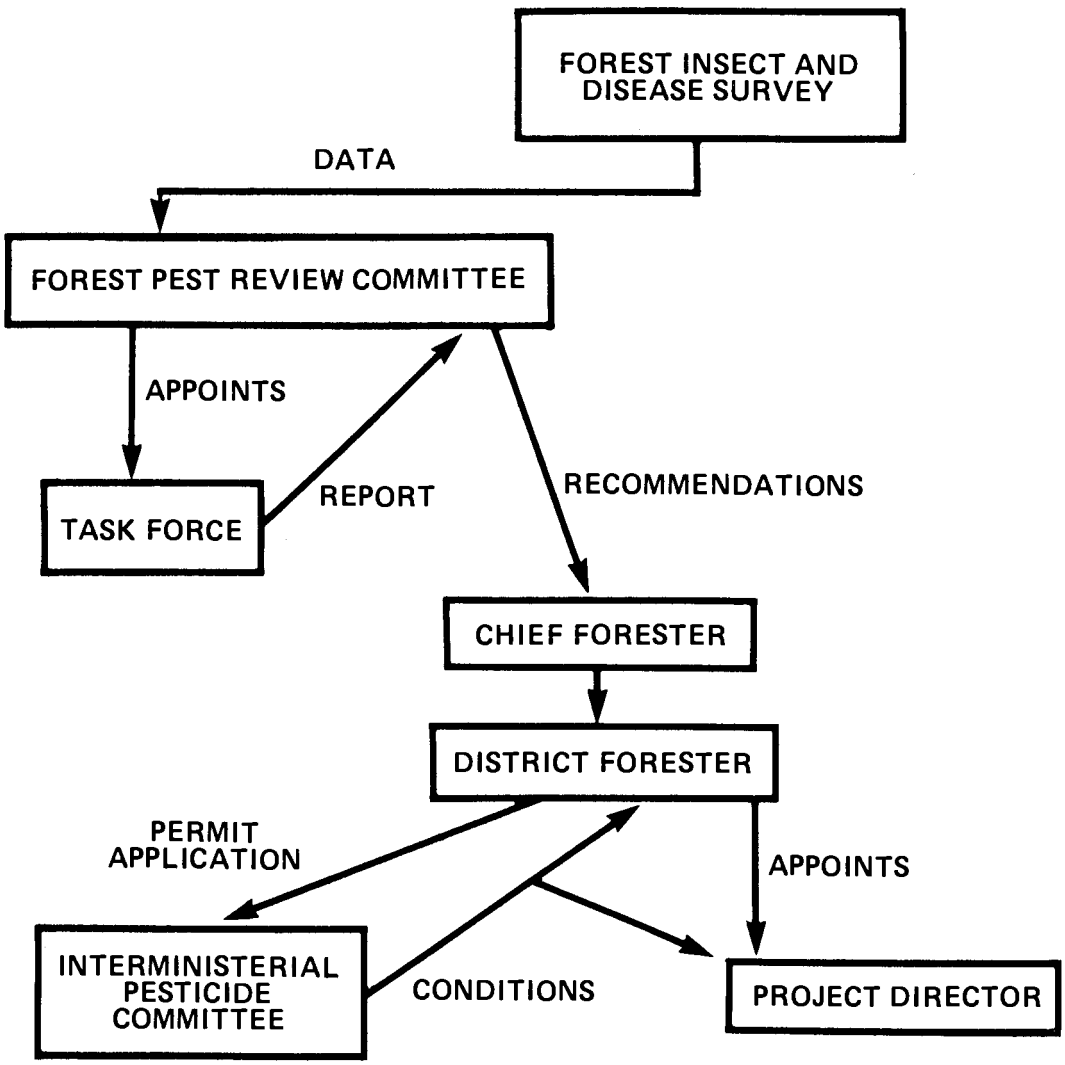
A great deal of work is required to mount such a program. Staffing arrangements must be made and additional personnel hired. On-site facilities for mixing chemicals and loading helicopters must be set up, along with a field camp. The treatment area must be surveyed in detail, to delimit environmentally sensitive areas and set out daily spray blocks. The actual helicopter flying is handled by an outside contractor; this must be arranged in advance, since the non-routine forestry program competes for flying time with

normal agricultural spraying. The large amount of insecticide required must also be ordered well in advance.

Both target and non-target organisms must be monitored, to determine the correct time to apply the spray, and to evaluate its efficacy and environmental effects. The time pressure on this last aspect of the program was particularly acute, since baseline data on the spray area must be assembled before commencement of the insecticide application. Since such work was not part of the routine business of the B.C. Forest Service, these requirements necessitated the hiring of independent consultants and the active participation of other agencies, such as the provincial Fish and Wildlife Branch. In January 1977, Mr. Edward J. McArthur, Technical Forestry Officer - Protection for the Vancouver Forest District, was appointed Project Manager to begin the detailed operational peparations.

By early March, matters seemed to be going well. The decision to attempt control of western spruce budworm had passed most of the steps necessary for approval (Fig. 6), subject to confirmation by calculation of a positive benefit/cost ratio. The spray block had been chosen, helicopter time had been reserved with Okanagan Helicopters Ltd. of Vancouver, and the supporting economic study was underway. The B.C. Forest Service application for a spray permit, the final administrative hurdle for the project, was before the Interministerial Pesticide Committee, while operational planning had already begun.

Fig. 6. Approval process for the Anderson block (Fraser Canyon) aerial spray program, 1976-77.


FOREST INSECT AND DISEASE SURVEY
DATA
FOREST PEST REVIEW COMMITTEE
APPOINTS
TASK FORCE
REPORT
RECOMMENDATIONS
CHIEF FORESTER
DISTRICT FORESTER
PERMIT APPLICATION
APPOINTS
INTERMINISTERIAL PESTICIDE COMMITTEE
CONDITIONS
PROJECT DIRECTOR

B. Informing the Public

Up to this point, the proposed budworm control program had been the subject of much intense discussion, but only within government agencies. The B.C. Forest Service had given no public notice of the venture it was considering, much less solicited opinions about the matter.

The first step towards informing the people of the Fraser Canyon about the project was taken on March 15, 1977. On that date the B.C. Forest Service invited members of the Fraser-Cheam Regional Board to attend a meeting of government technical personnel to be held at the Hope City Hall. The purpose of the meeting was "to acquaint all resource users/managers and involved agencies with operational phases and the sharing of information."[44] Represented at the meeting were the B.C. Forest Service, Parks Branch, and Fish and Wildlife Branch, the Canadian Forestry Service, and the Regional Board. Mr. McArthur, the Project Coordinator, described the infestation and the plans for spraying the Anderson block. The B.C. Forest Service plans for a public information program were presented in detail by Mr. Douglas E. Adderly, of the Information Services Division; these plans included news releases, brochures, press conferences, and sessions at which agency personnel would be available to answer questions.[45]

The plans for monitoring non-target organisms were also discussed, and here the presentation did not go so smoothly.

From the first there had been disagreement between forestry and environmental protection personnel about the desirability of the control project. This disagreement was hardly surprising, since the mandates and the whole philosophies of the two groups were in conflict. In fact, the Forest Pest Review Committee had been set up in order to provide an opportunity for such differences to be aired. After the pro-spray position had prevailed at the December meeting of the Interministerial Pesticide Committee the focus of disagreement shifted to the scope and funding of the non-target organisms monitoring program.[46] The B.C. Fish and Wildlife Branch expected an extensive monitoring program to be conducted at B.C. Forest Service expense.[47] The B.C. Forest Service insisted that, while it accepted the necessity of monitoring and was willing to pay for it, "the funds for this aspect are not unlimited, and monitoring requested by [other] agencies would have to be assessed with this [in mind]."[48]

One of the local officials in attendence at the City Hall meeting was Mr. Walter Kassian, Vice-Chairman of the Regional Board. A long-time resident of Yale, he and his wife Sophie were very active in community affairs. Mr. Kassian had served on the local hospital board, as well as for more than seven years on the Regional Board. He had also been a leader in a long fight to get a sewage treatment plant for the area. He recalled being uneasy at the tone of the March 15 meeting in Hope. "I didn't like what they [the B.C. Forest Service] were saying to the Wildlife people at the Regional resources meeting. It didn't

look right to me that the Forest Service shut them up, wouldn't provide funds for monitoring."[49]

Mr. Kassian kept his impressions to himself at the meeting, but he shared them with his wife when he got home. Mrs. Kassian tended a big vegetable garden as well as several cattle while her husband was working for a local logging contractor. She was the one who had dealt with B.C. Hydro workers putting a transmission line across their property a few years earlier. She had found them arrogant, inclined to do what they liked on her land without asking her leave. So when she heard that government workers would be back, this time from "the Forestry," Mrs. Kassian made up her mind to fight them. "I don't know what Orthene is, but it won't happen here!"[49]

Unbeknownst to the Forest Service, the anti-spray campaign had begun!

C. Dr. Nagle's Benefit/Cost Study

Meanwhile, trouble was brewing in another area. Dr. Nagle submitted his confidential report to the Forest Service on March 10, then boarded a plane for Rome to take up another contract.[30][50] His study had been commissioned to help members of the Forest Pest Review and Interministerial Pesticide Committees to evaluate the proposed budworm control program by telling them whether the insecticide treatment was economically justified. But the report was not written clearly enough for the

foresters and biologists on the committees to feel confident that they understood what they were reading.[51] The economists they turned to for help found its assumptions and methods both questionable and presented with insufficient detail to allow independent verification.[52][53]

The benefit/cost study was based on three fundamental assumptions. The first was that the western spruce budworm was of concern because the defoliation which resulted from its feeding at high population densities caused reduction in quality and quantity of wood produced by attacked Douglas-fir trees. The second was that the proposed insecticide spray program would limit the spread and duration of the insect population outbreak, allowing the trees in the treated area to return to full realization of their growth potential. The third was that the value of the forest lay chiefly in the wood it produced. The benefits of the spray program were thus considered to be the dollar value of the amount of timber which would be gained by applying the insecticide treatment. Three analyses, with appropriate input data, were necessary in order to calculate these expected benefits. Each of these analyses presented theoretical difficulties; the generation of each set of input data (Appendix C) involved further assumptions and extrapolations.

The first analysis was concerned with the insect infestation and its rate of spread. Evaluation of the dispersal ability of the insect and the consequent potential for spread of

the infestation had to be combined with field observation of the 1976 extent of the infestation in order to choose appropriate boundaries for the spray application early in the following summer. The B.C. Forest Service's planned treatment block included a wide perimeter around the infested area. Dr. Nagle considered the possibility that decimation of the budworm population within the treatment block might protect an even wider area of timber, adjacent stands to which the infestation might have spread in the absence of a control program. Accordingly, he produced two sets of benefit/cost ratios. The first was based on the benefits expected from preventing defoliation in the currently infested area, which covered about 50% of the proposed treatment block, while the second set included the benefits of preventing defoliation in an area totalling 125% of the spray block itself, the "threatened area."

The second analysis was a quantitative description of the impact of outbreak level budworm populations on timber production by Douglas-fir. Because this species is remarkably resistant to defoliation, mortality is a relatively minor component of the loss incurred. Dr. Nagle used a figure of 0.33%, calculated for the U.S. Forest Service's Pacific Northwest Region, to estimate a total area of dead timber and volume of standing dead wood for the Anderson Block.

Most of the losses in stands attacked by budworm are due to slowing of the radial and height growth of defoliated trees, so that a choice must be made between waiting additional years

before harvesting to compensate for the loss or accepting a reduced yield at the scheduled harvest. Measurement of this impact required estimation of:

a) the growth potential of stands in the infestation area in the absence of an insect outbreak;

b) the amounts of growth lost with each successive season of severe defoliation;

c) the duration of the infestation in terms of expected years of defoliation;

d) the number of years without defoliation required for stands to recover normal growth rates; and

e) the number of years without defoliation required for the loss to be made up.

Dr. Nagle probably used standard forest inventory practices to compute annual growth increment in the absence of budworm infestation, but the calculations were not described fully in his report. A Mean Annual Increment of 72 ft^3/acre/year [4.98 m^3/ha/year] was mentioned as the average rate of growth for the type of forest found in the Anderson Block, and a graph was presented comparing actual growth patterns with potential yields in the absence of budworm infestations.

The benefits were calculated by comparing growth estimates for stands undergoing a seven-year infestation with those for stands treated in the third or fourth years of infestation. The table presenting these figures was missing when the draft report was submitted to the B.C. Forest Service. Two other tables were

also missing, namely those which showed the comparisons for the entire infested area within the treatment block and for the wider "threatened area," respectively. The omission of these tables made it impossible for readers to understand how Dr. Nagle obtained his figures for the impact of the infestation on radial growth.[53] (The tables were added by Dr. Nagle in August, after his return from Europe.)

Qualitative as well as quantitative losses can occur when immature stands are attacked. Young trees which are severely defoliated sometimes die back at the top, resulting in deformation which may make the trees usable only as pulp rather than as the much more valuable sawlogs. Instead of attempting to assign a dollar value to such quality loss, Dr. Nagle considered top kill as an additional volume loss of timber, which would be prevented by spraying.

The third analysis was required to convert the calculated gain in volume of wood into an evaluation of the economic benefit of controlling the spruce budworm population. Increased yield due to insecticide treatment may be realized as each treated stand comes to maturity and is harvested, or it may be counted as an immediate contribution to an increase in the annual allowable cut allotted for the area by the Forest Service. This annual allowable cut is the regulated amount of logging designed to ensure long-term sustained yield from British Columbia's forests. The validity of the second approach was a matter of considerable debate among foresters and

economists.[29]

The choice between realization of increased wood at harvest or an immediate increase in annual allowable cut is critical to the benefit/cost calculation. The costs of the spray program would be immediate, whereas the benefits would be realized only in the future. Since the value of money decreases with time, the benefits must therefore be adjusted, i.e. discounted, in order to compare them with the costs. The further into the future that benefits are to be realized, the less their present value will be.

Dr. Nagle decided to base his computations on annual allowable cut effects. The setting and distribution of each year's allowable cut is a major, and always problematic, activity of the B.C. Forest Service. Dr. Nagle avoided getting into the details of this; he simply divided the total volume gain expected to result from the insecticide treatment by the number of years in an entire rotation cycle of 92 years, to arrive at a rough estimate of the increase in annual allowable cut. The correct discount rate to be applied to this figure depends on many economic factors which are difficult to measure and predict. Therefore Dr. Nagle followed standard practice by calculating two sets of present value figures based on different discount rates of 6% and 10% respectively.

The most straightforward representation of wood value is stumpage. This is the price per unit volume of lumber paid by the forest companies, which harvest and market the wood, to the

province, which owns the standing timber. Stumpage varies with type and quality of wood. Dr. Nagle cited $12.80/100 ft^3 [$452.10/m^3] as the average stumpage price for the Vancouver Forest District, in which the Anderson Block was located, then reduced this by a 20% "grade adjustment."

The benefit of averted tree mortality was calculated to be about equal to the cost of reforesting an area equal to the total estimated area of dead timber.

In an economy as focussed on forestry as that of B.C., increased timber yield might be expected to produce indirect gains to the economy as well, but such "secondary benefits" are very difficult to compute. Dr. Nagle used F.L.C. Reed's [1975] study, The Forest Industry: Its Impact on the Economy, to derive a range of figures for the worth of Douglas-fir timber to the economy of B.C. Stumpage is only a minimal measure of the value of wood. The Reed study provided totals of provincial taxes paid by forest companies and for value added to the worth of lumber by processing. Dr. Nagle's report once again omitted the procedures he used to convert these totals into dollars per volume of lumber. His final benefit/cost summaries contained three sets of ratios, based upon: stumpage; provincial government revenue; and value added of finished lumber, respectively. Appendix C presents the expected benefits calculated by Dr. Nagle.

Only the direct costs of carrying out the spray program were included in the benefit/cost ratios (Appendix C), although

the report discussed possible side effects of the chemicals at length in a separate section. The costs of monitoring the non-target organisms, later estimated at $1.00 per acre,[54] were not included. Dr. Nagle calculated his ratios for two chemical treatments: Orthene alone, and 90% Sevin + 10% Orthene. The figure for combined treatment was based upon use of Orthene instead of Sevin along watercourses.

The conclusions reached by the economist were hardly definitive. Consideration of two insecticide treatments, two models of infestation spread, two discount rates, and three levels of benefits produced a matrix of twenty-four ratios (Appendix C). This approach was adopted because the values of none of these key variables could be predicted with certainty. The reader was simply left to decide which combinations of values were most realistic.

The standard criterion for economic acceptability is a benefit/cost ratio greater than or equal to 1.0. The Nagle study found considerable variation among the ratios calculated for its various cases. In cases where the entire area was treated with Orthene the benefit/cost ratios were well below 1.0, except when the benefits were calculated in terms of the huge "contribution to GNP of logs and lumber."[29] Even the combined Sevin + Orthene treatment did not always generate benefit/cost ratios greater than 1.0. Dr. Nagle selected as most important one case, in which Sevin + Orthene treatment was assumed to protect the whole "threatened area," and benefits were evaluated as the net

present value of stumpage at a 6% discount rate. The calculated benefit/cost ratio for this case, 1.12, was quoted in later arguments about the "return on the dollar" of the spray program.[55]

Dr. Nagle's work was criticized on several grounds. Proponents and opponents of the spray program agreed that the report was incomplete and poorly written.[51][52][53] According to the author himself, the key weaknesses of the study were to be found in the biological models available to him. After he had accepted the B.C. Forest Service contract, he found that no impact model had been designed, so he had to construct one himself. He also expressed frustration at the impossibility of pinning down any of the biologists he questioned with respect to the imminence of a spontaneous collapse of the budworm population.[30] He therefore performed his calculations based on what he felt to be a reasonable model for duration of the infestation, and discussed separately the implications of a population collapse.

Dr. Nagle's attempts to evaluate the "secondary benefits" of increased timber yield were singled out for questioning.[52] His figure for "total provincial revenue" included royalties and other fees which are levied independently of the market price of wood, as well as provincial property taxes and corporate taxes on income derived from log exports and processing.[30] This figure might appear to be an appropriate indication of the return from increased timber volume, since it seems to measure

provincial revenue offsetting the provincial outlay for the spray. But it would be necessary to compare the increased provincial revenue with the return from any equivalent expenditure. In addition, a benefit/cost study should be concerned with benefits to society at large, not simply with balancing the books of the provincial treasury.

Similarly, so-called "value added" in processing should be counted as a benefit only if it represents a greater return from the money spent on processing the extra wood than would alternative use of that money. If already existing manufacturing capacity or labour power were under-utilized in the province generally, or in the lumber industry or the Fraser Canyon region in particular, this condition might have been fulfilled to a limited extent. Even so, Dr. Nagle's figure, more than six times the value of stumpage, must have vastly overestimated the magnitude of the net contribution of increased timber yield to the GNP.

There is no question but that Dr. Nagle was asked to perform a difficult and complex task in less than three months. Nevertheless, the technical shortcomings of the study, the obvious omissions, and the lack of clarity in its presentation made it difficult for resource managers to exercise the judgement necessary to take direction from its findings. Dr. Nagle's study did not provide the B.C. Forest Service with clear-cut economic support for the spray program.

D. Deliberations of the Interministerial Pesticide Committee

On March 24, 14 days after the benefit/cost study had been submitted, the Interministerial Pesticide Committee met to consider the Fraser Canyon spray proposal.[56] Once again, the B.C. Forest Service presented its case for the control program. Once again, supporting entomological data were provided by the Canadian Forestry Service. The committee members grilled the forestry representatives, Mr. J. Michael Finnis of the B.C. Forest Service's Protection Division and Mr. Howard Tripp of the Canadian Forestry Service, about the need for the program and its environmental safety. Mr. Finnis assured them that the budworm population would continue to be closely monitored; if the numbers declined on their own, the spray program could be cancelled up to the last minute.

The Nagle study had reported benefit/cost ratios of less than 1.0 for Orthene-only treatments. In view of this, the committee considered that the B.C. Forest Service's continued advocacy of the spray program amounted to setting aside the findings of the economic analysis commissioned by the Forest Pest Review Committee. The representatives of agencies with environmental protection mandates opposed the program on the grounds that the anticipated benefits would not be sufficient to justify taking environmental risks. Once again they insisted that comprehensive environmental monitoring be provided if the spray program were to proceed in spite of their objections.

Other members of the Committee were willing to accept the Forest Service's judgment that the control program was necessary,[39][57] and concentrated on setting down guidelines to minimize hazards to residents, employees, bees, and aquatic organisms.[56]

The reservations expressed were serious enough for the Committee chairman, Mr. Bayne Vance, to suggest the possibility of witholding approval of the B.C. Forest Service proposal and referring the matter directly to Cabinet. The Committee agreed instead to approve the project "with restrictions."[56] These went beyond operational matters, such as the inspection of pesticide mixing facilities, to include the broader concerns expressed in the Committee's discussions. The B.C. Forest Service was instructed to undertake a "comprehensive public information program."[56] The responsibility for designing and implementing an environmental monitoring program "that meets the requirements of the agencies represented on the BC Interministerial Pesticide Committee" was also given to the B.C. Forest Service. The chairman of the Interministerial Pesticide Committee was to be kept informed about results of ongoing monitoring of the budworm population, and the B.C. Forest Service was formally required to be ready to terminate the project "at any time,"[56] if these data indicated a natural collapse. The question of economic justification for the project had priority of place as the first point in Mr. Vance's letter conveying the Committee's requirements to the District Forester

in Vancouver:

> ... this committee respectfully requests that prior to the commencement of the project that the Ministry of Forests clarify its reasons for apparently setting aside the findings of the confidential study recently completed by Nowitka [sic] Renewable Resource Consultants Ltd.[B.C. Ministry of Forests 1977a, pp.32-3].

Less than two weeks later, on April 4, the Committee reconvened to consider a B.C. Forest Service request to use Sevin after all. They had been informed that the producers of Orthene could not supply nearly enough of it to treat the Anderson Block; adequate supplies of Sevin-4-oil were available. After considerable discussion, the Committee approved the use of Sevin as needed, with Orthene to be substituted for it as fully as the supply allowed. In particular, Orthene was to be used along watercourses and in other environmentally sensitive areas.(46)

This meeting was taken as an opportunity to go one more round on other aspects of the B.C. Forest Service proposal. Mr. Finnis presented a letter from Mr. Macdonald to Mr. Don H. Owen, Director of the B.C. Forest Service's Protection Division,(51)(50) as the required justification for "apparently setting aside the findings of the cost:benefit study [B.C. Ministry of Forests 1977a, p 32]." The Environmental Protection Service representative on the Committee thought that use of a Canadian Forestry Service official's opinion for the purpose called into question that agency's supposedly neutral position on the spray program.(58)

Be that as it may, Mr. Macdonald's letter, and the discussion it sparked in the committee meeting, illustrated the confusion surrounding the Nagle report. Mr. Macdonald seemed to think that the benefit/cost analysis supported the spray program, which he favoured. Members of the Interministerial Pesticide Committee who opposed the spray program continued to cite Dr. Nagle's ambiguous work as evidence against it.

The plans for monitoring studies were also reviewed. Mr. Alex C. Molnar was to be hired to coordinate the Non-Target Organisms Monitoring Program. Once again the list of concerns was aired. Where were the staff and equipment to come from? What agency would provide the funds? Could all the necessary arrangements be made in time to get the crews into the field to collect baseline data before the actual spraying began? These questions had been asked and answered before. While the spray program was once again officially approved, misgivings remained.[59]

E. Public Opposition Begins

There were plenty of misgivings back in the Fraser Canyon as well. On the same day as the Interministerial Pesticide Committee's reconsideration of the Forest Service application (April 4), nearly seventy residents attended a special meeting of the Yale Ratepayers Association. The B.C. Forest Service declined to send a representative, "on the grounds that there

had been no decision [as to] whether there would be a spray program."[60]

The residents proposed to fight the Forest Service. A protest telegram containing sixty-eight signatures was sent to Mr. Waterland.[61] Copies were mailed to the Sun and Province (Vancouver's major newspapers), SPEC (a local environmentalist organization), [62] Mr. Alex B. Patterson (M.P. for Fraser Valley East), Mr. David Barrett (New Democratic Party Leader of the Opposition in the provincial Legislative Assembly), and Mr. Robert E. Skelly (Environment Critic for the provincial NDP). A letter to the editor of the Hope Standard, the area's local newspaper, was to be written on behalf of the Association. Members were urged to send individual letters as well. The group also planned to erect large signs protesting the spray at each end of the town, to catch the attention of passing motorists during the coming holiday weekend.[63][64]

On April 8, Good Friday morning, a small group of women met at Sophie Kassian's house, wondering what they could do to stop the spray. As Mrs. Kassian tells the story:

> "Simple, we'll stand on the [Trans-Canada] highway and picket! Say whatever you want [on your signs]: if they can't give us the answers, let them come around and prove that we're wrong!"[49]

The slogans ranged from matter-of-fact ("The Anderson is important, too") through doggerel ("Sevin-four, stay away from my door") to downright inflammatory ("Mommy, will I die?," worn by a small child). The accuracy or good taste of the signs may have been questionable, but they were effective. That weekend

cars were lined up bumper-to-bumper, full of city people wanting to get out into the fresh air, a sympathetic audience. Residents with placards stopped traffic on the Trans-Canada Highway by using the single pedestrian controlled crosswalk in Yale. "People with children pulled over, saying 'got a sign? we'll help you out for half an hour!'"[49] By Easter Sunday there were 60 protesters standing along the highway.[65]

That first weekend of picketing got the protest on the front page of the local paper.[66] The story was also carried by both radio and television news programs of the Canadian Broadcasting Corporation (CBC), and a Prince George newspaper, as well as by the Vancouver papers.[65] There was no direct response from the B.C Forest Service. On Easter Monday a petition calling for passage of a by-law prohibiting mass spraying of pesticides in the district was drawn up, to be circulated for signatures, then passed to Mr. Kassian for presentation to the Regional Board Board.[65] Letters to the Editor expressing opposition to the spray program began appearing regularly in the Standard.

Although the Yale group was busily preparing to take on the B.C. Forest Service, not all those who lived in the Fraser Canyon area were as ready to oppose the spray program. On April 12, the Hope Ratepayers Association met to discuss the situation. Since the project had now been officially approved,[67] Dr. Shepherd and Messers. Bertram and McArthur appeared to answer questions. In spite of Mr. Kassian's

presentation of the reasons behind the Yale Association's anti-spray stance, the Hope Association did not choose to take a position on the issue.[65]

The group of anti-spray activists that formed around Mrs. Kassian began with no technical knowledge of either pesticides or spruce budworms. But concern about environmental issues in general, and chemicals in particular, was part of the atmosphere of the day. A serious herbicide spill at a chemical factory in Sovesto, Italy, had received widespread publicity, the story of poisonings from chemical wastes along the Love Canal in Niagra Falls, New York, was current news, and the Thalidomide tragedy had raised persistent doubts about the adequacy of chemical testing.[49][68] The eastern spruce budworm was in the news, too, as the subject of a recent segment on the CBC's popular "Fifth Estate" television magazine. People had heard the questions being asked about the effectiveness of budworm control programs in New Brunswick and Nova Scotia, and about a possible connection between imsecticide spraying and a rare, fatal children's disease called Reye's syndrome.[68][69] Small wonder that there were some who viewed the prospect of a spray program in their neighborhood with discomfort, or even alarm.

Recognizing that they had more worries than information, the Yale residents began looking for outside expertise. A University of British Columbia forestry student, who chose to remain anonymous, gave Mrs. Kassian the name of his professor of

forest entomology. When she called Dr. Kenneth Graham, he said "It's a waste of a million dollars. If I lived in your area I'd be out there picketing too!"[49][70] In the hectic months that followed, he lent the weight of his reputation and expertise to the anti-spray camp.

The editor of The Critical List, an environmentalist magazine, suggested that Mrs. Kassian contact Mrs. Merriam Doucet, a Coquitlam housewife who made a full time occupation of speaking out against pesticide use. A self-confessed crusader, Mrs. Doucet had been instigating and participating in controversies all over North America for years.[71][72] She had amassed a huge volume of technical literature to support her contention that pesticides can be serious hazards to health. By the time Mrs. Kassian called her to ask for information on possible dangers associated with Orthene and Sevin, Mrs. Doucet had already heard about the proposed Fraser Canyon spray program.[73] She was more than willing to assist the Yale group in their anti-spray campaign.

The residents had also directed their questions to the B.C. Forest Service.[71] Dissatisfied with the response, they turned to the office of Mr. Patterson, their federal Member of Parliament.[74] The request for information passed quickly through the federal bureaucracy: Mrs. Kassian, Mrs. Sharon Gazzola and Mr. John Ingwerson of Yale were all phoned the next day by Dr. Shepherd and Mr. Macdonald. Documenting this exchange for his superiors at the Department of Environment and Marine

Services, Mr. Macdonald wrote:

> Dr. Shepherd ...and I answered specific questions from the three Yale Ratepayers concerning control of the WSBW and misinformation that they had been given about Orthene. We did not attempt to answer Mrs. Kassian's questions regarding her religious concerns about this operation, forest management or environmental protection.(75)

F. The Public Information Days

The B.C. Forest Service did acknowledge a responsibility to tell the people who lived in the Fraser Canyon about its plans to spray the area. So, in midwinter 1977, after the Anderson Block had been selected as the area where budworm control would be attempted, the Protection Division approached the Information Services Division for help in setting up a "Public Information" program. There was no question of involving the public in the management process; all the major decisions had already been made. There seemed to be no need to ask the local residents to identify environmentally sensitive or valuable locations within the spray area; that was the business of the Fish and Wildlife Branch. In fact, as Mr. Adderly, the Information Officer assigned to the project, put it, "the time frame was such that the only option was a persuasion program."(76)

The Protection Division was not anticipating an adverse public reaction. When they presented their plans to local elected officials at the March 15 preliminary meeting, they had hoped to get an indication of any future difficulties with the

residents of the area. No objections to the spray program were made at that time. They had another reason to be confident: during the previous summer they had sprayed Orthene over 22,000 acres near Kamloops to control the Douglas-fir tussock moth, and had been welcomed by the local residents [Canadian Forestry Service 1980].[13][43][76] Above all, they were busy with the myriad details of organizing the actual spray operation. So in spite of Mr. Adderly's warnings to be prepared for trouble,[76] they left Information Services to get on with the public relations while they got on with the job.

In an attempt to anticipate public concerns, a brochure entitled "Insect Control Spray Program: Answers to some questions" [B.C. Ministry of Forests 1977b] was mailed to every resident of the Canyon as soon as final approval of the program had been announced by the Minister of Forests. The same material was also printed as a full page advertisement in the Standard[77] and on posters displayed throughout the area. The brochure contained a map supposedly indicating the boundaries of the spray block, but it was highly inaccurate. The problem obviously was not that the B.C. Forest Service did not know where they were going to spray. Nor were they trying to mislead anyone: an accurate verbal description of the spray block boundaries had appeared in the Standard on April 6.[67] Apparently the artist assigned to produce the map for the public information materials had been working from a map of the infestation rather than of the spray area. According the the

Standard, the error was brought to the attention of the B.C. Forest Service by opponents of the spray program.[78]

The infestation and its impact on the forest, the spray program and the B.C. Forest Service's reasons for undertaking it, and the differences between the B.C. and New Brunswick programs were all introduced in the brochures. While many of the major issues were thus addressed, albeit briefly, these offerings missed the mark by failing to mention the health matters which concerned Mrs. Kassian and her friends. The brochures and advertisements did include, however, an invitation to all residents to attend "public meetings" on April 13, 14, and 15 in Boston Bar, Yale and Hope [B.C. Ministry of Forests 1977b]. Unfortunately for the B.C. Forest Service, these prearranged dates fell after the Easter weekend picketing of the Trans-Canada Highway.

The Public Information Days formed the centrepiece of the B.C. Forest Service approach to the Fraser Canyon residents. The following account has been constructed from newspaper coverage and interviews with several parties.[6][13][49][55][69][71][76][79][80][81] The Public Information Days were not designed to be formal meetings, with speeches and question periods, but rather as "open houses". Displays included maps of the infestation, specimens of damaged trees, and aerial photographs of defoliated stands. Dr. Shepherd and Messers. Finnis and Bertram planned to be on hand to answer questions as residents toured the exhibit. The B.C. Fish and Wildlife Branch had been invited to send a

representative, but they declined to participate because they did not endorse the spray program.[82] Provincial and federal forestry personnel would be able to talk to people on a one-to-one basis until each questioner had been satisfied. The open house format was chosen to give people freedom to look around and consider the information available;[76] it would also be less conducive to the direct confrontations which often develop in conventional public meetings.

Things went more or less according to plan at the first session, in Boston Bar. From 1:00 to 7:00 p.m. people quietly passed through the exhibits in groups of two and three. Several members of the Yale Ratepayers Association turned up with placards, but there were no unpleasant incidents. The next day, in Yale, the afternoon was peaceful enough. Then, at about 6:00, more than 50 people arrived in a body, set up chairs in rows, and demanded that the forestry personnel face them all at once.

Finnis, Adderly and Shepherd had come prepared to discuss the budworm population and its impact on the forest, but the angry crowd bombarded them with questions about pesticide toxicity. The citizens of Yale had found allies. People had telephoned university scientists as far away as California, and now quoted their remarks about hazards associated with Orthene. Ms. Suzy Sims read a statement written by Dr. Graham criticizing the spray program in terms of both efficacy and safety.[70] Mrs. Doucet was there with a briefcase full of reprints from the scientific literature on pesticide testing. Equipped with a

prodigious memory for detail and a bold self-confidence, she was a formidable opponent. When Dr. Shepherd protested that he was an entomologist, not a chemist, the crowd shouted "Where, then, are your chemists?"[55] In response to a question about the economic benefits of the spray program, Mr. Finnis said that he was not an economist, then went on to cite Nagle's figure of $1.12 returned for every $1.00 spent on the spray. Unsatisfied, residents replied that "It was incredible that human health might be jeopardized through some unforseen effect for an economic return of only one-tenth."[55] Finnis countered by referring to another Nagle case which showed a return of $3.10, but someone shouted "now you're changing it!"[55]

The next day, in Hope, the Forest Service fared no better. The Honourable Mr. Waterland, Minister of Forests, was scheduled to spend two hours at the open house. Thomas H. Waterland was in his second year as a Cabinet Minister, and as a Member of the Legislative Assembly (MLA). For the first year, in addition to his Forests portfolio, he had also been responsible for the Ministry of Mines and Petrolium Resources. Although described by one of his associates as a "quick study,"[83] he was still relatively new to his demanding portfolio, and to politics. His training as a mining engineer was as technical as that of the foresters on his staff, whose positions he staunchly upheld.

The towns of Hope, Yale and Boston Bar were in the Minister's own riding; when a crowd of his constituents appeared at the Hope Town Hall on April 15, he was the man put on the

spot. Mrs. Doucet, who happened to have a broken leg, was pushed to the front in a wheelchair by residents who demanded that she share centre stage with Mr. Waterland. When the Minister turned to Finnis or Shepherd for technical information to answer questions, they often could not provide it. Once again, the B.C. Forest Service looked ill-equipped to meet the residents' concerns. Whether the crowd could have been satisfied by anybody was perhaps questionable; according to Mr. Finnis, they wanted "guarantees [of safety] that scientists couldn't give."(13) But the fact remains that the B.C. Forest Service had not anticipated the kind of organized vocal opposition that surfaced at the "Public Information Days;" Finnis and Shepherd faced it unprepared.

After about two hours of heated confrontation, Mr. Waterland left, declaring that any reconsideration of the decision to spray would be made on "scientific evidence, 'not emotionalism.'"(80) He did promise to hold a conference of experts, both supporters and critics of the program, to provide him with technical advice.

G. The Opposition Campaign Continues

The contentious public information sessions in Yale and Hope were given front page headlines by the Vancouver papers.[55][81] This was another media success for the anti-spray faction. But an article by Waterland in the April 20 Standard made it clear that they were far from their goal of stopping the spray program. Taking a fatherly tone, he declared:

> "As MLA and Minister of Forests, I certainly would not consider anything even remotely hazardous to anybody's health, or remotely hazardous to the environment. I believe in the program. I believe it will save our trees and our jobs, and our environment, and I believe it is totally safe."[84]

A "Budworm Committee," formed under the auspices of the Yale Ratepayers Association, settled in for a long campaign. Weekly strategy meetings were held to plan future activities activities.[49] Responsibilities were assigned to subcommittees: coordination, compilation of information materials, media and information, group activities, and recruiting.[85] Mr. Richard Lemm was delegated to present the Yale citizens' concerns to Mr. Waterland in written form.[86] The group continued to fill the Standard's "Letters to the Editor" columns with anti-spray statements.[87][88] They also corresponded with a New Brunswick group who had been opposing the spray program there for some years.[89] The highway was picketed again on April 23, this time at the "gateway to Hope," a much more prominent location on the Vancouver side of the three-way junction of Highways 1, 3 and 7.[90]

Other organizations began to take public positions opposing the spray program. The Geenpeace Foundation, an environmentalist group famous, or infamous, for exploits of civil disobedience in defense of whales and seals, announced that its members would march into the Anderson block to prevent the insecticide application from proceeding. ("Mr. Waterland may be willing to dump chemicals all over the trees, birds, animals and fish, but we hope he will think twice about poisoning people," said Greenpeace President Dr. Patrick A. Moore to the Vancouver Sun).[91]

The "Budworm Committee" was not always successful in its bids for support. Mr. Walter Kassian, as Vice-Chairman of the Fraser-Cheam Regional Board, presented the Board with the Committee's petition asking them to enact a by-law prohibiting aerial insecticide spraying in their jurisdiction. But the Directors were not eager to take such a step, and decided merely to seek further information about possible impacts of the chemicals to be used.[92]

H. Mr. Waterland's Conference

Meanwhile, Mr. Waterland's technical conference was being organized. It was to be a tightly structured affair, with participation as either a panelist or observer by invitation only. Once again, the Canadian Forestry Service was involved in the planning. It was Mr. Macdonald who suggested that employees

of Chevron and Union Carbide be invited to answer questions about their products. He also recommended that the "environmentally concerned" point of view be represented by more than Mrs. Doucet and the Fraser Canyon residents. Accordingly, an invitation was extended to the president of the B.C. Wildlife Federation, a group singled out by Macdonald as one with which the B.C. Forest Service had "developed good communications."[93]

The Canadian Forestry Service was also well-represented on the invitation list. Not only was Dr. Shepherd attending, to present the control program he had such a large part in designing, but Mr. Macdonald would join him on the technical discussion panel. Two other Canadian Forestry Service scientists were to be flown in from Eastern Canada to "support the consensus arrived at in this Province."[94]

Two "independent," i.e. non-government, entomologists were asked to sit on the panel. These were Mr. Hector A. Richmond, a private consultant who had been involved in nearly every aerial spray program ever undertaken in B.C.,[95][96] and Dr. Kenneth Graham, the University of British Columbia Forestry Professor who had offered his assistance to the Yale Budworm Committee. Another entomologist was added to the list when Dr. Bryan P. Beirne, the Director of Simon Fraser University's Pestology Centre and an internationally renowned expert on biological pest control, called Mr. Waterland's office to request an invitation.[97]

Two of the strongest anti-spray voices at the Conference arrived there by accident. The Chairman of the Fraser-Cheam Regional Board had been asked to observe on behalf of the local government. He was unable to attend, so the invitation passed to the Vice-Chairman of the Board, who happened to be none other than Mr. Kassian.[49] Dr. Kornder, the head of the provincial Occupational Health and Safety Branch, and a member of the Interministerial Pesticide Committee, was expected to be present as the spokesperson on pesticides for the Ministry of Health. Dr. Kornder was not available, and his place was assigned to Dr. McInnes, the Medical Health Officer for the Health District which included the Fraser Canyon area. Dr. McInnes did not plan to take a position on the advisability of the spray program; in fact he arrived at the conference expecting to act as his Ministry's observer, and was "unnerved" to find himself seated on the panel.[40] But, as will be evident, his contribution had a significant impact on the proceedings.

Participation in the Conference was not always easy to come by. Neither the provincial Fish and Wildlife Branch nor the federal Environmental Protection Service were originally invited. The responses of these two agencies, which cooperated closely with each other throughout the Fraser Canyon affair, differed markedly. The provincial Branch chose to push the B.C. Forest Service to include them, by having their Assistant Deputy Minister make the request;[58][82] such a senior-level official would have been difficult to refuse. The person who attended the

Conference on behalf of the Fish and Wildlife Branch was Mr. Donald J. Robinson. As Acting Director, he held a position significantly higher than that of the Biologist who had taken part in the committee-level considerations of the spray program.

By contrast, the Environmental Protection Service chose not to pursue the matter, although they, too had a staff member, Mr. Otto E. Langer, who had participated extensively in the earlier discussions of the project. In Mr. Langer's view, the failure of the B.C. Forest Service to include the Fish and Wildlife Branch and the Environmental Protection Service on the original attendence list cast suspicion on the whole purpose of the Conference.[58] The objections of these two agencies to the spray program had been apparent at meetings of both the Forest Pest Review and the Interministerial Pesticide Committees; their contributions to the Conference would clearly be necessary to provide Mr. Waterland with the complete picture he was ostensibly seeking. Mr. Langer felt that obtaining a reluctant invitation would merely obliterate the evidence that the B.C. Forest Service was not really interested in what he had to say.

He had a good point; an enterprising newspaper reporter contacted Langer to ask why his agency was not taking part in the Conference Conference.[58] The story that a "pesticide expert" had been "denied [a] place at [the] Canyon spray Conference"[98] was another piece of bad publicity for the Forest Service. The stated justification for his exclusion, viz. that the interests of the Federal Department of Fisheries and

Environment were represented by Dr. Shepherd and Mr. Macdonald, the Canadian Forestry Service panelists, was not reasonable, since they were forestry experts and had been involved in planning the program that the Environmental Protection Service opposed; this excuse could only detract from the credibility of the Conference. In addition, Mr. Langer's criticisms of the spray program itself were featured prominantly in newspaper coverage of the Conference;[98] they might well have received less attention had he been one of the participants inside.

The "Conference on Fraser Canyon Budworm Spraying Programme" was held on April 28 and 29 at the Parliament Buildings in Victoria. The following account is summarized from the verbatim transcript (Hansard) published by the Queen's Printer in Victoria [B.C. Ministry of Forests, 1977a].

Participants were divided into two sections: a "technical discussion group," or panel; and a group of "observers and technical advisors." The B.C. Forest Service, the Canadian Forestry Service, local governments of the Fraser Canyon area, and environmentalist groups were all represented, as were the provincial health and fisheries agencies. The independent entomologists were there to discuss budworm biology with the Canadian Forestry Service scientists. People who had worked on budworm control programs elsewhere in North America were brought in to give the benefit of their experience. Chemical company personnel were present to defend their products, and a commercial aerial spraying company sent its Director of Flight

Operations. The three Commissioners of the 1975 provincial Royal Commission of Inquiry Into the Use of Insecticides and Herbicides were invited to provide expert opinions on pesticide safety. They were joined by a university pesticide chemist, an official of Agriculture Canada's Plant Products Division, which regulates pesticide registration, and the Chairman of B.C.'s Interministerial Pesticide Committee. In all, there were 10 panelists and 29 observers (Table 9). Newspaper accounts of the Conference quoted opinions of Mrs. Doucet, Mr. Langer, and Dr. Moore that the attendance list was biased in favour of proponents of the insecticide treatment.[71][98][99][100] My own tally shows the panel to have been evenly divided, but the majority of the "technical advisors" were people whose institutional connections might have led them to support the B.C. Forest Service's bid to spray. In particular, the inclusion of seven chemical company employees and only one, reluctantly invited, fisheries expert supports the contention that the pro-spray position was over-represented. At the same time, Mr. Waterland's willingness to place two avowedly anti-pesticide environmental activists on the discussion panel of this highly publicized event must be given due credit.

The meeting was chaired by Mr. Waterland himself. Most of the participants, regardless of their opinions about the spray program, found him to be both even-handed and efficient in this role.[13][83][101][102][103] Mrs. Doucet disagreed, accusing Waterland of cutting her remarks short while allowing her

Table 9. Participants in the "Conference on Fraser Canyon Budworm Spraying Programme," Victoria, B.C. April 28-29, 1977 [B.C. Ministry of Forests 1977a].*

Role in Conference	Name	Affiliation
Technical Discussion Group:	Dr. R. Shepherd	Research Scientist Defoliating insects Pacific Forest Research Centre Can. Dept. of Fisheries and Environment Victoria, B.C.
	D.R. Macdonald	Entomologist and Deputy Director Pacific Forest Research Centre
	Dr. R. DeBoo	Research Scientist Canadian Chemical Control Research Institute Ottawa, Ontario
	Dr. W.O.H. McInnes	Director Upper Fraser Valley Health Unit Medical Health Officer Chilliwack, B.C.
	M. Doucet	Chairman Pesticide and Chemical Resource Committee S.P.E.C. Federation Vancouver, B.C.
	Dr. K. Graham	Entomologist - Professor Faculty of Forestry U.B.C. Vancouver, B.C.
	H. Richmond	Consulting Entomologist Nanaimo, B.C.
	Dr. P. Moore	President Greenpeace Vancouver, B.C.
	Dr. P.C. Oloffs	Simon Fraser University
	D.H. Owen	Forester i/c Protection Division B.C. Forest Service Victoria, B.C.

Table 9. Continued

Role in Conference	Name	Affiliation
Observers and Technical Advisors	E.L. Young	Chief Executive Officer B.C. Forest Service Victoria, B.C.
	J.M. Finnis	Forester i/c Pest Management Protection Division B.C. Forest Service Victoria, B.C.
	E.H. Lyons	Forester i/c Information Division B.C. Forest Service Victoria, B.C.
	E.J. McArthur	Project Manager Budworm Control Project Vancouver District Office B.C. Forest Service Vancouver, B.C.
	Janet Taylor	Plant Products Division Canada Dept. of Agriculture Ottawa, Ontario
	R.D. Cavelli	Toxicologist Chevron Canada
	J.N. Ospenson	Research Director Chevron Canada
	Robert C. Wilkes	Business Manager Union Carbide Canada Ltd. Toronto, Ontario
	Donald J. Robinson	Acting Director Fish and Wildlife Ministry of Recreation and Conservation
	B.J. Otway	Executive Director B.C. Wildlife Federation Vancouver, B.C.
	R.H. Corbett	Mayor City of Hope Hope, B.C.

Table 9. Continued

Role in Conference	Name	Affiliation
	W. Kassian	Vice Chairman Fraser-Cheam Regional District
	John Bailey	Yale Rate-payers Association
	D. Graham	Director, Insect and Disease Control U.S. Forest Service Portland, Oregon
	B. Marsden	Director of Flight Operations Conair Aviation Abbotsford, B.C.
	J. Oakley	Vice President and Manager Chevron Chemicals (Canada) Ltd. Burlington, Ontario
	L.L. Stephens	Area Representative Union Carbide Co. Chairman of Task Force on forest spraying projects for Pacific N.W. Yakima, Washington
	Miss A. Gillespie	Bio Chemist Royal Jubilee Hospital Victoria, B.C.
	R. Eller	Micro Biologist Product Specialist and product development sales for Sevin-4-oil Union Carbide Canada Ltd. Toronto, Ontario
	P. Nelson	Expert on use of Sevin-4-oil in California Products Services Manager Union Carbide Salinas, California
	**Dr. C.J.G Mackenzie	Professor Head of Health Care and Epidemiology Faculty of Medicine U.B.C.

Table 9. Continued

Role in Conference	Name	Affiliation
	**Dr. W. Powrie	Professor Chairman Department of Food Science U.B.C.
	**Dr. W.K. Oldham	Associate Professor Civil Engineering U.B.C.
	Dr. J. Robert Blais	Research Scientist Laurentian Forest Research Centre Ste. Foy, P.Q. (Spruce budworm and bacterial control specialist)
	Dr. Bryan P. Beirne	Professor of Pest Management; Director of Pestology Centre Simon Fraser University Vancouver, B.C.
	B. Vance	Chairman, Inter-departmental Pesticide Committee Pesticide Branch, Environment Protection B.C. Ministry of the Environment
	L. Irland	Maine Forest Service Augusta, Maine
	Rick Johnsey	Department Natural Resources Washington State Olympia, Washington
	C. Bennett	Protection Division B.C. Forest Service

*Names and affiliations reproduced verbatim from the Hansard transcript of the "Conference on Fraser Canyon Budworm Spraying Programme," Victoria, B.C. April 28-29, 1977 [B.C. Ministry of Forests 1977a].
**Commissioners on the Royal Commission on the Use of Insecticides and Herbicides in British Columbia, 1973-75.

opponents to speak at length.[71] The Minister did take very clear charge of the proceedings, stating at the outset that their purpose was to provide him with information on which to base his decision about the fate of the Fraser Canyon insecticide application.

The accumulation of technical information was probably not Mr. Waterland's only objective in holding the Conference. When he began by asking the Chief Forester, Mr. Young, to describe the legal responsibility of the B.C. Forest Service to protect the forest environment, this was probably for the benefit of the other participants and the press, whose presence had been actively sought.[93] The process by which the B.C. Forest Service had arrived at its decision to spray the Anderson block, which Mr. Waterland then asked Mr. Owen to present, was doubtless also known to the Minister.

The B.C. Forest Service position, as revealed over the course of the Conference, was that the decision to spray the Anderson block had been based upon thorough discussion of the spruce budworm infestation and the options available for dealing with it. They maintained that the Fraser Canyon spray program was necessary, was well planned, and would be both safe and effective. This position was supported by the testimony of some of the technical experts who had been invited to attend, while others took exception to one or more of its propositions.

The B.C. Forest Service and Canadian Forestry Service personnel maintained that it was not possible to predict when

the infestation would collapse naturally. They felt that the potential for loss of growth in immature stands attacked by budworm meant that they could wait no longer to intervene. The Nagle report was described briefly by Messers. Owen and Macdonald as generally providing economic justification for the proposed spray program. But Mr. Richmond seemed to think that the emphasis on insecticide spraying was misplaced. He considered the real threat to the trees to be the possibility of Douglas-fir beetle attack. This was the same conclusion reached by the Pacific Forest Research Centre (Canadian Forestry Service) forest protection group in their September meeting, but the implications were different for Mr. Richmond. The Canadian Forestry Service scientists wanted to protect stands from beetle attack by controlling the budworm infestation that was weakening them. In Mr. Richmond's opinion, stands which had been defoliated were already vulnerable; he felt that the B.C. Forest Service should spend its money on a salvage program to harvest susceptible stands before they could be killed by the beetle.

The "independent" entomologists, Drs. Graham and Beirne and Mr. Richmond, were not convinced that the control program was necessary, or even the best way, to protect the forest. They suggested that the extremely high level of the budworm population might in fact be an indication of its impending collapse. Dr. Beirne was concerned that the spraying might actually prolong the infestation by severely reducing populations of budworm parasites which he felt would contribute

to its eventual decline [B.C. Ministry of Forests 1977a, p. 56-57].[97]

The spray program had been designed as an attempt to control the budworm population in a single treatment. The question of whether this was a realistic goal became another important theme of the Conference. Although they recognized that in eastern North America budworm control programs had developed into annual and expanding operations, the technical people of both the B.C. Forest Service and the Canadian Forestry Service believed the situation in the west to be significantly different.

Widespread mortality can occur in spruce and balsalm fir stands after repeated severe defoliation by eastern spruce budworm. In order to save stands which have reached this point, it is essential to protect the current crop of needles by spraying early in the season. Early instar larvae are relatively resistant to the insecticide treatment, because they are better hidden in their shelters and consume smaller quantities of the insecticide-laden foliage than do later instar larvae. A considerable residual population thus remains after early-season spraying programs. Because western spruce budworm's principal host, Douglas-fir, is more tolerant of defoliation than are the host trees in the east, growth loss rather than outright mortality was the concern in B.C. This made it possible to plan the spray program to kill more mature larvae, later in the season. Some foliage would thus be sacrificed in order to obtain

a higher budworm mortality. The B.C. Forest Service and Canadian Forestry Service representatives felt that the less severe impact of defoliation, and the attendent opportunity to inflict heavier losses on the target insect population, would allow B.C. to avoid the kind of annual spraying program carried out in New Brunswick. Dr. Graham rejected this concept; he felt that spraying after most of the season's defoliation had already occurred would make the value of the whole exercise questionable.

The government forestry scientists expected B.C.'s rugged and dissected terrain also to work to their advantage, by restricting the flight of budworm adults from unsprayed areas into the treated block. But Dr. W. K. Oldham, one of the members of the Royal Commission on pesticides, pointed out that B.C.'s mountainous geography had not been preventing the spread of the budworm infestation. (In this remark he has assumed that the outbreak spreads rather than arising independently in each area. The true mode(s) of outbreak growth are unknown.) Dr. Oldham thought it was therefore unreasonable to assume that reinvasion would be blocked. Dr. Shepherd responded to the skepticism of these critics of the spray program by invoking the successful operations carried out in the U.S. Pacific Northwest, where less than 1% of 4-5 million acres [1% of 1.6-2.0 million ha] sprayed over a 20 year period had required repeated treatment [substantiated in Dolph 1980].

While Mr. Owen read "into the record" the Forest Pest Review Committee's resolution to "avoid any implied committment to an annual respraying program," and Dr. Shepherd declared that he "personally would not agree with going along with repeated applications in the area," Mr. Richmond was not satisfied that such statements represented "an ironclad guarantee that no recurrent spray would be undertaken." The Fish and Wildlife Branch felt that it could accept a one-season treatment, but considered the possible impact of repeated insecticide sprays on aquatic invertebrates to be a significant risk to fisheries in the area. Mr. Robinson informed the Conference that "if it went into a longer-term repeat situation, we would certainly have to reassess our position substantially."

The assertion that the spray would be safe was also the focus of much discussion. Mrs. Janet Taylor, of Agriculture Canada's Plant Products Division, presented a description of the pre-registration testing of pesticides that sounded impressively extensive. The men from the chemical companies praised the insecticides, but their claims of safety were contested by Mrs. Doucet. Considerable time was devoted to her quotations from the toxicological literature, with rebuttals and counter-quotations from Mrs. Taylor and the chemical company representatives. Mrs. Doucet's skepticism about pesticide safety was seconded by Drs. McInnes, Moore and Graham, who pointed out that laboratory tests use genetically identical and uniformly reared animals, while human populations are heterogeneous in age, nutrition and state

of health.

While much of the conversation regarding pesticide toxicology revolved around possible hazards to human health, concern about possible environmental impacts of the spray treatment was also evident. Mr. Lloyd Irland of the Maine Forest Service reported that Sevin applications in his state had been found to kill large numbers of aquatic insects, possibly jeopardizing the food supply for fish. The B.C. Forest Service plan to protect the aquatic fauna by substituting the less toxic Orthene for Sevin near watercourses was presented. The practicality of this arrangement was questioned by Dr. Oldham, who wondered how the helicopter pilots were going to switch insecticides every time they approached a stream.

Mr. Irland and Dr. J. Robert Blais, from the Laurentian Forest Research Centre in Quebec, reported that no serious direct effects to birds, fish or mammals had ever been noted in connection with budworm control programs in their jurisdictions, which used mainly Fenitrothion and Sevin. In fact, Mr. Robinson, the Acting Director of the B.C. Fish and Wildlife Branch, told the Conference that his agency's willingness to tolerate a single insecticide treatment was based on their estimate of low immediate risk to fisheries.

The Branch's agreement was contingent on the B.C. Forest Service promise to leave pesticide-free "buffer" zones along all watercourses, a provision which could cause operational problems. Dr. Shepherd admitted that such unsprayed strips might

contain a significant residual budworm population, capable of reinfesting the treated areas. Meanwhile, the same mountains which were expected to limit reinfestation from outside the boundaries of the spray block would make control of the spray deposition very difficult by creating unpredictably windy conditions. The B.C. Forest Service proposed to maintain the 10 m buffer zones by shutting off the helicopter spray booms within 500 metres of streams. The practicality of this procedure was called into question by reports from Messers. Irland and Richmond of sprays drifting three to six miles [4.6-9.6 km].

Even if effective buffer zones could be created, other problems would remain. Although the Interministerial Pesticide Committee's conditions for the spray program included a requirement to identify and "protect" domestic water supplies within the treatment block, Dr. McInnes insisted that he had not had enough notice to locate all the licensed water sources in the area, let alone those which had never been registered with the Ministry of Environment's Water Rights Branch. For this reason he suggested that the spraying be postponed for a year to allow sufficient time to map the water supplies and incorporate this information into the operational plans.

Toward the end of the second day, the people representing residents of the Fraser Canyon area were invited to address the Conference. Mr. Roy H. Corbett, the Mayor of Hope, welcomed "the interest that people have in our little area," and endorsed the spray program. But Mr. John Bailey, of the Yale Ratepayers

Association, and Mr. Kassian, remained convinced that the insecticide treament would be a mistake.

The Conference ended with summary statements by each of the panelists. Dr. McInnes spoke first, voicing his concern about domestic water supplies, and was supported by Mrs. Doucet. Dr. Oloffs of Simon Fraser University presented calculations designed to demonstrate the minimal risk to humans represented by the proposed insecticide dosages. The local Canadian Forestry Service people, Dr. Shepherd and Mr. Macdonald, emphasized that the decision belonged to the B.C. Forest Service. Mr. Owen used the opportunity to remind everyone that the B.C. Forest Service was "accountable" for carrying out its mandate to protect the forest, a responsibility he said he felt personally. Dr. Robert F. DeBoo, speaking for the Canadian Forestry Service Chemical Control Research Institute in Ottawa, expressed confidence in the ability of the B.C. Forest Service to conduct the program. Mr. Richmond and Dr. Graham reiterated their opinion that a salvage operation would be more valuable than the spray program. Dr. Moore condemned the insecticide treatment as destructive of the "natural balance of the forest." Mr. Waterland himself had the last word; he ended the Conference as he had begun it, in terms of his "grave responsibility" to make the final decision on the Fraser Canyon budworm control project.

The metropolitan newspaper coverage of the Conference mentioned some of the Forest Service arguments, but devoted much more space to the problems raised by critics of the spray

program. The reports particularly stressed potential health hazards of the insecticides and the difficulties of controlling drift. Considerable significance was also given to Mr. Langer's exclusion from the meeting.[98][99][100][104][105][106] The Hope Standard took a very different approach to reporting the Conference: they asked Mr. Waterland about it. The same reservations about the spray program were mentioned, but the interview format turned them into the Minister's own concerns.[107] A later article which was based on the Hansard transcript of the Conference, described the meeting as both unbiased and inconclusive.[108]

Evaluations varied widely as to which position, pro-spray or anti-spray, was presented more strongly, and seemed to reflect the evaluator's own position more than what actually happened at the meeting.[49][71][83][101][109][110] The Health Officer, Dr. McInnes, who had no previous interest in the spray program, formed his opinion that the operation was poorly planned on the basis of the debates at the conference.[40] In Mr. Waterland's own assessment of the evidence presented to him, the Health Officer's reservations about the program stood out as uniquely significant.[111]

I. The Opposition Intensifies

The Conference in Victoria did not pursuade the Yale Budworm Committee to change its position. While Mr. Waterland studied the transcripts and weighed his decision they continued their protest activites. During the April 30 - May 1 weekend the "gateway to Hope" was again lined with placard-carrying residents,[112] while six of the committee members went up to Boston Bar to discuss the spray program with interested residents of that community.[113]

They also presented their arguments in writing, producing five mimeographed pages in the same format as the slickly printed brochure distributed by the B.C. Forest Service in April. The Committee's "Budworm Control - Answers to some of your questions" was delivered to every mailbox in the area, from Silver Creek to Boston Bar and North Bend. This publication was as disquieting as the earlier B.C. Forest Service material had been reassuring. Problems with effectiveness and environmental impact associated with eastern spruce budworm programs were cited as "past experience" in such efforts.[114] The writers anticipated significant spray drift, and predicted a general mortality of insects, leading to food shortages for larger wildlife. They emphasized the discrepancy between the planned 500 m buffers around domestic water sources and the one mile [1.6 km] pesticide-free zones recommended by the 1976 Royal Commission.

Some of the Yale Budworm Committee's statements were distinctly unfair. Brief general remarks about possible teratogenic effects of "pesticides" were quoted from the Report of the 1976 Royal Commission as evidence for the suggestion that Orthene and Sevin-4-oil could cause birth defects. Symptoms of outright poisoning by Sevin were described without making allowances for the extremely low dosages likely to be encountered by humans as a result of spray drift. The bias attributed to Mr. Waterland's conference was exaggerated; it was misleading to say that "only 1 1/2 hours were devoted to opposition participants... after most of the media had left to meet their news deadlines."[114] Although the local residents were not invited to speak until the the end of the Conference, technical people opposed to the spray program were active participants throughout the discussions. The stories which appeared in the Sun and Province made it obvious that the reporters had heard plenty of anti-spray arguments. In short, the B.C. Forest Service's categorical assertions of safety were answered with categorical allegations of danger.

On May 8, the Yale Committee held a fund-raising "Walkathon." Fify-one people walked the fifteen miles from Hope to Yale and earned almost $1,400 in pledges. The Yale and Spuzzum Indian Band contributed by donating a salmon barbeque to be sold to the walkers and their friends.[49][115][116]

Meanwhile, the base of support for the anti-spray position was becoming broader. Mr. Erik Wood, the financial secretary of

the International Woodworkers of America (I.W.A.) Local 1-367, in Maple Ridge, was a former resident of Hope who decided to contribute to his home town by "bringing labour into the fray."[117] He arranged for Mrs. Doucet to speak to the executive board of the local, who unanimously agreed to take a stand against the spray program.[117][118] This outcome was in marked contrast to the attitude adopted by I.W.A. locals south of the international border, who supported budworm control operations in Washington and Oregon.[12]

After obtaining backing from his own union, Mr. Wood approached the British Columbia Federation of Labour for its support. Mr. Clive Lytle, a senior member of the Federation's paid staff, prepared a report on the situation for his executive. It was not uncommon for the Federation to endorse positions taken by its affiliates, and the organization had a strong environmental protection policy.[119] On May 4 the Federation's opposition to the spray program was announced in a press release. It contained the text of telegrams sent to Mr. Waterland and to the Premier of B.C., the Honourable William R. Bennett, stating what had become the standard anti-spray position: concern regarding possible environmental and health impacts of the insecticides and a prediction that the budworm infestation would soon subside from natural causes.[120]

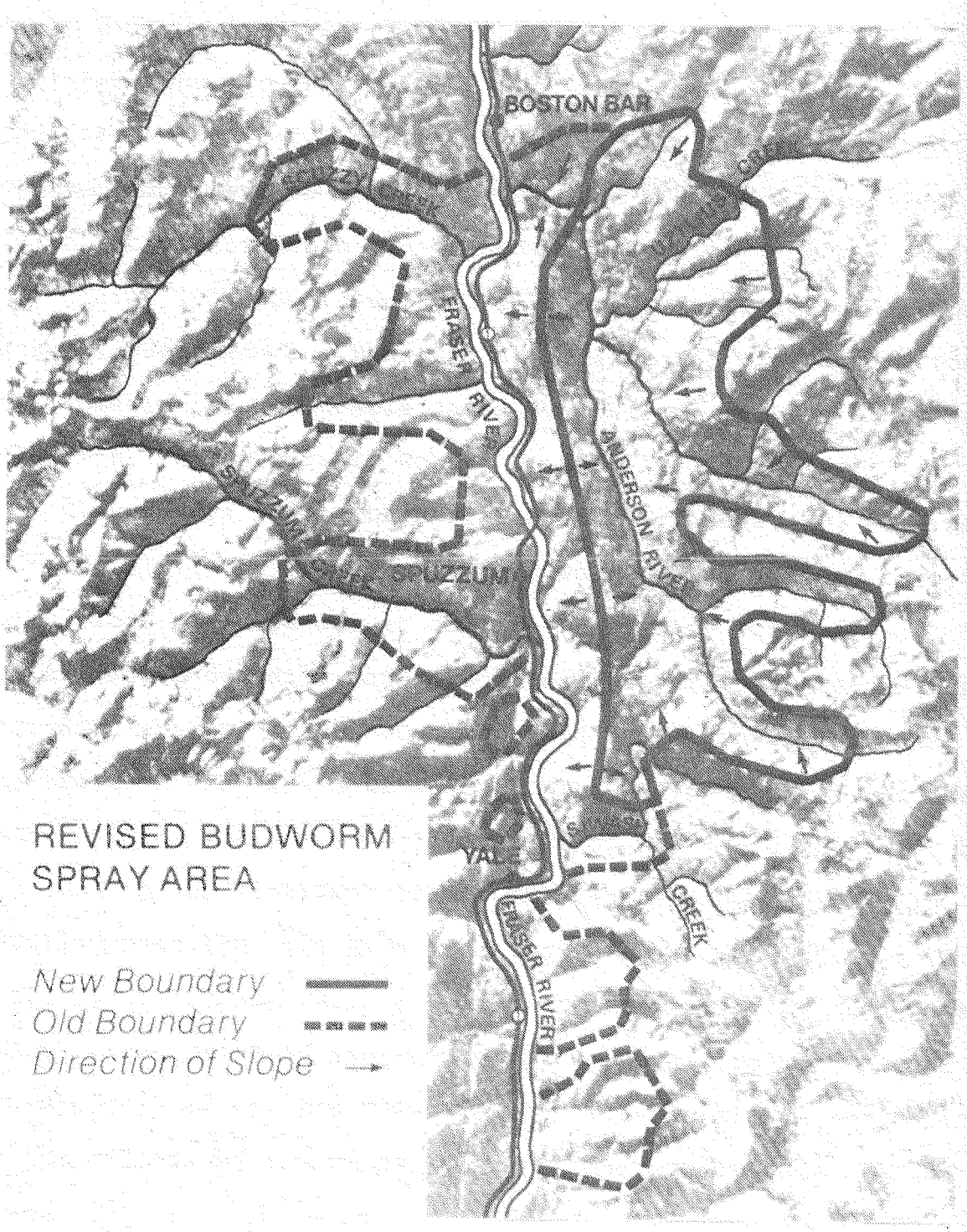
On May 9, the I.W.A. local held a public meeting in Hope to emphasize its support for the anti-spray campaign. Mrs. Doucet was an invited speaker. There were hints of possible civil

disobedience and strike action by forest workers if the spray program were to be implemented.[71][117][121]

Mrs. Doucet contacted Robert Heffelfinger, M.D., Chairman of the B.C. Medical Association's Environmental Health Committee, who agreed to hold a special meeting of the Committee. Mrs. Doucet and Dr. Courtland Mackenzie presented the arguments against the spray program, and discussed possible health hazards of Sevin and Orthene exposure.[71] On May 9, the BCMA stated its opposition to the spray in telegrams sent to Messers. Waterland and Bennett, as well as the Minister of the Environment, the Honourable James A. Nielson, and the Minister of Health, the Honourable Robert H. McClelland.[122][123]

Eleven days after the Conference in Victoria, Mr. Waterland had made his decision. The Minister announced on May 10 that the spray block would be cut in half to remove any risk of contaminating domestic water supplies. Only the Anderson River drainage, east of a 3500 foot mountain ridge running parallel to the Fraser River, would be sprayed. The Canyon itself, and the somewhat more inhabited sections west of it, would no longer be included in the treatment block. The revised boundaries (Fig. 7) complied with the 1976 Royal Commission's recommendation [B.C. Ministry of Forests 1977, p. 35] that no insecticide be applied within three miles of any community. The press release issued by the Ministry of Forests stressed that more intensive monitoring of the effects of the spray would be possible in this smaller area.[124]

Fig.7 Photomap of revised spray block boundaries.[124]


BOSTON BAR
FRASER RIV
ANDERSON RIVER
SPUZZUM
SPUZZUM
YALE
CREEK
FRASER RIVER
REVISED BUDWORM
SPRAY AREA
New Boundary
Old Boundary
Direction of Slope

Mr. Waterland felt that this modification recognized the real concerns which had been expressed about the original program.[111] although he himself remained "personally convinced, on the basis of all of the technical evidence, that the sprays to be used are not injurious to health or to the environment."[124] The entomologists involved in planning the operation agreed that the smaller program could still be effective, because it would still cover a complete drainage system.[9][13][43] But the groups who had been opposing the spray were not satisfied with the compromise. Dr. Heffelfinger of the B.C. Medical Association told the press that while the reduced area was an improvement, the Association was still "unhappy" about the program.[122][123][125][126] On the same day that Mr. Waterland announced the revised treatment boundaries, Dr. Moore of Greenpeace revealed that representatives of the Yale Ratepayers Association, the International Woodworkers Association, the B.C. Federation of Labour, Greenpeace and SPEC had been meeting to coordinate their anti-spray activities and would continue to do so in spite of the changed Forest Service plans.[123][125][126]

On May 18 they held a joint strategy session at the Federation of Labour offices in Vancouver. The meeting was chaired by Mr. Lytle, who wanted to help the more moderate Yale residents withstand pressure from Dr. Moore to undertake the kind of flamboyant civil disobedience that was the trademark of the Greenpeace organization.[119] Members of the Yale Budworm

Committee worried that threats of protesters "chaining themselves to trees" would serve only to alienate supporters.[127] The participants issued a joint press release, restating their opposition to the spray. They promised to continue publicizing the issue, presenting their views to government, and carrying out other, unspecified, "protest actions."[128]

The B.C. Forest Service information officer, Mr. Adderly, was also busy during May. He wrote another, much longer, set of "Questions and Answers," addressing many of the issues raised at the Public Information Days, and in letters sent to the Minister.[76] This 24 page document presented the B.C. Forest Service's reasons for spraying far more thoroughly than had the earlier public relations materials. Several of Mrs. Doucet's claims of insecticide toxicity were specifically refuted, and the description of the pesticide registration process, taken verbatim from the transcript of Mr. Waterland's Conference, was included as an appendix. The pamphlet also described the safety precautions designed to minimize hazards to both humans and wildlife. It was mailed out in response to all correspondence received by the Ministry of Forests concerning the spray program.[129]

Waterland himself wrote an impassioned plea for the program. He called the forests the "heart of B.C.... threatened, being literally eaten away by countless insects." He told the people of the province: "We must perform this treatment on our

heart, our forest. If we allow this budworm disease to progress, the pulse of British Columbia might eventually stop."[130] This dramatic appeal was sent as an open letter to the newspapers of the province,[131] who did not seem eager to reproduce it.

Undeterred by the intensifying controversy, the B.C. Forest Service/Canadian Forestry Service team continued their preparations. They built a base camp for the applicators and the monitoring crews, who were already conducting pre-spray biological studies, under the direction of Ms. Sandra C. Bourque. Ms. Bourque had been hired as Technical Supervisor of Monitoring after it had become clear that regular agency staff would not be available to carry out the work.[132][133] A helicopter landing pad was constructed, and insecticide mixing facilities were designed in consultation with inspectors from the Pesticide Control Branch.[134]

But the atmosphere was uneasy. Mr. Adderly was warned in Hope that people were "disturbed enough that they would shoot helicopters out of the air" or take "pot shots" at Forest Service vehicles.[76] Security guards were posted at the mixing site. There were rumours of bomb threats to the B.C. Forest Products Ltd. sawmill at Boston Bar, and spray project personnel worried about possible sabotage of helicopters of other equipment. One contract truck driver tried to force a Forest Service pickup truck off the road; he was fired by B.C. Forest Products for his pains.[7]

Some of the leaders of the public anti-spray protests were becoming more openly militant. In the wake of the May 18 meeting, Ms. Sims, Mrs. Kassian and Mr. Wood told reporters that they might be willing to risk going to jail for their attempts to force the government to abandon the insecticide program. Mr. Waterland replied - "It's their choice."[135] Dr. Moore promised that if other means proved ineffective, Greenpeace would "lead an active force into the spray area."[136]

The B.C. Forest Service reacted by hiring Pinkerton security guards to seal the access roads into the Anderson block.[102][136][137] Local residents were outraged: "We couldn't believe our MLA would have turned on the constituents with private police using public money!"[49] Opposition leader Mr. David Barrett, at the New Democratic Party provincial convention in Vancouver, condemned Pinkerton's, "an American private police force that has a record of being anti-people since the Chicago riots of sixty or seventy years ago.[138]" Even the Standard, which had been relatively sympathetic to the Forest Service all along, deplored the move as "one of the dumbest ideas of all time... flaunting a name that union men have been taught to hate for about a century in the face of the NDP annual meeting."[139]

The Orthene arrived by tanker truck from California on Saturday of the Victoria Day long weekend (May 21). No one was at the B.C. Forest Service office, so the drivers checked into a motel in Hope, leaving the trucks parked on the street[49][58]

The Kassians were worried about the lack of security: "If some crackpot damages those tankers, we'll be blamed for it."[49] The Yale couple pursuaded the RCMP to move the trucks into a Ministry of Highways work yard, where they would be behind locked gates. These trucks were designed for highway use; when they were driven up the Canyon, they couldn't climb the steep logging road into the Anderson block. According to the Mrs. Kassian: "The first truck almost got wiped out. They had to come down with a cat[erpillar tractor] and pull them up. They nearly lost the whole works into the Anderson River... And McArthur said we'd have no accidents!"[49]

On May 24, the Budworm Committee used funds from their walkathon to charter a bus to Victoria. They had an appointment to meet with Mr. Waterland, but only a small group was actually invited into his office. They chose 4 representatives to go inside, while 13 others marched back and forth in front of the Parliament buildings, carrying anti-spray placards. The Legislative Assembly was not in session at the time, but the picketers did get some publicity, which was the aim of the exercise.[49][140][141][142][143][144][145]

The meeting between Mr. Waterland and the Fraser Canyon residents was not pleasant for either party. When Ms. Heather Leader asked the Minister if he had any connections with the chemical companies, he took offense and insisted that she leave his office. In spite of the delegation's appeals that he respect the wishes of his constituents, Mr. Waterland told them that the

Anderson block would be sprayed as planned; furthermore, if the current program proved successful, more areas would be sprayed in years to come come.[49][141][142][143][145]

J. The Cabinet Decides

Two days after this categorical statement from the Minister of Forests, the spray program was precipitously called off by Cabinet order.

According to the May 26 announcement by the Minister of Environment, Mr. Nielson, [146] the program was to be "postponed" until passage of a new Pesticide Act. This Act, due to come before the legislature later in the year, would provide formal appeal procedures to accomodate popular objections to any proposed pesticide program.

Maintaining the confidentiality of Cabinet deliberations, Mr. Nielson mentioned none of the technical or political criticisms of the Fraser Canyon program. In the same press release, Mr. Waterland restated his position that the spruce budworm control treatment was necessary. He promised that his Ministry would continue monitoring the problem and would recommend a spray program for the next year, if budworm population levels warranted such action. Mr. Waterland's final remark made his displeasure clear: "Another year's damage to immature timber will have to be accepted in order to provide for appeal procedures to be set out in the new Pesticide Act."[146]

The Minister of Forests went even further, by breaking traditional Cabinet solidarity to tell reporters that he still believed the spray operation should have gone ahead.[147][148][149]

K. The Controversy Continues

Opponents of the spray were delighted with the Cabinet ruling. The Yale Budworm Committee held a victory celebration at the Kassian's house. Because they were well aware that Mr. Waterland still believed the budworm should be sprayed, they decided to continute meeting once each month during the coming year.[150]

After the Cabinet decision, Dr. Moore revealed the Greenpeace plan to occupy the Anderson Valley. They had intended to enter the spray block from a camp set up at the mouth of the Anderson River, on land belonging to one of the local Indian bands, thus avoiding the sealed access roads. The two hundred campers would have flown red balloons and kites to announce their presence to the spray pilots. A smaller group was to camp near the helicopters and surround the machines at dawn.[49][151]

Greenpeace was also planning to embarrass the provincial government by confronting the summer highway traffic with huge billboards at Yale and Boston Bar proclaiming "You Are Entering a Poison Spray Area." Next to each billboard, a pull-out area for cars would have been staffed by volunteers with leaflets

presenting the anti-spray position. The organization expected that booths set up there to sell Greenpeace posters, T-shirts and lottery tickets would have financed the protest.

Mr. David Boehm, a Greenpeace organizer, told the press that the local people were "completely behind" the plan, and were so angry that "they would have set fire to the forest and burned the whole thing down if the spraying started."(151) This statement finally convinced the pro-spray residents to speak out. A small group of them wrote a petition protesting the suspension of the 1977 spray program. After referring specifically to Boehm's remarks, they went on:

> "We as thinking and concerned citizens have and still do support the program proposed by the BCFS, as an experiment with very little risk to human life or the environment. ...We are appalled to see the effects of so small, though highly vocal [a] group of people on public thinking and the actions of our elected representatives."(152)

In the wake of the Cabinet decision, the B.C. Forest Service conducted an internal review of the Fraser Canyon affair. Mr. William Young, Assistant Chief Forester - Resource Management, had been out of the country during the spring of 1977. He was appointed to assess the B.C. Forest Service's role in the controversy. His report identified two key weaknesses, one organizational and the other attitudinal. He considered the responsibilities of the Chief Forester's position too broad to be managed effectively. He also criticized the public information program as proceeding from insufficient sensitivity to public concern. Mr. Young emphasized the importance of

acquainting the public with forest management issues and pest problems, so that when a control program is contemplated it can be judged from an overall forestry perspective. He recommended going to the public with the options, rather than presenting them with a finalized decision as was done in the Fraser Canyon.(153)

Although no budworm control would be attempted in 1977, the controversy was by no means over. Looking ahead to 1978, Mr. Waterland made it clear that he still favoured the spray program. Throughout the summer he kept his position before the public by writing letters published in the newpapers at the coast and in his southern interior constituency.(154)(155)(156) The Minister of Forests exposed the political basis of the Cabinet's action by saying: "If I had some public support before the Cabinet decision to postpone the spraying, I believe the decision would have been different. Do you realize that I received about 250 letters against spraying and only one in favour?"(154) Reminding everyone that the spray program was not cancelled but only "deferred," he urged readers to advertise their support for it by signing petitions, writing letters to Cabinet Ministers, and talking with their neighbors.

Six people from the Fraser Canyon area presented their pro-spray petition to both Mr. Waterland and Mr. Nielson in Victoria on June 20. According to Mrs. Ann Schudeleit, a Boston Bar resident and one of the originators of the petition, at least seventy-five percent of those asked agreed to sign [Young

1977]. Of the 351 signatures collected, 250 were from Boston Bar; the rest came from North Bend, Yale and other communities.[157] On the same day Mr. Waterland issued a press release publicizing his receipt of the petition and welcoming such "public support for control of this serious budworm infestation." He again promised that "if necessary, [the Ministry of Forests] will recommend a spray program for next year."[158]

One week later, Mr. Owen, backed by statements from Drs. Harris and Shepherd, reported that the budworm population was alive and well, producing widespread defoliation as predicted. This press release included a photograph of one of the roadside signs put up by the Forest Service to inform motorists that they were passing through an "insect damaged area."[159][160][161][162]

Meanwhile, the U.S. Forest Service spray program was carried out with only minimal public opposition. More that 350,000 acres [141,400 ha] in north-central Washington were treated with Sevin-4-oil [Dolph 1980; U.S. Dept. of Agric. -Forest Service 1978].[163][164][165]

In the hot weather of midsummer, defoliated trees turned an alarming red-brown colour. Mr. Waterland's July letters asked people who opposed the spray program to travel to the infested areas: "Will those who do not wish our forests to be protected please have a look at what is happening?"[166][167][168][169]

The B.C. Forest Service organized helicopter tours from the Anderson base camp to show off the visible effects of the infestation. A group of professors from the U.B.C. Faculty of Forestry went up on June 21;[170][171][172] the Interministerial Pesticide Committee followed on July 12. When the press arrived by invitation on July 21, Dr. Harris, Mr. McArthur and other forestry personnel were on hand to acquaint the reporters with scientific aspects of the situation. The Vancouver Sun was critical of Mr. Waterland's absence from the event, complaining "there was nobody there to answer questions of a political nature."[173]

Opposition MLA's were also critical of Waterland on July 15 when he opened legislative debate on his budgetary estimates by intoning "Let us spray [Prov. of B.C. 1977, p. 3723]." During this customary opportunity to put the Minister on the defensive about his policies, the New Democratic Party Environment Critic, Mr. Skelly, and others of his party repeated the standard arguments against the spray program. Mr. Waterland replied with the standard arguments in its favour. The discussion was duly reported in the newspapers, continuing the press coverage of the budworm spray issue.[174][175]

Through all of the controversy, statements from the forest industry had been conspicuous by their absence. The industry was certainly not above the exercise of political influence; the Council of Forest Industries maintained a full-time lobbyist in Victoria to keep track of government activities and promote the

Council's interests.[176][177] Nor were they averse to aerial spraying: the Council of Forest Industries itself had conducted a 1973 control program against blackheaded budworm on Vancouver Island [Carrow 1974; Lejune 1975].[83] But the Council was not particularly inclined to become embroiled in the Fraser Canyon dispute and the individual companies preferred to avoid identification with contentious public issues.[7][110]

Although the spruce budworm infestation was of great concern in some areas, in the overall picture of B.C. forestry it was not of significant magnitude to force the Council as a whole to take a position. Most of the forested land in B.C. is publicly owned; the forest companies consider themselves "tenants" on this Crown land.[178] Because the control block was not part of a company-managed tree farm license, or even in an active cutting area, no company was directly and vitally concerned concerned.[176][178] Even B.C. Forest Products Ltd., which held harvesting rights for most of the Anderson block, did not publicly advocate the spray.[7] Uncertainty regarding the economic return from the program made it appear even less worthwhile for industry to get involved. The Minister was distinctly displeased with this lack of support.[111][176]

The first public statement about the spray program from a forest industry source came on July 27. On that date, the newly elected executive of the B.C. Independent Logging Association issued a press release supporting Mr. Waterland's position.[179] The BC Lumberman, a trade magazine published by a subsidiary of

the Southam newspaper chain, devoted a feature length article in its August issue to the "Budworm Controversy [Young 1977]." Although it did refer to the opposition campaign as "hysteria," the piece presented arguments and personalities on both sides of the issue, before concluding that the infestation should have been treated years earlier, when it was still small.

Throughout the summer, debate over the spray program continued in the Editorial and Letters columns of Victoria, Lower Mainland, and Southern Interior newspapers.[180][181][182][183][184][185][186][187][188][189][190][191][192][193][194][195][196]

Meanwhile, the B.C. Forest Service was left with a base camp, helicopter pad, large quantities of insecticides, and a crew of biologists hired to carry out the non-target organism monitoring program. Unfortunately, the Sevin-4-oil had already been mixed with its fuel oil carrier, and could not be returned to the manufacturer. It was pumped back into tanker trucks and shipped to Kamloops for storage.[58][197] The Canadian Forestry Service entomologists had planned their summer field season around the budworm control project; the end of May was far too late to begin designing completely new experiments.[43] How could they all make the most of the resources which were already bought and paid for?

The forestry scientists decided to use the personnel and equipment they had assembled for the spray program to fill some of the information gaps which had weakened their defense of the

spray program. They collected biological data on the budworm over an area more extensive than the Anderson spray block, and expanded their planned research on the effect of defoliation on Douglas-fir growth and survival.[198][199]

They also hoped to get some answers to nagging questions of drift in the windy hills of the Fraser Canyon area. But their plan to spray test plots with coloured water and oil, which would also have provided operational experience to B.C. Forest Service staff, was not carried out because of difficulties with the spray equipment.[133][200] Mr. Tripp's proposal to test the efficacy of the bacterial insecticide Bacillus thuringiensis against spruce budworm in a 200 acre [80.8 ha] patch of forest[198][199] was dropped because it too was a "spray program" [Young 1977].

The non-target organisms monitoring program was revised as an intensive base line study of game animals, birds and fish, in anticipation of future insecticide applications.[133][201] In addition, Dr. Oloffs examined the effects of Orthene on fish and aquatic insect populations by deliberately introducing the chemical into a small stream.[133][201]

The western spruce budworm infestation continued to be an important topic of discussion in forestry circles. On August 19, the Council of Forest Industries invited a group of university, government and independent entomologists to a workshop on budworm population dynamics and management strategies.[202][203] The Pacific Forest Research Centre of the Canadian Forestry

Service held an all day seminar, "Current status, impact and control of western spruce budworm," on October 21, with speakers from the Canadian Forestry Service, the U.S. Forest Service, and the Canada-U.S. Budworm Research program (CANUSA)[204] which had recently been established.[205]

In August another provincial government task force was set up to study the budworm problem, this time under the auspices of the B.C. Forest Service rather than the Forest Pest Review Committee. Mr. Robert C. Sutton of the Protection Division was appointed to lead the group. He was joined by staff from several of the B.C. Forest Service divisions; Dr. Shepherd represented the Canadian Forestry Service. They were charged with the task of recommending the course of action, if any, to be taken against the western spruce budworm in 1978.

L. The End of the Spray Program

The B.C. Forest Service was generally expected to propose a spray program for the coming year, since Mr. Waterland had referred to the possibility in many of his letters and press releases. Mr. Owen told the June 24 meeting of the Forest Pest Review Committee that the "Minister wish[ed] planning to be on the basis of a 1978 resumption of the project unless there [was] a natural collapse of the insect in the interim."[206]

Such a collapse did not appear likely. B.C. Forest Service news releases in August and September informed the public that

the area of the infestation was increasing. Although Canadian Forestry Service field surveys indicated that fewer budworm eggs had been laid in 1977 than in the preceding summer, they still considered the potential 1978 population high enough to cause concern.[207][208][209][210][211] In November, 1977, the Canadian Forestry Service again recommended to the B.C. Forest Service that they consider an aerial insecticide treatment.[212]

The report of Mr. Sutton's task force, submitted in December, restated the observation that the infestation was still spreading. It also repeated the earlier B.C Forest Service and Canadian Forestry Service conclusion that aerial spraying of a chemical insecticide was the only currently feasible control method. But the benefit/cost analysis conducted by task force member Mr. Winston Wai, of the B.C. Forest Service's Special Studies Division, reached conclusions that were radically different from those of Dr. Nagle's earlier study. (The Council of Forest Industries also carried out an economic study, which has never been made public.[111][176]) According to Mr. Wai, at best there would be only 22 cents of economic return for every dollar spent on a spray program in the Fraser Canyon. This figure was far less favourable than the $1.12 calculated by Dr. Nagle.

The basic terms of reference and assumptions of the two studies were similar,[213] but the B.C Forest Service economist presented his methods in a far more methodical and detailed form than had Dr. Nagle [Sutton 1977]. The Task Force Report provided

the following explaination for the differing results:

a) The previous report based its estimates of volume gains from spraying on the rate of growth of treated stands at the time of spraying. This report measures these additional volumes based on rates of growth when the stands are likely to be harvested.
b) The previous report indicated spray costs of about $5.00/acre. This report indicates spray costs of $12.25/acre.
c) The previous report indicated that the benefits of spraying would arise on an area one and a quarter times (125%) the area sprayed, on the assumption that spraying would reduce the spread of the infestation. This report is far more conservative in this respect.
d) The previous report allowed for rehabilitation and salvage costs in the event of mortality from the infestation. Mortality is not considered in this report [Sutton 1977].

The task force report was made public on February 1, 1978. Mr. Waterland admitted that the benefit/cost figures made a spray program unlikely, but would not commit himself until the Forest Pest Review Committee had discussed the report and concurred with its negative recommendation. That agreement was reported March 23.[214][215] On that date the Minister of Forests finally confirmed that the western spruce budworm would not be sprayed in 1978.

IV. DISCUSSION

Three factors dominated the Fraser Canyon controversy. The first was the perception of the B.C. Forest Service Protection Branch that the decision to control the spruce budworm infestation was purely technical; the second was the existence of a segment of the public which was predisposed to object to any aerial insecticide application; the third was the inadequacy of the biological and economic information available to the B.C. Forest Service at the time. These factors made it possible for a small but vocal group of local residents to block the spray program, by transforming the decision from an ostensibly technical one, made within the confines of a few government agencies, to a political one, in which public opposition was impossible to ignore.

It was quite natural for the Protection Division staff who were evaluating the spruce budworm problem to consider it only in terms of forest biology and economics. Their training and experience were technical, and as for their mandate, how could it be wrong to protect the forest from fire, disease and insects? The operational foresters saw the infestation as analogous to a fire[8][9][13][178]; they did not seem fully to appreciate that insect suppression could be very different from and much more controversial than fire suppression.

Unfortunately for the Protection Division, 1976 and 1977 were unusually busy years for the senior civil servants in the Ministry of Forests. The Deputy Minister, Mr. T. Michael Apsey, who normally functioned as the link between the technical and political levels of the Ministry, was working full time on the complex, sensitive task of evaluating and implementing recommendations of the 1976 Royal Commission on Forest Tenures. The Chief Forester, Mr. Edward L. Young, had been appointed Acting Deputy Minister to replace him. The result was that a crucial level of political scrutiny was missing when the spruce budworm control program was being planned. Morever, Mr. Young's own workload had been doubled, and he simply did not have enough time to consider with due care everything that crossed his desk.[216] The lack of available political judgement led to serious underestimation of the extent and sophistication of the opposition that the spray program would engender.

The Fraser Canyon, and the province at large, held people who were ready to see government agencies as serving powerful vested interests, rather than the general public. Mrs. Kassian's past hostility to the B.C. Hydro crews as invaders of her privacy, and her initial reaction to the B.C. Forest Service in terms of "What are they going to do to us this time?" exemplified this attitude. Throughout the 1970's, environmentalists had been connecting instances of environmental degradation with profitable industrial ventures, and accusing governments of unduly protecting economic interests.

Well-publicized major scandals, such as the thalidomide tragedy or the Love Canal affair, strenthened suspicions that one does not necessarily "live better chemically" and that the sanction by experts of a substance or procedure was no guarantee of safety. Might not scientific expertise itself be a vested interest? The insensitivity displayed by the B.C. Forest Service staff in their dealings with the public, and their paternalistic tone of "trust us", combined with an inability to answer toxicological questions at the Public Information sessions, served to reinforce the apprehensiveness and skepticism of some.

For those people concerned about possible health and environmental effects of chemicals, modern life is full of occasions for anxiety. Proponents and planners of the Fraser Canyon spray program expressed exasperation at the opposition to their program, in which the amounts of pesticides to be used, and the exposure of humans to them, would have been negligible by agricultural standards.[8][9][178] It is interesting to note that the aerial spray programs against the Douglas-fir tussock moth near Kamloops, and against western spruce budworm in Washington, which met with little local opposition, were carried out in partly agricultural areas, where pesticides were used every season.[76][217]

Several characteristics of forestry operations made them particularly exposed to environmentalist attack. Farms are privately owned, but in B.C. most forest land belongs to the Crown and is thus a public resource, at least theoretically

subject to public control. Unlike agricultural applications of toxic chemicals, their use in forestry was not routine. The emerging public concern with real and imagined hazards of chemical use found pesticide treatments firmly entrenched in agriculture, but relatively sporadic in forestry. A discrete control operation was thus available for a discrete opposition campaign. Moreover, at the current level of management, infestations of forest insects typically became of concern when they extended over thousands of acres; thus the chemical treatments were large-scale and dramatic.

The wisdom of this tendency to treat forest insect outbreaks only after they have become widespread has been questioned. Several of the forestry professionals interviewed in the course of this study have said, with hindsight, that the western spruce budworm infestation should have been sprayed years earlier, while it was still limited in extent.(6)(8)(9)(178)

The decision to spray the Fraser Canyon was originally made on technical grounds. While it was being scrutinized by various government departments, the decision was wholly within the bureaucratic arena. The Forest Pest Review and Interministerial Pesticide Committees had been established to deal with conflict between government agencies by regularizing consultation and providing a means for imposition of safety conditions on pesticide use. This process was neither exposed to public view nor open to public input. (Only the Forest Pest Review Committee

and its 1976 Budworm Task Force contained a few non-government members, and even these industry participants dropped out of the picture once the Fraser Canyon was chosen as the treatment area.) Such a "closed" decision-making process was entirely typical of Canadian decision-making.

The premise on which the closed decision-making scheme is ostensibly based is that the public interest as a whole is served by dividing it into components which are then the mandates of government agencies. When the agencies reach a consensus, or at least an accomodation, about what is to be done in a given situation, the public interest as a whole has supposedly been reconstituted and served.

However, interministerial committees do not necessarily produce optimal environmental or health protection. Not only must information be gathered and considered on technical grounds, but its significance must also be weighed in order to reach a decision regarding a particular pesticide program. Can civil servants meeting behind closed doors be entrusted to make that evaluation? What kind of screening determines committee membership? How seriously are management options other than pesticides considered? What personal or agency conflicts and ambitions enter into the committee's discussions?

The decisions taken by a committee are functions of its composition. Although the B.C. Fish and Wildlife Branch was represented on the Forest Pest Review Committee, along with the B.C. Parks Branch and the federal Environmental Protection

Service, they were outnumbered by industry and government organizations with forestry mandates. This imbalance suggested that forestry was a more important contributor to the public interest with respect to forest land than was fisheries, that there were a larger number of forestry organizations requiring seats on the Committee, and/or that the Committee had been set up to give the agencies with environmental protection mandates a voice in the discussions but little chance of controlling them. Whether fairly or unfairly, the B.C. Fish and Wildlife Branch perceived the Forest Pest Review Committee as loaded, an accusation they made in the form of an open letter to the Committee chairman, Mr. Owen.[28] The letter was distributed to all members of the Committee, and drew a strong reply from the offended forester.[218]

The Environmental Protection Service actually had the legal right to order a halt to the program, by means of the federal Fisheries Act, which forbids any action that might endanger fisheries. But although they and the B.C. Fish and Wildlife Branch judged the spray program to be ill-considered, and strongly opposed it in committee discussions, they did not exercise their prerogative to prohibit it. They did not have a strong case for doing so, since their resource did not appear to be in immediate jeopardy, and the B.C. Forest Service had presented its plans to the Interministerial Pesticide Committee in good faith [B.C. Ministry of Forests 1977a, p. 70].[58][59] In fact, the Environmental Protection Service has seldom used

its authority to override the actions of other agencies.[58] Perhaps the strength of its legislation has not been matched by its strength as a player in the bureaucratic game.

The insularity of the decision-making process may have contributed to the lack of political sensitivity which characterized the whole affair. Since the public interest was supposedly taken care of by the make-up of the committees, the civil servants may have been insensitive to the need to find out the public's own perception of it. The environmentalists may also have presumed the anti-pesticide point of view to be inadequately represented by the technical personnel serving on the committees. Without any way of participating in the decision-making process, or even of assessing the perspectives of the people involved, unless they chose to express themselves publicly, the environmentalists were not likely to accept the results as sufficiently conservative with respect to pesticide use.

Security of tenure makes civil servants much less susceptible to public pressure than are politicians. In order to use effectively their one real weapon, adverse publicity, the Yale Budworm Committee had to shift the decision to spray or not out of the bureaucratic arena and into the political arena.

Any management decision is an exercise of judgement, because any real problem can be only incompletely described and imperfectly modelled. In this case, substantial gaps existed in both the ecological and economic data, and in predictive

ability. There were many technical questions about the spray program which could not be answered conclusively. These included:

WOULD IT HELP TO SPRAY?

1. When would western spruce budworm populations decline naturally?
2. Would one insecticide treatment do the job, or would treatment of the same area be needed in subsequent years?
3. Which larval instar should be sprayed?
4. At what point in the course of an infestation should treatment be undertaken?

WOULD IT HURT TO SPRAY?

1. Would Sevin or Orthene produce significant environmental effects?
2. Would the planned safety precautions be sufficient to protect personnel working on the project?
3. Would there be any danger to the public health?
4. Could the application be adequately controlled with respect to spray drift and aviation accidents?

WOULD IT PAY TO SPRAY?

1. How much timber would be gained, and at what time?
2. How much money is that timber worth?
3. Would an economically significant amount of degradation from sawlogs to pulplogs be prevented by the treatment?
4. What would be the economic value of averting other budworm impacts, such as increased fire hazard or ugly brown hillsides?
5. Would these savings be greater than the direct and indirect costs of the spray?
6. Would the spray program be the most productive use of the

expenditure?

7. Is western spruce budworm a real danger to the forest industry or merely a recurrent nuisance?

The spray plan was the "best guess" of B.C. Forest Service and Canadian Forestry Service protection personnel. As such, it was acceptable within this group of experts, who shared values about the primary importance of protecting the forests. But outside this group, the questions about the efficiency, safety and economic value of the spray program gave the anti-spray position a technical legitimacy which greatly aided politicization of the issue.

Mr. Waterland tried to prevent this politicization, declaring that "the decision will be made on technical not emotional grounds."[80] The authority of the Canadian Forestry Service and B.C. Forest Service over the decision rested on its characterization as a technical one. If disagreements about the technical validity of the program could not be resolved, the decision could not be contained inside the bureaucracy. The incompleteness of the technical information available to the B.C. Forest Service was thus a decisive element in the controversy.

Moving consideration of the spray program from the bureaucratic to the political arena was designed to make the elected government concerned about the impact of the issue on its public image, and hence on its ability to stay in power. This strategy called for winning the broadest possible support.

The opposition party always looks for issues with which to embarrass the governing party, but its participation was not necessarily an advantage to the single-issue anti-spray group. Overt New Democratic Party participation could detract from the substantive legitimacy of the anti-spray position, by suggesting its dismissal as mere "partisan politics."

The Budworm Committee was aware of this. They tried to avoid the image of an "NDP issue,"[49][69] which was not easy, since many of the individuals active on the Committee were NDP party members.[49][117] They were not successful in divorcing the issue from party politics: the anti-spray campaign was perceived as politically motivated by many of the supporters of the spray program.[3][6][8][13][43][101][110]

The same concerns which led the original group of Yale residents to oppose the spray program were at work to provide them with allies in the wider population. The positive portrayal of the protesters in the big city media both reflected this public sympathy and strengthened it. Emergence of such experts as Messers. Langer and Richmond, and Drs. Graham, Beirne and McInnes greatly increased the credibility of the anti-spray position. Although she was not a member of the technical community, Mrs. Doucet was a forceful speaker, who made frequent and impressive references to the scientific literature. The statements of these people provided another source of material for the media, further widening the appeal of the protest movement.

Treatment of the controversy by the Hope Standard differed greatly from that by the metropolitan papers. For example, where the Vancouver Sun headline read "Pesticide expert denied place at Canyon spray conference,"[98] the Standard said "Budworm enquiry appears unbiased."[108] The strong reactions to these differences expressed by various people involved in the controversy attested to the pivotal role of the media. Yale Budworm Committee members were offended by the reluctance of the Standard to oppose the spray program; they seemed to feel betrayed by their local press. At the same time, they recognized that in order to carry out their strategy of defeating the spray program by forcing government to consider its political consequences, they would have to court the big city papers.[49] They were notably successful in doing so. Meanwhile, supporters of the spray program praised the "unbiased" reporting of the Standard and condemned the Vancouver and Victoria papers as sensationalist and inaccurate.[9][12][13][155]

Mr. Waterland's direct backing of the spray program played into the Yale Budworm Committee's strategy. He was attempting to lend weight to the program by supporting it, but because he was a Cabinet Minister, his involvement automatically made the issue political. Perhaps Mr. Waterland's own technical background made it natural for him to support the Protection Division in the face of anti-spray picketers; perhaps the location of the spray block in his own riding led him to take a special interest in the matter. Either way, his participation removed a level of

political responsiveness, because he took an explicit public position before the extent of adverse reaction was fully apparent or gauged. (This observation is not my own. Several interview subjects who did not wish to be identified with such a criticism of the Minister suggested this to me in confidence.)

Mr. Waterland's stated purpose in holding his April Conference was to bring the spray decision back to its original technical level. But the Conference was also political, in the sense of the Minister's being seen to address the concerns of the anti-spray group. The decision to reduce the treatment block to the region east of the Fraser Canyon itself was similarly both technical and political. By avoiding spraying of settled areas, the reduction addressed the issue of unidentified domestic water sources, which Mr. Waterland judged to be the significant shortcoming of the original plan. It was also a visible and concrete response by the Minister to local uneasiness about the program.

Mr. Waterland delivered his compromise. But it failed to satisfy the spray's opponents. They wanted the program cancelled because they were suspicious of insecticides on the one hand and of the B.C. Forest Service on the other. No amount of attention to operational detail would satisfy people who had decided that the whole procedure for registering insecticides was an insufficient assurance of safety. From the Yale Budworm Committee's point of view, the Minister proved intransigent. The government as a whole therefore had to be persuaded that the

spray program was not in its interest.

The principle of Cabinet secrecy makes it impossible to ascertain what went on in the discussions which led to its final intervention. A political basis for the Cabinet decision was implied in the announcement made by them. It appeared to be a response to public pressure, couched in terms of providing an official channel for such protest in the future, rather than a rejection of the spray program on technical grounds. The Budworm Committee's strategy of politicization had succeeded.

V. EPILOGUE

Six years have passed since the task force chaired by Mr. Sutton recommended against western spruce budworm control. The following sections briefly describe subsequent developments in the areas of concern of the Fraser Canyon controversy.

A. The Infestation

Over the last few years the course of the western spruce budworm epidemic has been erratic (Table 10). As predicted by proponents of the spray program, the extent and severity of defoliation were very great in 1977. But although fall egg counts indicated continuing high levels in 1978, the actual experience of that summer was quite different. The area of defoliation fell to its lowest level since 1973, leading the Forest Service's Task Force to pronounce the infestation "in decline [Sutton 1979]."

The environmental groups and Fraser Canyon residents who had opposed the spray program were most gratified by this obliging behaviour on the part of the insect.[49][69][71][117][219][220][221][222][223] Unfortunately for both environmentalists and trees, the expected return to endemic population levels did not take place. Although the decline in defoliated area did continue in 1979 in the Fraser Canyon, the

Table 10. Number of budworm infested hectares in the Vancouver and Kamloops Forest Regions, 1977-1981 [Sutton 1977; Andrews and Monts 1979; Fiddick and Van Sickle 1979, 1980, 1982; Morris et al. 1979].

Region	Infested Areas by Year				
	1977	1978	1979	1980	1981
Vancouver	90,315	25,200	19,800	27,300	*
Kamloops	153,900	5,200	26,000	43,500	16,300

*two isolated patches of defoliation noted

infestation around Lillooet began to expand again. This increase continued in 1980 and was joined by expansion in the Fraser Canyon that year. In 1981 defoliation once again declined, precipitously in the case of the Fraser Canyon area (Table 10). Both the 1978 and 1981 seasons of reduced defoliation were associated with cool, wet weather [Fiddick and Van Sickle 1982].[8][178] It is not yet clear whether the 1981 decline was the beginning of a real collapse of the infestation.

B. Scientific Studies

The Non Target Organisms Monitoring Program

Ms. Sandra C. Bourque, technical supervisor of the Non-Target Organisms Monitoring Program (see p. 96 and p. 135), submitted her lengthy report to the B.C. Forest Service Protection Branch in February, 1978.[133] The program had been plagued by difficulties all along. These included: inadequate lead time for planning; the sudden shift in focus necessitated by suspension of the insecticide treatment; limited access to equipment; and insufficient funding.[58][200][224][225] In Ms. Bourque's own words: "it is physically impossible in one month to design a study, hire staff, find and test equipment, select and prepare sample sites and collect one week's pre-spray data

as was expected for this study."[226] The rough terrain and spring-swollen streams of the Anderson Block added technical difficulties to these organizational problems.

Conflicts between the B.C. Fish and Wildlife Branch and the B.C. Forest Service regarding financial support of the study led to a lack of clarity in budgeting. As a result, many samples were collected in the field which could not be processed when funds ran out. Statistical analyses of the data were not performed for the same reason.[58][200][224][225][227][228][229] This was a further source of friction between the B.C. Forest Service and the B.C. Fish and Wildlife Branch/Environmental Protection Service combination, who were concerned that an inconclusive study might forevermore be cited in support of future spray programs.[200]

The report, which was never published, presented tables of inventory data for terrestrial invertebrates, mammals, birds, amphibians and reptiles, pond invertebrates, periphyton (anchored algae and other plants), and fish in the Anderson Block east of the Fraser River. Practical difficulties encountered in the course of carrying out such work and ensuring its relevance to assessment of pesticide impacts, were emphasized throughout.

Based on her experience in carrying out this study, Ms. Bourque advised against attempting to assess the effects of spraying on higher vertebrates or aquatic organisms by means of pre- and post-spray field studies. She felt that sampling

problems, relatively low pesticide exposure, and the multiplicity of other influences on abundance of these organisms would combine to make a realistic assessment impossible. Instead, she suggested combining laboratory studies of pesticide effects with pre-spray inventory data. She did feel, however, that effects on terrestrial invertebrates could be evaluated directly, because pesticide exposure would be higher and available sampling methods were more reliable than those for vertebrates and stream organisms. She also recommended field studies of pesticide decay over time and of the effectiveness of buffer strips in keeping pesticides out of streams.

An experimental introduction of Orthene into Hidden Creek, a small stream located in the southwestern portion of the Anderson Block, was also described. The experimentors collected stream organisms before and after treatment. They also measured the survival of caged fish fry and aquatic insect larvae suspended in the treated water.

The results of both the inventory and stream injection studies were presented in tabular form only. Ms. Bourque declined to interpret the data, because they had not been analyzed statistically. She did, however, end her report with a general comment on what she found in the Anderson Valley:

> Finally, the budworm infestation in the Anderson Block was chosen to be treated with pesticides partly because it was felt that fish and wildlife resources in the area were comparatively low. However, this assumption was made because of the void of information-- the Provincial Fish and Wildlife Branch had not sampled any populations and no creel census or hunting records were available for either the Anderson, Spuzzum or Scuzzy watersheds.

> Yet after this summer's studies, rainbow trout, deer, bear, Evening Grosbeaks, Yellow-Bellied Marmots and chipmunks were all found to be abundant throughout the area.(230)

Studies of insecticide persistence

Mr. Yuen Sui Szeto and Dr. Oloffs, of Simon Fraser University, carried out laboratory studies on another aspect of possible insecticide contamination of aquatic systems. They measured the persistence of Orthene and Sevin added to water samples drawn from a pond and a stream near the Fraser Canyon. Sevin was shown to be less persistent than Orthene in such waters [Szeto et al. 1979].

Field trials of biological insecticides

In June, 1978, plots infested with western spruce budworm near Lillooet were sprayed with one of two so-called biological insecticides. This study was a joint project of the B.C. Forest Service and the Canadian Forestry Service. The materials tested were a virus isolated from the eastern spruce budworm and a commercial formulation of Bacillus thuringiensis. Although considerable larval mortality was produced by each material, only one out of three replicates of the virus treatment and one out of four replicates of the B.t. treatment were judged to give "adequate" control. The authors recommended further testing [Hodgkinson et al. 1979].

Evaluation of budworm impact on tree growth

Studies began in 1970 by scientists of the Canadian Forestry Service were far from completion in 1977. Damage appraisal cruises carried out in the summer of 1977 found low incidence of budworm-caused mortality and only occasional stands infested with Douglas-fir beetle [Shepherd et al. 1977; Collis and Van Sickle 1978]. In subsequent years, detailed dissections and tree ring width measurements were carried out on trees felled in budworm-damaged stands in the Pemberton and Anderson River areas. Losses in radial and height growth due to as many as five infestations during the lifetimes of individual trees were measured. These data were used in the development of a computer graphics program designed to calculate and display radial and height growth of actual trees, as well as estimations of potential growth in the absence of insect attack [Thomson and Van Sickle 1980]. Some of these trees had been marked, and the defoliation they endured recorded from 1970 to 1980. This procedure made possible the establishment of correlations between measurements of intensity of defoliation and amount of mortality and growth loss.

The stand at Railroad Creek, near Pemberton, was severely defoliated from 1970 through 1974. Mortality was 39%, concentrated in the suppressed and intermediate trees. Douglas-fir beetle was active in the stand, but most of the

infested trees recovered. Mortality began in 1973 and peaked in 1976, two years after defoliation had ceased. By 1978 annual mortality had returned to the pre-outbreak level of about 0.5% per year. The authors of the study therefore recommended that surveys be conducted at least three years after the end of the outbreak [Alfaro et al. 1982].

Trees at Railroad Creek, which had endured four infestations over their lifetimes, were found to have lost 32% of their potential height growth. In the stand observed in the East Anderson River drainage, two infestations produced a combined reduction in height growth of 19% [Van Sickle et al. 1983]. A survey of 17 stands carried out in 1977 found 35% of the standing trees showing dieback visible from the ground, while 85% of 65 stands examined in 1979 averaged 19% of trees with dieback. The frequency and severity of height growth reductions observed by the Canadian Forestry Service scientists led them to believe that "dieback is an important consequence of budworm infestations and should be considered in growth projections [sic] studies [Van Sickle et al. 1983]."

The combined radial growth effect of the four outbreaks at Railroad Creek was found by Alfaro et al. [1982] to average 12% of the estimated potential diameter of the trees at breast height. These authors felt that radial losses may be higher at upper levels in the stem where the annual growth rings are wider.

The gradual resumption of normal growth rates was also followed, and found to extend over a five-year period. The 1970-1974 outbreak thus caused a total of 10 years of subnormal growth at Railroad Creek [Alfaro et al 1982].

It is not possible to compare the findings of these studies, in which only a few stands were measured in detail, with the growth loss estimates used in the benefit/cost analyses of 1977. According to Dr. Rene I. Alfaro of the Canadian Forestry Service, the results from the stand at Railroad Creek, which experienced 5 consecutive years of severe defoliation, "represent the 'upper ceiling' of stand growth losses due to budworm rather than an average or common situation."(231)

Dr. Alfaro, in cooperation with the B.C. Forest Service, carried out extensive surveys in the Fraser Canyon, Manning Park and Pemberton areas in the summer of 1982. He found the most significant damage on the steep slopes of the Fraser Canyon, where mortality was frequent and topkill widespread.(231) When analysed, the data collected on Dr. Alfaro's 1982 survey will indicate the frequency and severity of mortality, topkill, radial growth loss and total volume loss on a per hectare basis.(231) This will make possible for the first time an overall estimation of the losses caused by the budworm infestation.

The Canadian Forestry Service researchers intend to carry their work to the point at which it will be of practical use to the forest manager. Thus budworm impact will be evaluated in

terms of merchantable volume, taking into account the quality losses associated with forked tops, crooks and other consequences of topkill. Furthermore, they point out that the merchantable value of a stand must be compared with the lowest value at which the stand can be economically harvested. They conclude that:

> If the cumulative effect of budworm outbreaks in a stand reduces merchantability below [this] operability limit, the budworm has essentially removed that stand from the harvest schedule, and effectively destroyed the entire volume of the stand [Thomson et al. 1982a].

These authors have developed a graphical method for relating predicted stand volume at rotation to stand age at the start of a budworm outbreak and the expected duration of the outbreak. [Thomson et al. 1982b]. If adequate data are available to construct such graphs for a variety of situations, they could be valuable aids to decision-making.

Surveys of budworm natural enemies

Two surveys of the level of parasitism in budworm populations were conducted in 1977 and 1978, one by Simon Fraser University entomologists [Doganlar and Beirne 1978] and the other by Canadian Forestry Service entomologists [Harris and Dawson 1979]. The Simon Fraser group confined their attention to the Yale-Spuzzum area in 1977, while the Canadian Forestry Service scientists worked mostly on both sides of the Fraser Canyon in 1977 and in the Thomson-Lillooet area in 1978. The

1977 results for total larval parasitism were quite similar in the two studies, around 50%. Seasonal trends were, however, different: the Simon Fraser group found parasitism increasing from early to late instars, and the Canadian Forestry Service group found the reverse. Total parasitism and seasonal trends also varied among the areas sampled by the Canadian Forestry Service team. Both studies reported low incidences of microbial disease in the budworms they collected.

The two publications differed in their assessment of the significance of parasitism for budworm control. Doganlar and Beirne [1978] state in their introduction that "the controversial decision...to spray the infestation of budworm in the Fraser Canyon district with chemical pesticides in 1977 was made apparently without adequate evaluation of the importance of parasites and predators that might contribute to the collapse of the outbreak but could be harmed by the pesticides." They do not, however, attempt to relate the results of their survey to this concern.

Harris and Dawson [1979] considered the occurrence of insect parasite populations throughout the infested area to imply that these populations would not be at risk from an insecticide treatment of only a portion of that area. An analysis of variance carried out by these authors showed no relationship between number of years of defoliation and level of parasitism at their various collection sites. They also noted that the 1978 decline in budworm populations occurred throughout

the infestation, regardless of the level of parasitism. These observations cast doubt on the importance of parasitism as a cause of outbreak decline.

Other studies

The report of the 1978 Western Spruce Budworm Task Force, again led by Mr. Sutton, described several other projects. These included: ground surveys of budworm defolation in the areas around Hope, Pemberton, and Lillooet; observations of wind patterns in mountainous terrain near Cache Creek; and evaluations of remote sensing techniques used in aerial estimation of defoliation [Sutton 1979; Harris et al. 1978].

C. Changes in the Ministry of Forests

The recommendations made by Mr. W. Young concerning responsibilities of the Chief Forester were incorporated into the general reorganization of the Ministry of Forests which took effect in 1979. The new structure was based on a separation between so-called "line" operations, carried out throughout the province, and overall planning and coordination, centralized in Victoria [B.C. Ministry of Forests 1979]. The Chief Forester's former responsibilities would henceforth be divided among four Assistant Deputy Ministers (Figs 8 and 9).

Fig. 8. B.C. Ministry of Forests Organization Chart, 1977. Adapted from B.C. Ministry of Forests [1978].

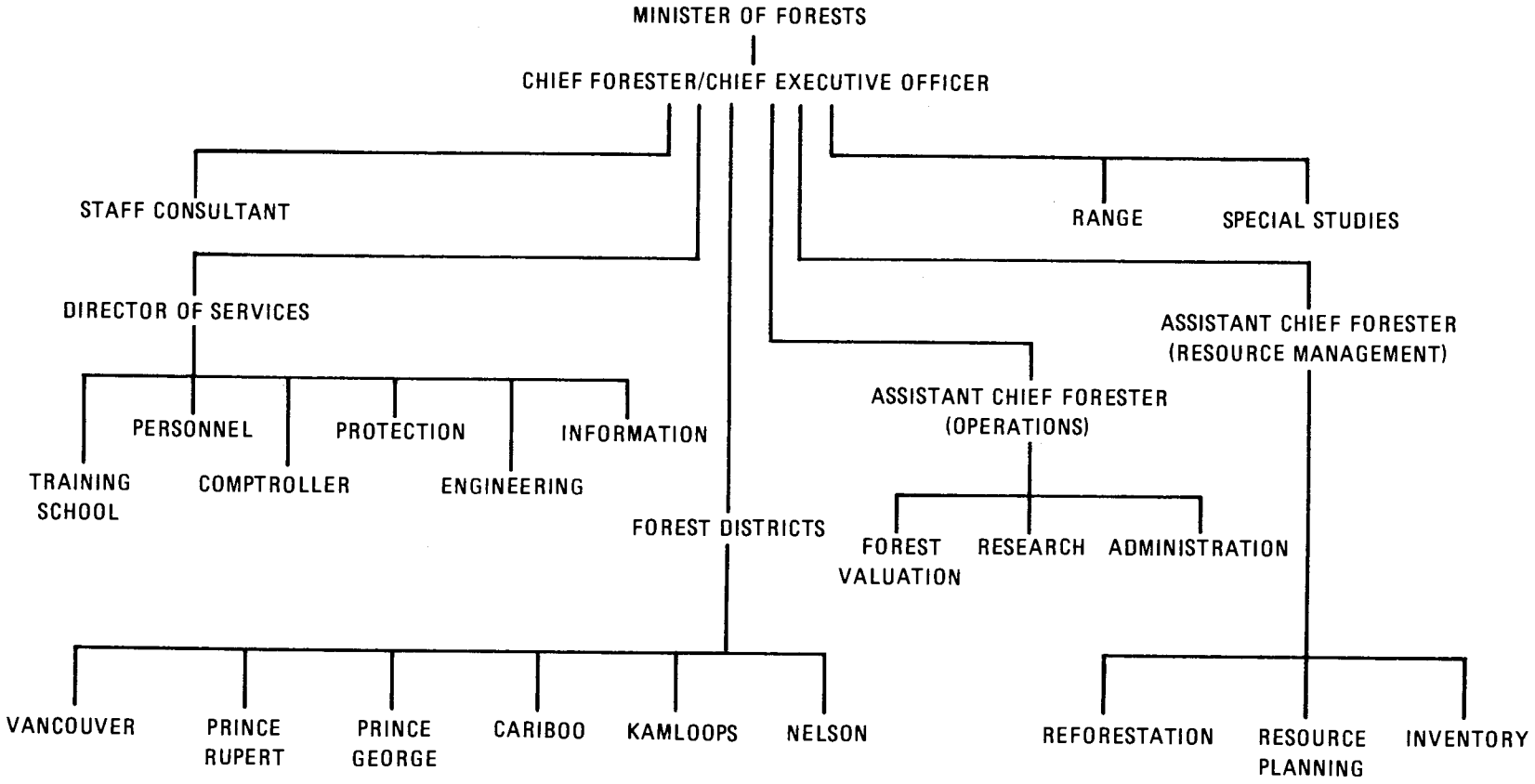
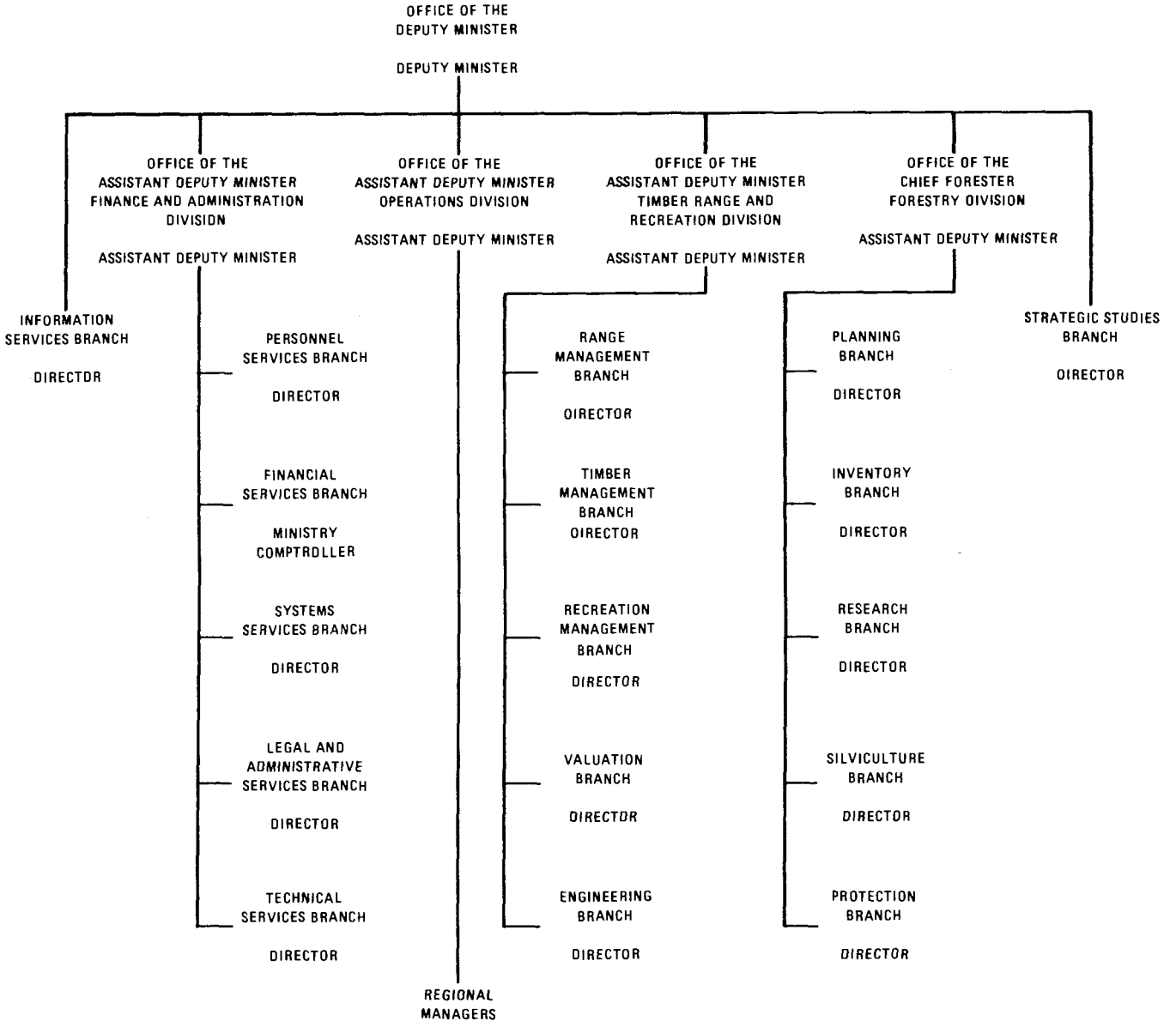

MINISTER OF FORESTS
CHIEF FORESTER/CHIEF EXECUTIVE OFFICER
STAFF CONSULTANT
RANGE
SPECIAL STUDIES
DIRECTOR OF SERVICES
ASSISTANT CHIEF FORESTER (RESOURCE MANAGEMENT)
PERSONNEL
PROTECTION
INFORMATION
ASSISTANT CHIEF FORESTER (OPERATIONS)
TRAINING SCHOOL
COMPTROLLER
ENGINEERING
FOREST DISTRICTS
FOREST VALUATION
RESEARCH
ADMINISTRATION
VANCOUVER
PRINCE RUPERT
PRINCE GEORGE
CARIBOO
KAMLOOPS
NELSON
REFORESTATION
RESOURCE PLANNING
INVENTORY

Fig. 9. B.C. Ministry of Forests Organization Chart, 1980. Adapted from B.C. Ministry of Forests [1981].


OFFICE OF THE
DEPUTY MINISTER
DEPUTY MINISTER
OFFICE OF THE
ASSISTANT DEPUTY MINISTER
FINANCE AND ADMINISTRATION
DIVISION
ASSISTANT DEPUTY MINISTER
OFFICE OF THE
ASSISTANT DEPUTY MINISTER
OPERATIONS DIVISION
ASSISTANT DEPUTY MINISTER
OFFICE OF THE
ASSISTANT DEPUTY MINISTER
TIMBER RANGE AND
RECREATION DIVISION
ASSISTANT DEPUTY MINISTER
OFFICE OF THE
CHIEF FORESTER
FORESTRY DIVISION
ASSISTANT DEPUTY MINISTER
INFORMATION
SERVICES BRANCH
DIRECTOR
PERSONNEL
SERVICES BRANCH
DIRECTOR
FINANCIAL
SERVICES BRANCH
MINISTRY
COMPTROLLER
SYSTEMS
SERVICES BRANCH
DIRECTOR
LEGAL AND
ADMINISTRATIVE
SERVICES BRANCH
DIRECTOR
TECHNICAL
SERVICES BRANCH
DIRECTOR
REGIONAL
MANAGERS
RANGE
MANAGEMENT
BRANCH
DIRECTOR
TIMBER
MANAGEMENT
BRANCH
DIRECTOR
RECREATION
MANAGEMENT
BRANCH
DIRECTOR
VALUATION
BRANCH
DIRECTOR
ENGINEERING
BRANCH
DIRECTOR
PLANNING
BRANCH
DIRECTOR
INVENTORY
BRANCH
DIRECTOR
RESEARCH
BRANCH
DIRECTOR
SILVICULTURE
BRANCH
DIRECTOR
PROTECTION
BRANCH
DIRECTOR
STRATEGIC STUDIES
BRANCH
DIRECTOR

The Protection Division, renamed the Protection Branch, has expanded its pest managment activities. Dr. R.F. DeBoo, whose participation in Mr. Waterland's technical conference had led him in part to shift from research to applied pest management, was brought from Ontario to fill the new position of Manager, Pest Management. He was joined by Mr. Peter C. Hall, who became the Protection Branch's Forest Entomologist. A Pest Management Coordinator was also hired for each Forest Region [B.C. Ministry of Forests 1981].

The Fraser Canyon affair, while particularly well publicized, was not the only occasion on which activities of the B.C. Forest Service have aroused controversy. From time to time plans to log particular areas have been strongly opposed by people who wanted to see other uses of the land prevail. Although the Ministry of Forests is not itself in the business of cutting trees, its overall management role has ensured that it frequently becomes caught up on such conflicts. In 1979, the Ministry's Planning Branch hired a consultant, Dr. Bruce E.C. Fraser, to develop a public involvement program to regularize public input into decision-making. A Public Involvement Handbook [Fraser 1981] has been published, and training sessions have been held for Regional staff. More than 15 consultative committees of one form or another have been meeting around the province, with various degrees of success in resolving resource-use conflicts.(232)(233)

D. Pesticide Regulation

The appeal process

The B.C. Pesticide Control Act [Revised Statutes of B.C. 1979] was proclaimed into force on March 8, 1978. As indicated in the Cabinet decision regarding the Fraser Canyon spray program, the new Act included provision for a Pesticide Control Appeal Board. This Board, and its successor, the Environmental Appeal Board, hears appeals against the granting of pesticide use permits and other orders of the Director of Pesticide Control. The Act specifically states that an appeal does not constitute automatic suspension of the permit or order in question until the Appeal Board has delivered its ruling on the case [Revised Statutes of B.C. 1979].

The appeal procedure has not met with approval from environmental and community groups, who feel that the composition of the Board has consistently represented vested interests favourable to pesticide use.[71][95] They also object to the legalistic form taken by the proceedings, which entails costly legal services.[49] Finally, they feel that the appeal process de-legitimizes without replacing the kind of public protests which have been so successful in attracting media attention.[49][127]

The IBT scandal

Agriculture Canada, the government agency responsible for pesticide registration, bases its decisions on toxicological data submitted by the proponent companies. The necessary studies are often performed by independent testing laboratories under contract to these chemical companies. In 1977, the U.S. Environmental Protection Agency and the U.S. Food and Drug Administration alleged that Industrial Biotest Laboratories (IBT), in Illinois, had falsified data submitted to them. This revelation cast doubt on the validity of the registration of one-quarter of the pesticides used in Canada [Hall 1981], the proportion of chemicals for which IBT had performed safety studies. Orthene was one of the chemicals for which key studies were found to be invalid, i.e. "the submitted study report cannot be substantiated by original laboratory data, creating a data gap."[234] Such a gap does not imply that adverse effects have been found, but does indicate that the safety testing required for the registration process is incomplete.

VI. CONCLUSION

There is no question that the Fraser Canyon affair exemplifies a costly, inefficient and painful way to choose between pest management options. The underlying causes of this behaviour were insufficient data and a profound mistrust between technical and lay people. The first of these problems must be addressed by the allocation of more research money, and the training of more scientists and pest managers who will use it wisely and effectively.

The second problem is much more difficult to remedy. Both sides of the battle have something important to contribute. There are real deficiencies in our ability to evaluate the health and environmental hazards of our way of life; and we do depend upon that way of life, which also provides us with considerable convenience and material comfort. Rational management, whether of pests or other problems, requires the recognition of both these propositions. This recognition means that the opposing camps must somehow learn to work together.

I have not developed a patented method for bringing this about. On a personal level, I believe I have increased my ability to contribute to this process. It is my hope that the readers of this study will be moved to do the same.

APPENDIX A. CHRONOLOGY OF EVENTS

1970	The infestation begins
Spring 1976	Foresters discuss spray option
September 1976	Budworm Task Force appointed
6 December 1976	Budworm Task Force recommends spray to Forest Pest Review Committee
January 1977	Anderson Block selected Project manager appointed Benefit/cost study commissioned
18 February 1977	Permit application submitted to Interministerial Pesticide Committee
10 March 1977	Benefit/cost study completed
15 March 1977	B.C. Forest Service and other government agencies meet with Regional Board members in Hope
24 March 1977	Interministerial Pesticide Committee grants conditional permit
6 April 1977	Minister of Forests announces approval of the spray program
8-11 April 1977	Easter weekend picketing of the Trans-Canada Highway
13 April 1977	Public Information Day - Boston Bar
14 April 1977	Public Information Day - Yale
15 April 1977	Public Information Day - Hope
21 April 1977	Greenpeace announces opposition to spray
28-29 April 1977	Technical Conference in Victoria
4 May 1977	I.W.A. and B.C. Federation of Labour announce opposition to spray
8 May 1977	Yale Budworm Committee Walk-a-thon
9 May 1977	B.C. Medical Association announces opposition to spray program

10 May 1977	Minister of Forests announces reduced spray block
18 May 1977	Joint strategy meeting of spray program opponents in Vancouver
19 May 1977	Media report B.C. Forest Service plan to hire Pinkerton guards
21 May 1977	Orthene arrives from California
23 May 1977	Yale residents meet with Minister of Forests
26 May 1977	Minister of Environment announces Cabinet decision to "defer" spray program
June 1977	U.S. Forest Service spray program in Washington and Oregon
December 1977	B.C. Forest Service benefit/cost study recommends against spray program

APPENDIX B. EXPENDITURES

The actual outlay of funds by the Canadian Forest Service and the B.C. Forest Service for the control program in 1977 is presented in tables B1 and B2. The total spent by both agencies was $406,800 for operations and materials (excluding the cost of insecticide), and $305,000 for salaries (18.2 person/years), for a grand total of $711,800.[235] The B.C. Forest Service spent $124,000 on the Non-Target Organisms Monitoring Program.[54]

Table B1. 1977 Canadian Forestry Service input to Western Spruce Budworm Control Program.

Project	Man/Years Professional	Man/Years Support	O & M	Salaries	Total
Reduction of losses from defoliating insects	1.7	4.1	$1,000*	$103,000	$104,000
Detection & Reporting (FIDS)		0.3	4,800**	5,000	9,800
Appraisals (FIDS)	0.1	1.0	500*	42,000	42,500
For. Pest Mgmt. Inst. (CCRI)		0.3	500	5,000	5,500
Totals	1.8	5.7	$6,800	$155,000	$161,800

*B.C.F.S. paid most of the O & M (Operations and Materials)
**Mostly aerial survey

Table B2. 1977 B.C. Forest Service input to Western Spruce Budworm Control Program as estimated by the Canadian Forestry Service.

Man/Years		O & M	Salaries	Total
Profes-sional	Support			
2.0	8.7	$400,000***	$150,000	$550,000

***$150,000 for Helicopters, $243,000 for Anderson River Camp, $7,000 for Supplies.

APPENDIX C. BENEFIT/COST CALCULATIONS

Dr. Nagle and Mr. Wai reached very different conclusions in their benefit/cost analyses of the Fraser Canyon spray program. In order to faciliate comparison of the two studies, I have set up the following tables of figures taken from their reports [Sutton 1977].[29] For discussion of the methods used, see pp. 84-92, and pp. 148-149.

Table C1 presents the characteristics of the infestation, the amounts of wood to be saved by an effective insecticide program, and the dollar value per hundred cubic feet of wood used by each author.

Table C2 presents the benefits calculated by each author, in terms of the net present value of increases to the annual allowable cut over a complete rotation cycle.

Table C3 presents the cost of the spray program. Tables C4 and C5 present the benefit/cost ratios calculated by Dr. Nagle and Mr. Wai, respectively.

Table C1. Input parameters for two benefit/cost analyses of the proposed Fraser Canyon budworm control project [Sutton 1977].[29]

PARAMETER	NAGLE		B.C. FOREST SERVICE	
	Case I Currently Infested Area	Case II Threatened Area	9 year Infestation	17 year Infestation
A. Infestation Characteristics:				
1. Spatial				
a. acres infested	56,515		47,020	
b. acres to be sprayed [as % of infested area]	112,000 [198%]		56,400 [120%]	
c. acres "protected" by spray [as % of infested area]	56,515 [50%]	140,181 [125%]	47,020 [83%]	
2. Temporal				
a. expected duration of outbreak (years)	7		9	17
b. length of recovery period (years)	5		5	
c. years between start of outbreak and spray	3-4		5	
B. Wood "savings" in Ccf*				
1. Radial growth, pure and mainly D-fir types	82,700	207,300	9,696	35,552
2. Topkill, pure and mainly D-fir types	2,900	7,200	9,718	9,718
3. Total, other types	16,800	42.000	--	--
4. Total "savings"	102,400	256,500	19,414	45,270
Rotation Age	92 years		94 years	
5. Total as yearly increase in allowable cut (Ccf/year)	1113	2788	206	481

Table C1 continued

PARAMETER	NAGLE		B.C. FOREST SERVICE	
	Case I Currently Infested Area	Case II Threat-ened Area	9 year Infest-ation	17 year Infest-ation
C.Value($/Ccf)				
1. Stumpage	10.25			12.80
2. "secondary benefits"				
a. "direct provincial revenue" (stumpage + taxes)	17.00			--
b. "contribution to GNP" (value added, logging and sawmilling)	69.00			--
c. "GNP including pulp and paper (estimate)"	130.00			--
d. "Gross value, lumber sales"	79.00			--
3. "provincial benefits" (estimated net gains in taxes and personal incomes)	--			22.80 (stumpage + $10/Ccf)
D. Discount rates used	6%,10%			4%,6%,8%

*1Ccf=1cunit=100ft^3

Table C2. Benefits of Fraser Canyon Spray Program as presented in two benefit/cost analyses [Sutton 1977].[29]

PARAMETER	NAGLE		B.C. FOREST SERVICE	
	Case I Currently Infested Area	Case II Threat-ened Area	9 year Infesta-tion	17 year Infesta-tion
A. Annual Benefits (from stumpage volumes saved)	$11,408	$28,577	$2,636	$6,157
B. Net Present Value (NPV) of A				
4%	--	--	$64,268	$156,064
6%	$189,000	$474,000	$43,763	$102,184
8%	--	--	$32,936	$76,904
10%	$114,100	$285,700	--	--
C. NPV of savings from mortality averted:				
1. reforestation				
6%	$63,200*	$126,800	--	--
10	$63,200*	$116,000	--	--
2. salvage costs + quality reduction				
6%	$35,800	$71,000	--	--
10%	$32,200	$64,400	--	--
D. Total NPV of direct benefits				
4%	--	--	$64,268	$150,064
6%	$288,200	$672,400	$43,763	$102,184
8%	--	--	$32,936	$76,904
10%	$209,500	$466,100	--	--
E. NPV of Contri-bution to direct provincial revenues				
6%	$314,145	$786,000	--	--
10%	$189,300	$473,900	--	--
F. NPV of Contri-bution to GNP				
6%	$1,274,000	$3,191,000	--	--
10%	767,850	$1,922,800	--	--

*One of these figures, copied from Dr. Nagle's report, must be incorrect.

Table C3. Costs of Fraser Canyon Spray Program as presented in two benefit/cost analyses of the proposed budworm control project [Sutton 1977].[29]

PARAMETER	NAGLE	B.C. FOREST SERVICE
A. $/acre		
1. Chemicals		
Orthene	6.00	--
90% Sevin + 10% Orthene	2.67	--
Sevin	2.30	6.00
2. Application		
Orthene	2.00	--
90% Sevin + 10% Orthene	1.42	--
Sevin	1.35	2.00
3. Other Expenses	1.35	4.25
4. Total Per Acre		
Orthene	9.35	--
90% Sevin + 10% Orthene	5.44	--
Sevin	5.00	12.25
B. Total Costs		
Orthene	$1,047,200	--
90% Sevin + 10% Orthene	609,280	--
Sevin	560,000	$690,900

Table C4. Benefit/cost ratios calculated in Dr. Nagle's analysis of the proposed Fraser Canyon budworm control program.[29]

CASE I: CURRENTLY INFESTED AREA				
	6%		10%	
	Orthene	Sevin + Orthene	Orthene	Sevin + Orthene
Direct Benefits	0.28	0.48	0.20	0.35
Contribution to direct provincial revenue	0.31	0.53	0.18	0.32
Contribution to GNP	1.24	2.13	0.75	1.28

CASE II: THREATENED AREA				
	6%		10%	
	Orthene	Sevin + Orthene	Orthene	Sevin + Orthene
Direct Benefits	0.65	1.12	0.45	0.78
Contribution to direct provincial revenue	0.76	1.31	0.46	0.79
Contribution to GNP	3.10	5.34	1.87	3.22

Table C5. Benefit/cost ratios calculated in B.C. Forest Service analysis of the proposed Fraser Canyon budworm control program [Sutton 1977].

	Infestation Duration	
	9 years	17 years
Discount Rate		
4%	0.09	0.22
6%*	0.06	0.15
8%	0.05	0.11

*I have calculated these ratios for comparison with those presented by Dr. Nagle.

APPENDIX D. A NOTE ON METHODS

This study has utilized four main sources of information:

1)scientific literature and other published materials;

2)interviews;

3)correspondence, memoranda and minutes of meetings; and

4)newspaper articles.

The standard questions which formed the basis of the interviews are listed below:

1. What was your job in 1977?
2. How did you first become involved in the controversy?
3. What was your role in the controversy?
4. What was your evaluation of the proposed spray program with respect to:
   a) need, efficacy, safety of the program;
   b) 100,000 acre vs 50,000 acre proposals?
5. Under what circumstances do you think a spray program is justified?
6. What are your comments regarding:
   a) B.C. Forest Service and Canadian Forestry Service personnel -- positions taken, reasons for those, conduct;
   b) the Conference held by Mr. Waterland in April 1977;
   c) Mr. Waterland's role and actions in the controversy;
   d) the B.C. Forest Service's public information program;
   e) the "normal" decision making process, including the Forest Pest Review and Interministerial Pesticide Committees;
   f) economic aspects of the program -- damage assessment, the benefit/cost studies which were conducted;
   g) the position and role of the forest industry in the controversy;
   h) the role of the chemical companies;
   i) the involvement of partisan politics;
   j) the role and actions of local residents;
   k) the role and actions of environmentalist groups;
   l) the role of the media;
   m) the Cabinet decision to "defer" the program?
7. What do you think are the proper role and means for public involvement in decisions regarding pesticide use?
8. On what basis should the final decision be made? By whom?

Each interview was unique; these questions were the scaffolding around which they were built. In addition to taking copious notes, I tape recorded all the interviews, with the exception of two in which the persons being interviewed would not permit me to do so. Occasionally I was asked to switch off the machine for a few moments; naturally, I complied. I found it interesting that the two topics which elicited this reaction were the conduct of the Minister of Forests and of the Council of Forest Industries.

I learned that consistency among interviews was not a matter of identical behaviour by the interviewer under all circumstances. Throughout the study I have striven for balance, carefully avoiding taking sides. But the dress and demeanor appropriate to the office of a senior bureaucrat was quite different from that expected in a Boston Bar kitchen.

NOTES

(1) Interview with Mr. Robert F. Sutton, Forester In Charge, Planning and Development, Protection Branch, B.C. Forest Service, Victoria, B.C., December 1980.

(2) Johnson and Denton [1975] define "outbreak" as "a sudden large increase in population" and "infestation" as "a prolonged, abnormally large population of the insect." Sutton [1977] seems to use the terms interchangeably.

(3) Interview with Messers. Norman Bowen and Ian Stewart, G and F Logging Co. Ltd., Hope,B.C., August 1981.

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(5) "Minutes of Meeting of the Forest Pest Review Committee," 29 September 1976.

(6) Interview with Mr. Bill Gilpin, Whonnock Lumber, Hope, B.C., August 1981.

(7) Interview with Mr. Greg Templeman, B.C. Forest Products Ltd., Boston Bar, B.C., August 1981.

(8) Interview with Mr. Glen Bertram, Operational Superintendent, Vancouver Forest Region, B.C. Forest Service, Chilliwack, B.C., August 1981.

(9) Interview with Dr. John W.E. Harris, Research Scientist, Canadian Forestry Service, Victoria, B.C., March 1981.

(10) Figures were presented in acres. I have converted them to hectares to conform with later usage.

(11) Dr. Rene I. Alfaro, Research Scientist, Pacific Forest Research Centre, Canadian Forestry Service, adapted from unpublished data.

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(29) George S. Nagle, "Benefits and Costs of Controlling

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(36) Mr. E.J. McArthur, Environmental Protection Officer, Vancouver Forest District, B.C. Forest Service, letter to Mr. B.F. Vance, Chairman, B.C. Interministerial Pesticide Committee, 18 February 1977.

(37) Mr. J.M. Finnis, letter to Mr. B.F. Vance, 10 May 1977.

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(226) Ms. S.C. Bourque, op. cit, p. 70.

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(228) Mr. R.L. Morley, letter to Mr. A.C. Molnar, 2 September 1977.

(229) "Minutes of Non-Target Organisms Monitoring Program Steering Committee Meeting," 16 December 1977.

(230) Ms. S.C. Bourque, op. cit., p. 74.

(231) Dr. R.I. Alfaro, personal communication, 20 January 1983.

(232) Interview with Dr. Bruce E.C. Fraser, Consultant, Public Involvement, Planning Branch, B.C. Ministry of Forests, August 1981.

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