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INFORMATION FORESTRY

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Pacific Forest Research Centre
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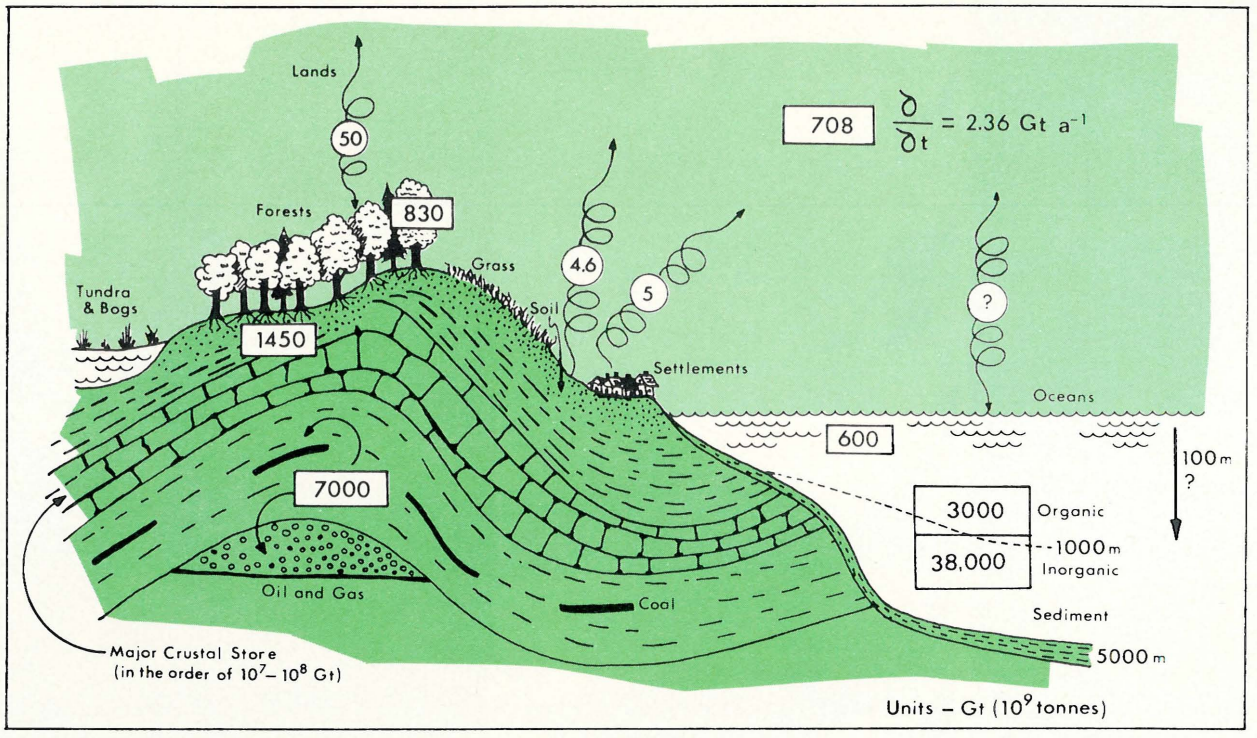
Winter 1981

The Global Carbon Dioxide



Sketch of the principal reservoirs and exchange routes for the carbon cycle. Storage in rectangular boxes; annual exchange in circles. (Gt = gigatonne = 10^9 tonnes) Diagram from Proceedings of the Workshop on "Energy/Carbon Dioxide Issues and Impacts".

The global carbon dioxide question revolves around a single irrefutable fact - carbon dioxide in the Earth's atmosphere is increasing. The implications of this fact are conjectural, but include scenarios that promise considerable disruption of global social, economic and political institutions. The carbon dioxide question is a global question in all its components. It concerns processes with time scales ranging from seconds to eons. It concerns the atmosphere, the oceans, the soils and rocks of continents, and the Earth's mantle of living biomass.

For quite some time scientists and the public have been concerned with the rate at which atmospheric CO_2 concentrations are increasing and with the dire global climatic and other changes such increases might trigger.

According to the proceedings of the Workshop on "Energy/Carbon Dioxide Issues and Impacts" held in Toronto in August, 1979, carbon (in carbon dioxide) in the atmosphere is increasing by about 3 per cent per decade, or about 2.3 billion tonnes per annum - added to a global inventory of 708 billion tonnes. This increase has been going on since the nineteenth century, but is now accelerating.

The proceedings also tell us that world-wide burning of coal, oil and natural gas is adding five billion tonnes per annum to the atmosphere. Losses of humus in soils, plus the cutting of forests, are also adding carbon. If we increase our dependence on fossil fuels, plough up more land and continue to destroy forests the discharge of carbon dioxide to the atmosphere can only increase.

Much global biomass is concentrated in forests, where almost half the dry weight is carbon. Countries with

Question ~ A Vital Issue

extensive forests are thrown into the carbon question. Canada is a forest country of major proportions. Canada is also custodian of other significant elements of the carbon dioxide question, namely, fossil fuels, organic soils and polar ice.

As might be expected, global CO_2 balances have been examined, with special emphasis on CO_2 generation through fossil-fuel combustion and on ocean sinks, but more recently attention has been directed to the role of forests and their management. It is realized that the tremendous reservoirs of solid fuels such as coal owe their origins to a highly productive vegetation cover, so it is not unreasonable to suppose that present-day forests, especially the extensive Canadian ones, can play an important role in fixing atmospheric CO_2 and in reducing the adverse ambient build-up.

ROLE OF THE CANADIAN FORESTRY SERVICE

From time to time questions are put to the Canadian Forestry Service. What is the role of Canadian forests in the global CO_2 balance? Will more intensive forest .nanagement practices, including site preparation, slash-burning, improved genetic stock, shorter rotations, fertilization, agriforestry, and increased tree-utilization affect the situation? If so, by how much? How does fire suppression, clear cutting, and the replacement of over-mature stands affect the picture? And, is CO_2 fixation changed when forestlands are alienated to agriculture? Last but not least, what is the CFS doing about it?

Clearly basic forestry statistics, forest productivity, meteorology, harvesting and soil science are all involved and are contributing; but fundamental to the answering of these questions is tree physiology and perspective understanding of the carbon cycle.

It would seem appropriate, therefore, for a tree physiologist to take the lead part in preparing an authoritative reference paper that would address the above questions.

Dr. Doug Pollard, a research scientist and tree physiologist at the Pacific Forest Research Centre, has been identified as that expert. In the late 1960's Dr. Pollard conducted studies of forest carbon cycling while working at the Petawawa National Forestry Institute. In 1970 he undertook an assignment similar to this current one, and since his appointment to PFRC in 1978 he has been consulted on the global CO_2 situation on numerous occasions. There is no doubt he has been recognized, within the CFS, as an expert on the question. **Drs. Peter Rennie** and **Les Carlson** of CFS headquarters will provide advice and assistance on this study as well.

His specific assignment, which should take about six months to complete and which will culminate in a draft statement sometime in the summer of 1981, is to gather together all Canadian literature and studies relevant to Canadian conditions and to consult with numerous authorities within and outside the CFS. The end product is intended to be an authoritative and incisive state-of-the-art treatment which can be used by senior CFS officials and the Minister of Environment Canada when referring to this issue.

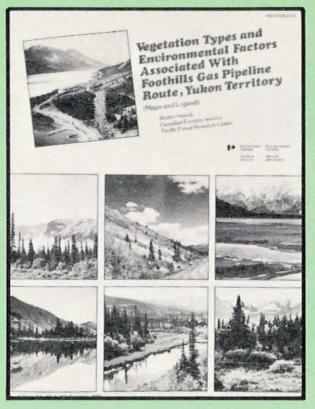
MANY UNANSWERED QUESTIONS

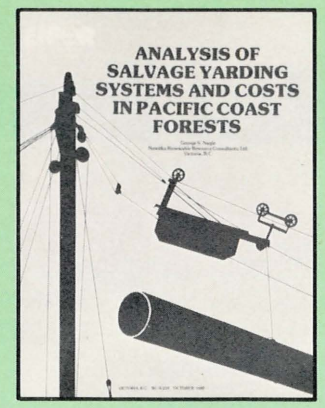
Long-term planning of almost every environmental issue needs to take into account the question of the effects of CO_2. No one really knows the fate of the added carbon. Human action is adding carbon much faster than the atmosphere is accumulating it but where does the missing carbon go? Perhaps to the ocean but possibly we are wrong in our estimate of soil and forest losses, or of ocean behavior. Answers are needed quickly if we are to decide on future policies.

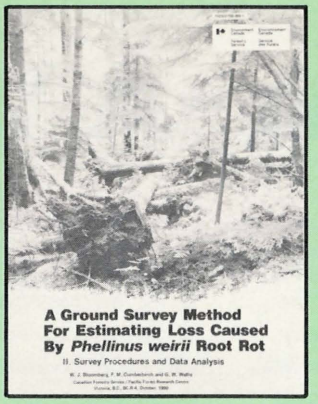
A major uncertainty is the effect of carbon dioxide buildup on climate. According to the workshop proceedings on "Energy/Carbon Dioxide Issues and Impacts", atmospheric scientists are unanimous that a doubling of carbon dioxide levels - likely early in the next century, will raise world surface temperatures perhaps by two degrees Celsius. The effect would be much larger in high latitudes and Canada would get appreciably warmer. This alone would call for big adjustments in agriculture, forestry and fisheries.

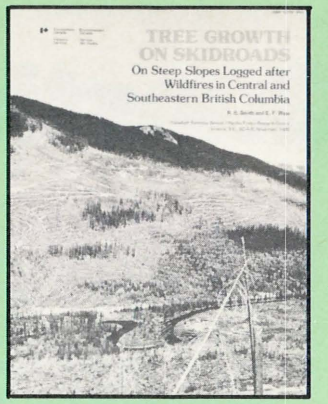
There is no way of predicting, at the present time, the effect on rain and snow. Some regions will become much wetter - others much drier. This in turn will affect forestry practices.

It is hoped that through the intensive research which must go into the development of the Canadian Forestry Service position paper on the global carbon dioxide question we may move closer to understanding this complex question. At the very least, we shall identify gaps in our knowledge.









Recent Publications

Vegetation Types and Environmental Factors Associated with Foothills Gas Pipeline Route, Yukon Territory

Walter Stanek

This report is the result of a survey in 1978 along the Alaska Highway, Yukon Territory, from the B.C. border near Watson Lake to Beaver Creek near the Alaska border. The contents of this report are being offered for predictive use in the applications where site sensitivity or other ecological conditions have to be assessed, and as a framework for a more complete ecological inventory.

BC-X-205

Analysis of Salvage Yarding Systems and Costs in Pacific Coast Forests

An ENFOR (ENergy from the FORest) study commissioned by the Canadian Forestry Service

The objective of this study was to review and analyze existing cost estimates for harvesting forest residuals to guide development of new equipment and systems.

BC-X-214

A Ground Survey Method for Estimating Loss Caused by *Phellinus weirii* Root Rot II. Survey Procedures and Data Analysis

W. J. Bloomberg, P. M. Cumberbirch and G. W. Wallis

Procedures are described for designing a ground-survey for *Phellinus weirii* root rot in forest stands.

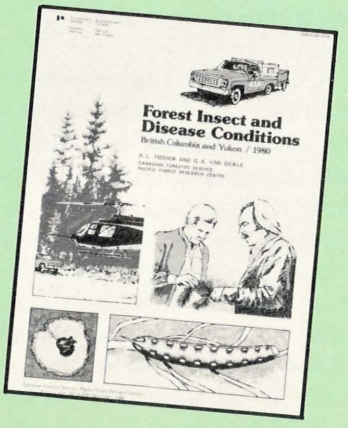
BC-R-4

Forest Insect & Disease Conditions, British Columbia & Yukon / 1980

R.L. Fiddick and G.A. Van Sickle

This summary of forest pest conditions in British Columbia and the Yukon in 1980 was compiled from records and field reports of 11 forest insect and disease technicians. Emphasis is on damaging pests that are or may become major management problems.

BC-X-220



Tree Growth on Skidroads on Steep Slopes Logged After Wildfires in Central and Southeastern British Columbia

R.B. Smith and E.F. Wass

Measurements of Douglas-fir, western larch, lodgepole pine and Engelmann spruce were taken 16 to 18 years after salvage logging of steep, wildfire burned areas to assess growth of trees on contour skidroads. A system was devised to rate sites on their sensitivity to disturbance in terms of tree growth on the disturbed surfaces.

BC-R-6

Copies of these publications may be obtained by filling out the enclosed card and returning it to the P.F.R.C. Information Office.

VOL. 8 NO. 1 1981

Supplement

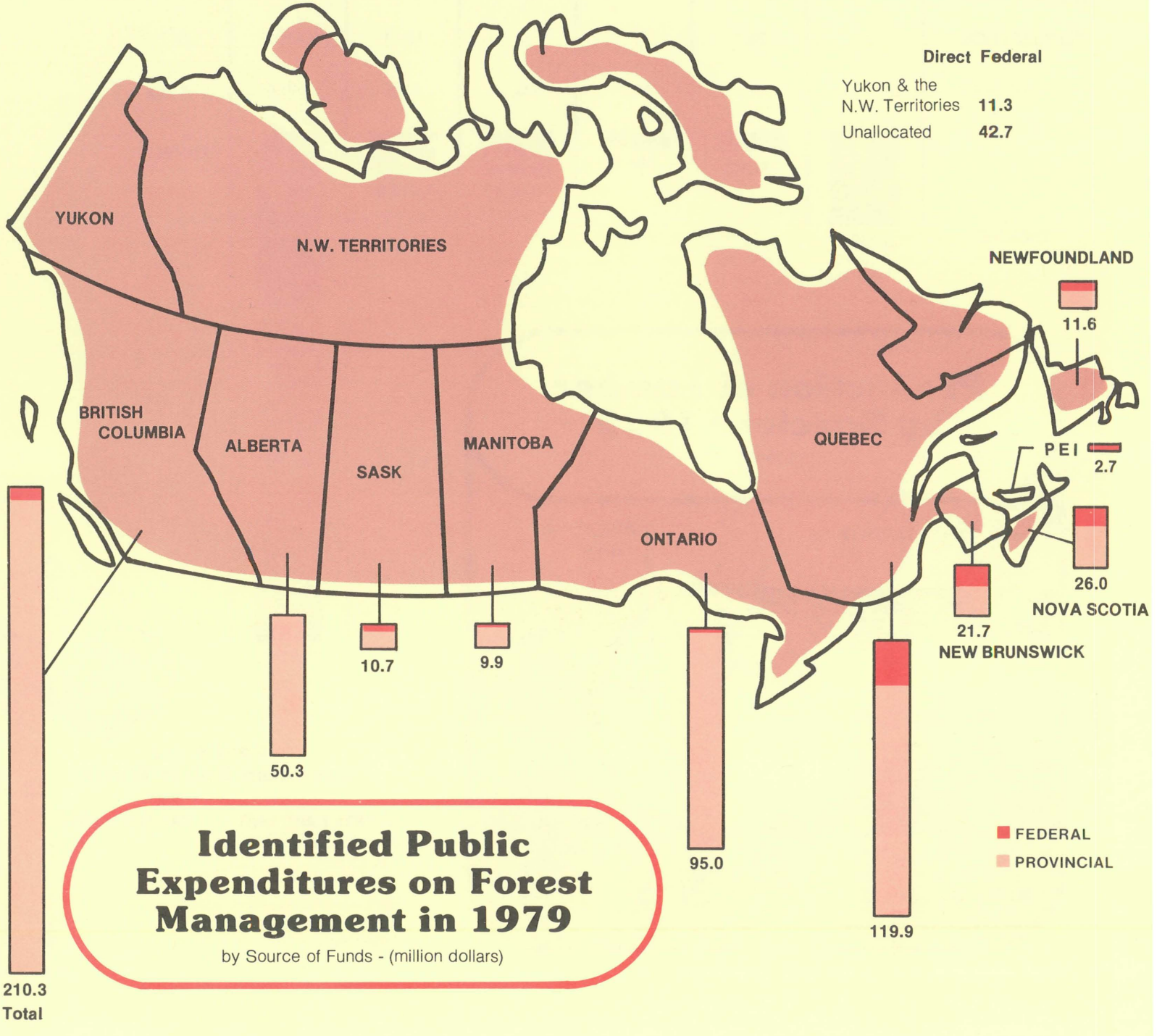
INFORMATION FORESTRY

A newsletter from the
Pacific Forest Research Centre
Canadian Forestry Service
Environment Canada

FOREST MANAGEMENT

For a number of years, provincial and federal governments have expressed concern about the adequacy of forest management. This concern has increased with forecasts of increased demands on the resource and word of impending land withdrawals for non-forestry uses.

One of the roles of the CFS is to bring forest management needs to the attention of the public. There statistics review current expenditures on forest management in B.C. and the rest of Canada.



Identified Public Expenditures on Forest Management in 1979

by Source of Funds - (million dollars)

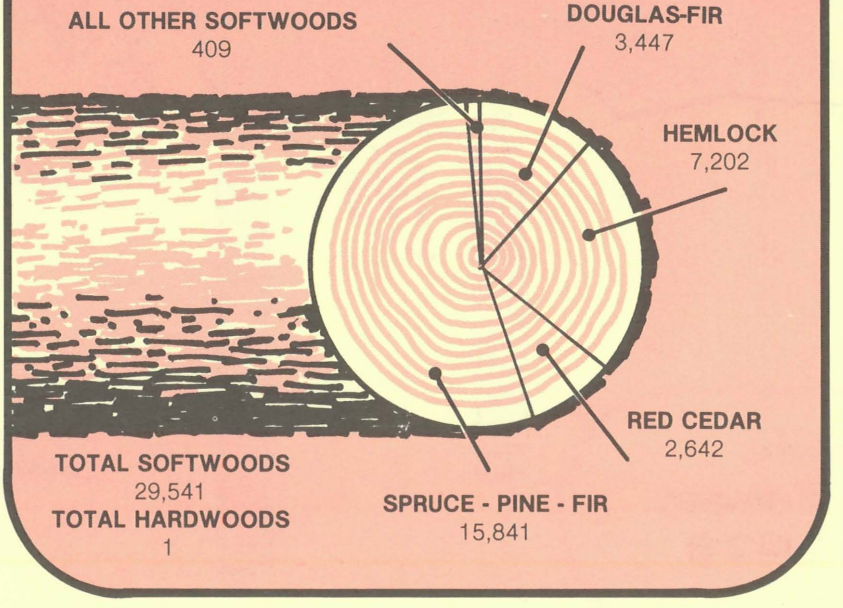
Silviculture Activities in B.C. - 1979

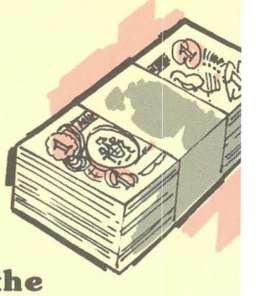
(hectares)

	CARIBOO	KAMLOOPS	NELSON	PRINCE GEORGE	PRINCE RUPERT	VANCOUVER	TOTAL
CONIFER RELEASE	-	12.0	-	57.0	118.2	2,280.2	2,467.4
JUVENILE SPACING	1,156.8	568.3	670.0	442.1	1,458.1	10,278.9	14,574.2
SITE REHABILITATION	-	113.9	-	80.6	14.3	415.0	623.8
FERTILIZATION	-	23.0	-	-	164.1	8,830.0	9,017.1
OTHER	2,772.2	61.0	46.7	406.9	62.2	129.2	3,478.2
TOTAL TREATED	3,929.0	778.2	716.7	986.6	1,816.9	21,933.3	30,160.7

Production of Lumber by Species - 1979

('000m3)





What's the Canadian Dollar Worth?

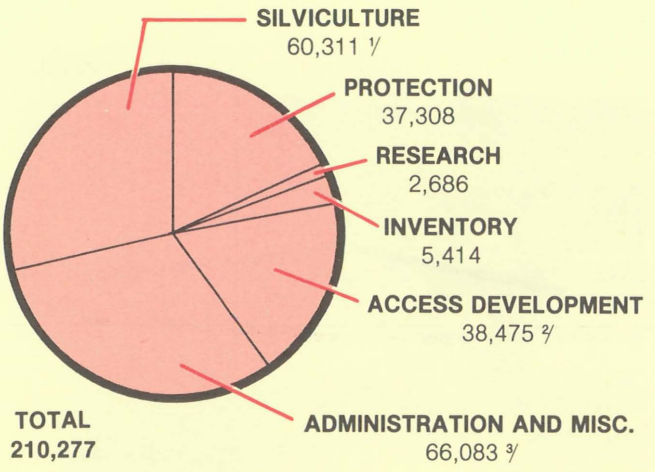
COUNTRY AND UNIT	CANADIAN $/UNIT
United States (dollar)	1.1706
U.K. (pound)	2.6172
France (franc)	0.2911
Germany (mark)	0.6805
Switzerland (franc)	0.7383
Japan (yen)	0.0049

(December 1979

Distribution of Expenditures by the British Columbia Ministry of Forests

(fiscal year ending March 31, 1980)

Forest Management Expenditures (thousand dollars)



TOTAL
210,277

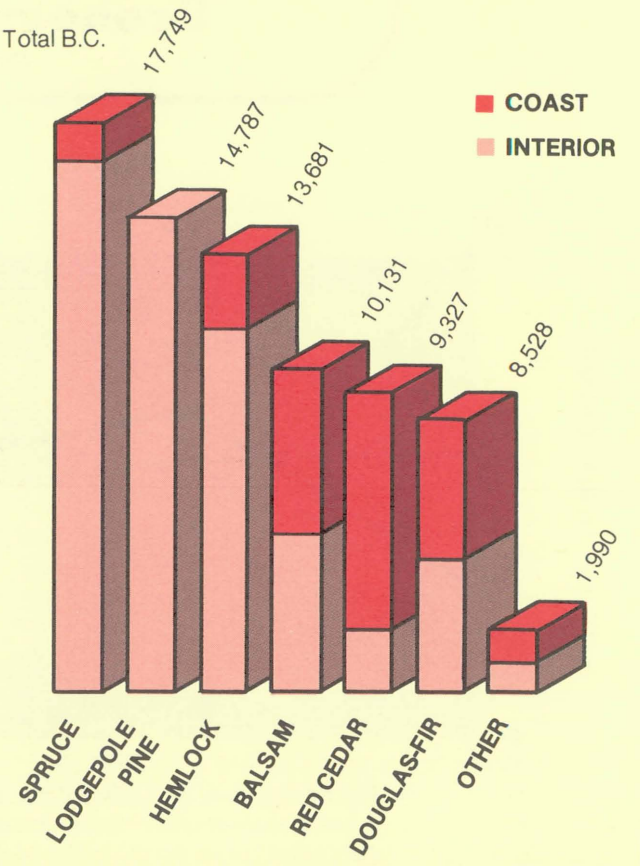
1/ Includes an estimated $18.9 million made available to industry through "forestry cost" allowances against stumpage charges. Also includes $5.7 million Federal contribution to Canada - British Columbia Intensive Forest Management Subsidiary Agreement.

2/ Includes an estimated $30.4 million made available to industry through stumpage account credits for the construction of main access roads.

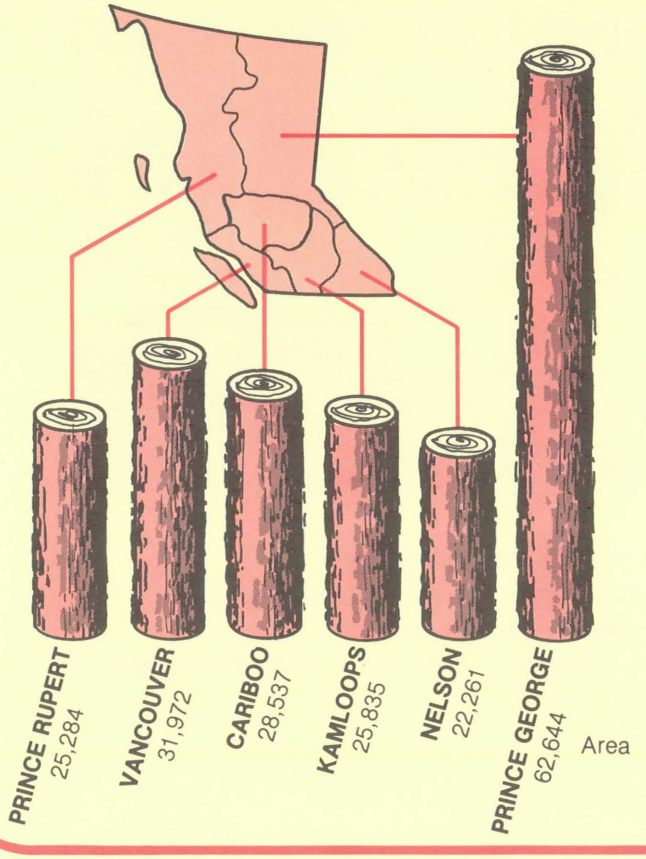
3/ Includes an estimated $4.7 million in industry stumpage credits for protection, inventory and planning.

Species Harvested - 1979

('000m3)

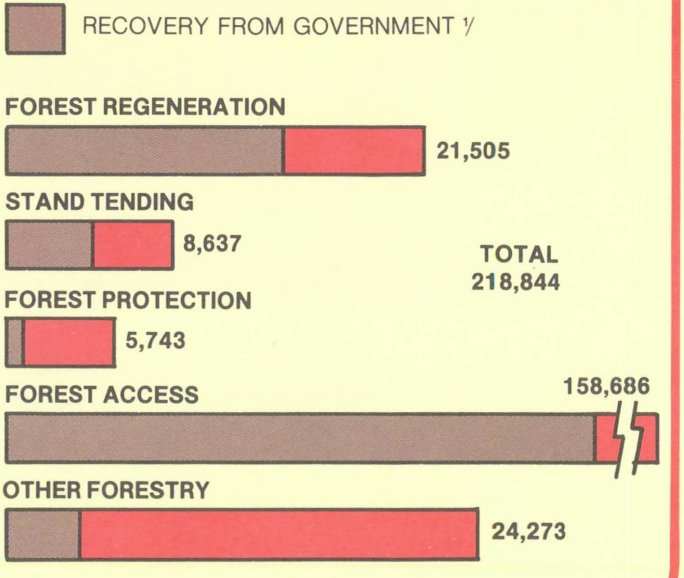


Hectares Logged - 1979



Estimated Private Expenditures on Forest Management in 1979 British Columbia

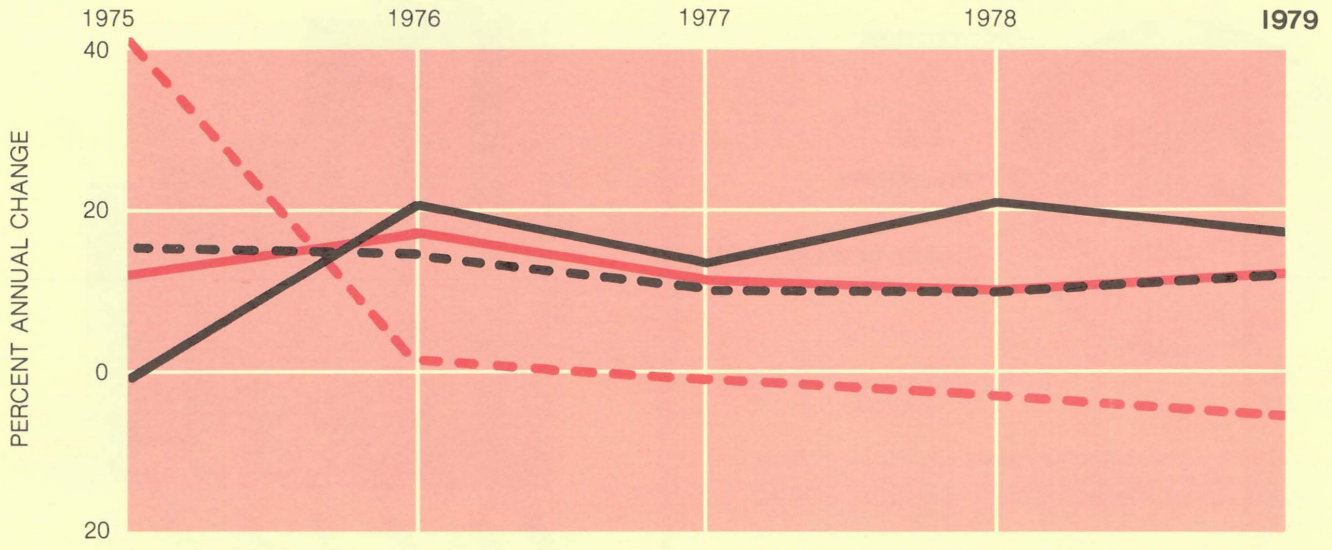
(thousand dollars)



1/ Government stumpage credits for fiscal 1979/80 only. Additional offsets may be achieved in a future year through deferred credits.

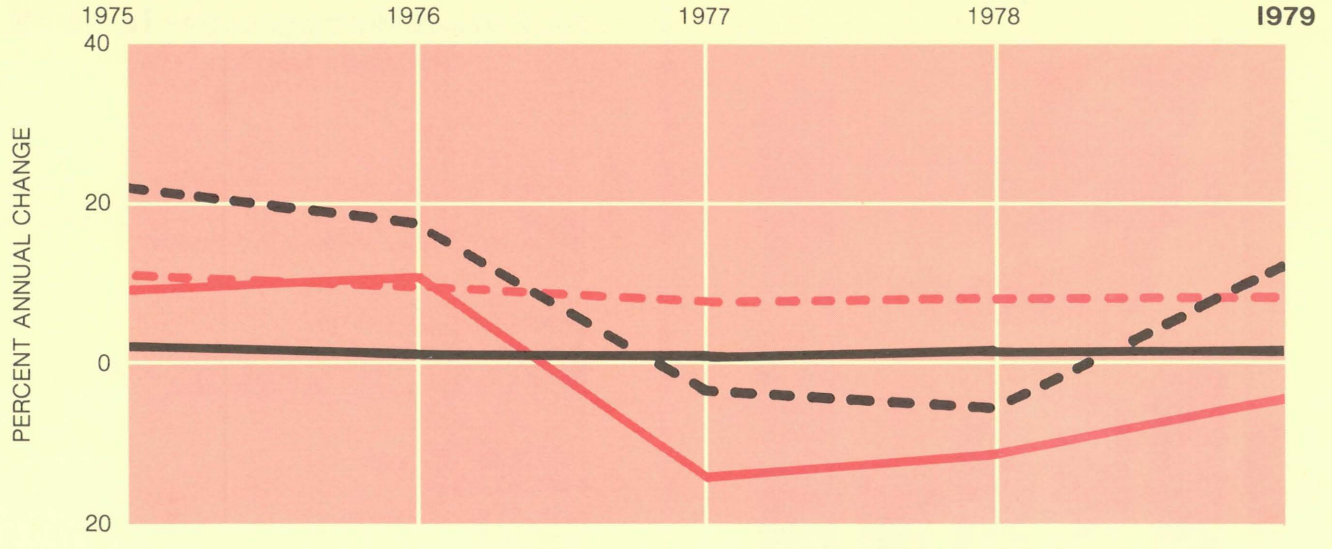
Some British Columbia Economic Indicators

(Percent Changes)



Personal income, employment and the value of shipments are major factors that reflect the economic health of the forest industry.

- Gross Provincial Product
- Total Personal Income
- Unemployment Rate
- Selling Value of Factory Shipments



The growth of the economy is based, to a large extent, on the use of wood products.

- Housing Starts
- Value of Building Permits
- Population
- Consumer Price Index (Vancouver)

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Victoria, B.C.

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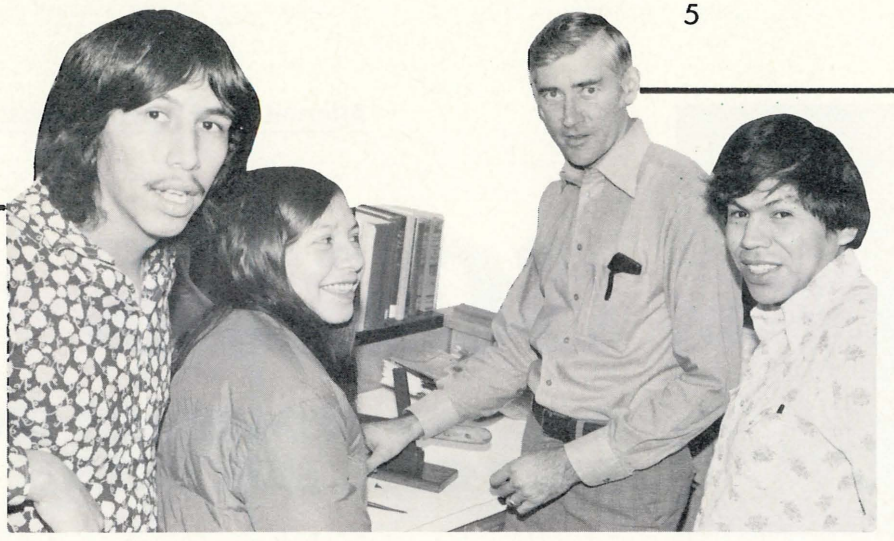
Source
-B.C. Gov't.
-Stats. Canada
-CPPA



Frank Qualtier, Shirley Terbasket and Wayne Terbasket (far right) get some instructions from Doug Ruth (second right) on nursery pests.

On-the-Job Training

Three members of the Lower Similkameen Indian Band have spent the last ten weeks at the Pacific Forest Research Centre as part of a forest management training program.

Shirley and **Wayne Terbasket** and **Frank Qualtier,** who have already had 10 weeks of instruction at the British Columbia Institute of Technology (BCIT), on forestry management practices, have concentrated their learning on forestry protection practices, and have been spending their time in the lab and out in the field with Protection personnel.

The Lower Similkameen Indian Band, located about 30 miles east of Keremeos, B.C., has applied for a tree farm licence and are therefore required to perform extensive high quality forest management to upkeep and to promote forest production. As a result of this the Band is training various members in order to carry out these responsibilities.

"We are delighted with the enthusiasm and effort these students have put into their training and we are pleased to participate with the Department of Indian and Northern Affairs in this program," said **Dr. Doug Miller,** Program Manager, PFRC Forest Protection program.

What's in a Name?
Peat, muck, moor, moss, mull, turf, bog, mud....

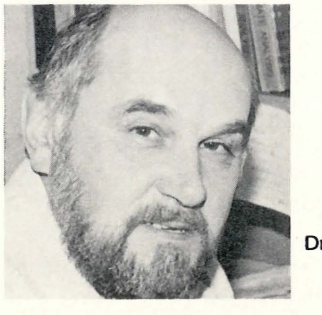
The concept of peat formation was established long ago. It was recognized and defined as an accumulation of dead plant remains under conditions, particularly water-logging, that prevent the complete decay of the organic matter. The exact nature of peat, however, is still not entirely understood.

The terminology for designating peats and peat formations has been and is of concern in Canada, the USA, as well as to working groups of the International Union of Forest Research Organizations (I.U.F.R.O.) and the International Peat Society. Much confusion exists, and it is sufficient to direct attention to the terms most commonly used. Many are merely synonyms - peat, muck, moor, moss, mull, turf, bog, mud, mild humus, ooze, sludge, forest peat, fuel peat, sphagnum peat, sapropel, gyttja, dy, liver peat and many more. Confusion in terminology similar to this exists in regard to peatlands, wetlands, muskegs, bogs, swamps, fens, moors, etc.

Clarification of many of the applied terms is needed. The best way to achieve this is by defining specific terms, identifying synonyms and translating the terms and definitions into languages most frequently used in that field.

Recently the International Peat Society has established a working group dealing specifically with the terminology of peats and peatlands to compile a multilingual dictionary. **Dr. Walter Stanek,** a research scientist at PFRC, is heading this group with the cooperation of scientists from Canada, the USA and several European countries including Finland and Russia.

Over 100 terms were defined and are being scrutinized. After reaching consensus the English definitions will be translated into German, Russian and perhaps also into Finnish and French. A first translation should be available in 1981.



Dr. Walter Stanek

Dr. George Puritch

SOAPS

MAKING COMEBACK ON PEST CONTROL SCENE

There are fatty acids in your skin and in your laundry room. Dr. George Puritch, a tree physiologist at the Pacific Forest Research Centre (PFRC), is attempting to reintroduce a use they had 50 years ago - killing insect pests.

With new developments on an old remedy, the result could be a major alternative to petrochemical pesticides.

Fatty acids, obtained from plant and animal fats and oils, are the class of chemicals that Dr. Puritch has found to be effective in controlling a number of pests of the forest and agriculture industries. To make them soluble for spray application, the fatty acids are neutralized with a base to form fatty acid salts - and that, by any dictionary definition, means soap.

Many people have come to assume soap is a single chemical compound with a single use. However, nature holds hundreds of fatty acids that can be neutralized with a host of bases to give thousands of different soaps - many of which are not suitable for either washing things **or** killing insects. (In industry, soaps are used to manufacture a variety of products from lubricants and paints to crayons and cosmetic powders.) In addition, many household soaps are not pure fatty acid salts, but contain detergents and other substances.

The fatty acids, from which the soaps are made, are natural plant and animal products and are ingested every day as part of the human diet. In fact, fatty acids are a natural constituent of human skin and one of the barriers against disease-causing fungi. One example is pelargonic acid which controls ringworm fungus in humans, though it is only after puberty when this fatty acid starts being produced in the body.

Dr. Puritch more or less stumbled into soap research in 1973 while studying hormonal activity in the balsam woolly aphid. During an experiment a fatty acid solution was used as a control instead of water. "To our surprise it knocked them dead," he said. That led to further experimentation with varying combinations of fatty acids.

HOW SOAP WORKS

Dr. Puritch's research has shown that insecticidal soaps, when sprayed on the insects, penetrate their bodies causing destruction and disruption of their membranes - usually resulting in death. As well, the insecticidal soaps accumulate in the nervous system and cause paralysis. What he has also discovered is that many of those insects which are not killed outright are affected in such a way that they never reach maturity, thus never having the chance to reproduce.

Insecticidal soaps have proven to be an excellent material for controlling some insects in urban gardens, tree lots and nurseries. However, the feasibility and economics of large-scale use in forestry and agriculture have not been determined.

Besides killing aphids, insecticidal soaps have proven effective in the laboratory on several other forest pests including gall aphids, black headed budworm, tussock moth and spruce budworm. The soaps have also been used successfully to treat an aphid infestation in a commercial seed orchard.

It is on the farms and in the orchards and gardens that Dr. Puritch sees the greatest prospects for the use of fatty acid salts.

Dr. Puritch credits British Columbia's Ministry of Agriculture with taking a lead role in recognizing the agricultural potential of his research and spreading the word. The ministry has funded summertime student help for the studies and has encouraged government researchers at Summerland and Vancouver to try fatty acid derivatives in their insect and disease control investigations.

"For the agricultural industry, one of the main advantages of fatty

acids is how much we know about them - where they come from, where they go and their place in the food chain," says Dr. Puritch.

Aphids, earwigs, mealybugs, mites and white flies as well as several disease organisms are among the common agricultural pests that have been shown to be controlled by applications of soap. Researchers continue to add to the list: nematodes, spittlebugs, gypsy moth and pear psylla also have given indications of being susceptible to certain fatty acid salts.

There's another interesting angle for farmers in all this: a new market for their products. If insecticidal soaps go into mass production, the industry will require supplies of fats and oils from plant and animal sources - raw materials that can come through the farm gate along with other food by-products.

FUNGICIDAL USE

Several years ago Dr. Puritch, in collaboration with **Dr. Duncan Morrison,** a plant pathologist and expert in root diseases at PFRC, began investigating the possible uses of fungicidal soaps, as distinct from insecticial soaps, to treat root rot in trees. Preliminary trials showed that treating freshly cut stumps with a solution of fungicidal soap kills the root rot fungal spores. Research is now underway to determine the effectiveness of using the fungicidal soaps in the field to prevent root rot infection.

"Thinning tree stands without taking measures to control root rot is counterproductive," says Dr. Puritch. Studies are also being carried out to determine soap's effectiveness on other fungi such as those causing Dutch elm disease and grey mould.

Dr. Puritch also has been working with the B.C. Ministry of Forests to develop algicidal soaps for nursery applications to control moss and algae contamination of containerized seedlings. Nursery operators are currently handpicking out this unwanted material at considerable expense and time. An application of the algicidal soap solution has proven effective in time and cost savings.

As a result of Dr. Puritch's research and his subsequent successful trials, a Victoria-based company is now marketing insecticides derived from fatty acids. (See story on page 8.) These include a compound for use on ornamental houseplants, commercial compounds for use on conifers and several compounds for vegetables, shrubs and trees. Currently the company has registered an insecticidal soap for use against aphids, mealy bugs, mites and whitefly.

As well, Re Tech, operating out of the University of Victoria, has received funding from the Canadian Forestry Service and Supply and Services Canada to conduct additional research. (See story on page 7.)

"The possibilities are unlimited," Dr. Puritch says, "and the time appears right to continue to push for additional research and promotion of safe and effective alternatives to petrochemicals."

University Research Bridges Gap Between Basic Research & Practical Application

***Botrytis,* or grey mould, is a serious fungal disease of conifer seedlings, which is responsible for large losses each year. The synthetic fungicides which are currently used to combat this problem can be toxic and environmentally suspect.**

Research by **Dr. George Puritch** of the Pacific Forest Research Centre has shown that specific naturally occurring short chain fatty acids can effectively control insect and fungus problems.

Re Tech, a pioneer company in Discovery Park at the University of Victoria, specializes in applied chemistry. They are a link between the basic research ideas generated and their practical application in industry and public enterprise.

The Canadian Forestry Service and Supply and Services Canada have awarded Re Tech a contract to carry out a study aimed at synthesizing various derivatives of the fungicidal fatty acids and determining the best compounds for killing the fungus within the plant. Besides *Botrytis,* these chemicals are also being tested against another fungus, *Fomes annosus,* to see if they may also combat root rot.

The Re Tech team consists of **Drs. John Wood** and **Paul Monette, David Robertson, Helen Becker** and **Kathy Charters** who receive encouragement and assistance from the various university faculty members in chemistry, biology, biochemistry and microbiology, as well as PFRC staff, in

Dr. Puritch examines some nursery stock tested with algicidal soaps.

conducting their studies.

The study has completed its first stage, confirming Dr. Puritch's findings of the effectiveness of the fungicidal fatty acids. Studies with carbon-14 labelled radiotracer compounds are now starting to test the penetration, transport and persistence of a wide range of related compounds in conifer seedlings.

From this work it is hoped to develop environmentally safe fungicides for conifer that will be utilized by the plant to provide its own protection. On completion of the project it is hoped manufacture and distribution of these non-toxic fungicides will be developed commercially.

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Contract Awarded to Develop Non-Toxic Pest Control Products

An agreement was recently signed between the Canadian Forestry Service and Safer Agro Chem Ltd. of Victoria, B.C., to fund research by that company for the development of new, safe, pest-control products from fatty acids and other bio-derivatives.

The contract, in the amount of $60,400, was awarded under the federal government's Cooperative Project with Industry (COPI) program under which funds are made available for technology transfer from the government research facility to the industry.

The objective of this contract is to promote the commercialization of three different fatty acid products so that they become available in the market place for the general public.

The awarding of this contract is a direct result of the research being carried out at PFRC by **Dr. George Puritch** on fatty acid salts.

Safer Agro Chem Ltd., which has been marketing insecticidal soaps to control such pests as aphids, mealy bugs, white fly and spider mites for the past three years, is the only company in Canada and the United States developing and marketing bona fide fatty acid and insecticidal pesticides for both domestic and commercial use.

The new product line they will be researching will include ways and means of controlling mosses, algae, liverworts and moulds and will be especially useful in nursery and home applications for such things as demossing roofs, lawns and sidewalks.

"The advantage of these products is that they are very low in toxicity to animals and man and are non-corrosive in nature," says **Sergei Condrashoff,** President of Safer Agro Chem Ltd.

At the moment the company generates work for six or seven local people but could be expanded considerably once these new products have been developed and marketed.

"We are delighted that research initiated by the Canadian Forestry Service will have the opportunity to be developed by the private sector and will assist in the creation of new products and job opportunities," says **Ross Macdonald,** Director of the Pacific Forest Research Centre.