

TIMBER

NO. 3 SUMMER 1987

NORTHERN FORESTRY CENTRE

EDMONTON, ALBERTA

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Sophisticated light-sensitive scanner produces intriguing "snapshots" for forest inventory. See story page 3.

STEVE ZOLTAI HONORED



(left to right) J. Maxwell, Acting Deputy Minister, Environment Canada; Steve Zoltai; J. Maini, Assistant Deputy Minister, Canadian Forestry Service.

Northwest Territories. He was recently honored in Ottawa for his many contributions to wetlands research.

In June Mr. Zoltai, together with Charles Tarnocai and Clayton Rubec (of Agriculture Canada and Environment Canada, respectively) received a Group Achievement Merit Award from the Government of Canada. This award recognizes the significant contributions each man has made to wetlands ecology and conservation -- both on an individual basis, and as working partners with the National Wetlands Working Group of the Canada Committee on Ecological Land Classification.

Wetlands interest many people for many reasons. They are important for forestry, as wildlife habitats, for their outdoor recreation possibilities, and for peat used for energy or as a soil conditioner. Mr. Zoltai's fascination with

HONORED continues on page 6

If you don't know the difference between a bog and a fen, Steve Zoltai can tell you. Mr. Zoltai, a research scientist with the Northern

Forestry Centre, has labored thousands of hours in the swamps, peatlands, bogs, fens and marshes of the prairie provinces and

FOREST RENEWAL HITS THE NEWS!

Official openings usually call for elegantly dressed people arriving in sleek cars, but at The Pas, Manitoba on May 29th, jeans and rubber boots were more appropriate. It was the official opening of new facilities built at the Clearwater Provincial Forest Nursery with funds provided by the Canada-Manitoba Forest Renewal Agreement. Clearwater supplies primarily black spruce seedlings to two customers: to the nearby Manfor Ltd. lumber and pulp mill; and to the Manitoba Forestry Branch for reforestation of provincial Crown lands. On hand to dedicate the 20 new greenhouses, 10 shade frames and seeding line building were Mr. Len Harapiak, Manitoba's Natural Resources Minister, and Mr. Jean-Claude Mercier, Associate Deputy Minister of the Canadian Forestry Service.

A few days later, on June 2nd, the scenario was similar, this time at the Pineland Provincial Forest Nursery, 50 Trans-Canada miles east of Winnipeg. Again, capital facilities built with funds from the Canada-Manitoba Agreement were officially opened. Doing the honors here were Canada's Minister of State for Forestry and Mines, Mr. Gerald Merrithew, and again, Mr. Len Harapiak. At Pineland, twelve greenhouses, a cold storage building for overwintering seedlings, and a tree improvement complex are now making important contributions to



Manitoba Natural Resources Minister Len Harapiak (second from left) and Minister of State (Forestry and Mines) Gerald Merrithew (second from right) check the growing stock at the Pineland Forest Nursery.

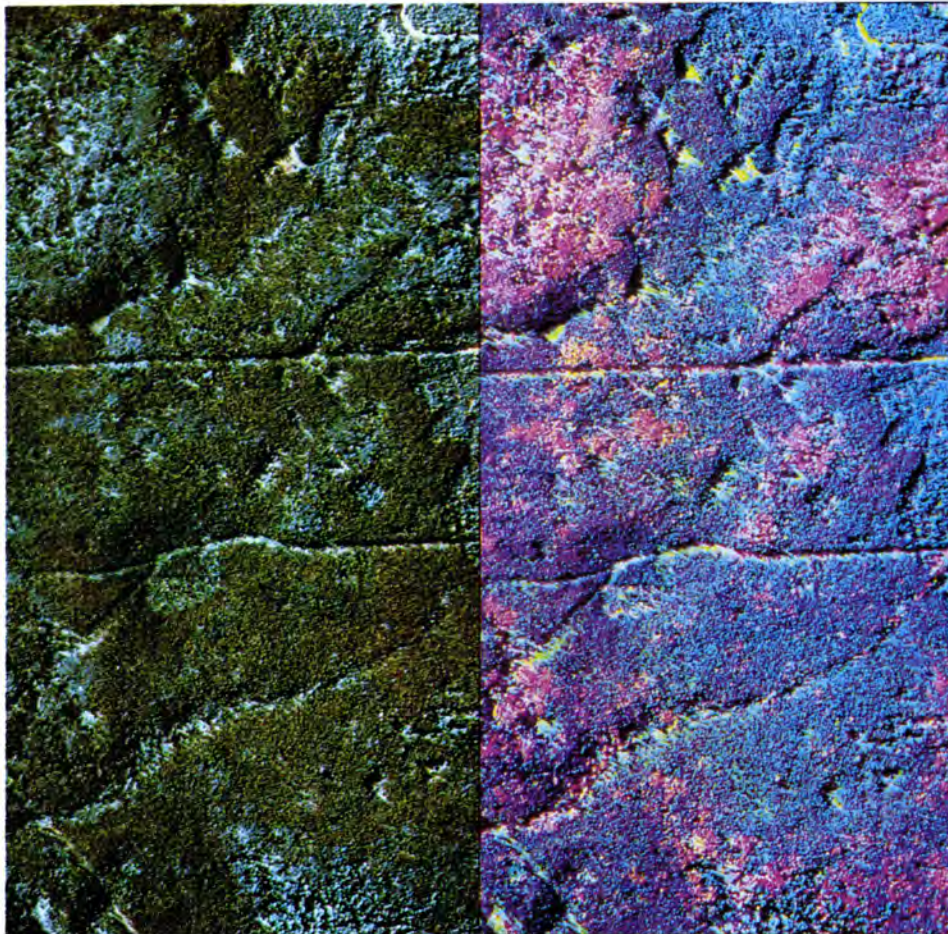
the day-to-day business of renewing Manitoba's forests. Together, the Clearwater and Pineland nurseries expect to be producing about 20 million seedlings annually by 1989.

At that same ceremony on June 2nd, the two forestry ministers signed a research agreement known as the MOU (Memorandum of Understanding Concerning the Coordination of Forest Research). The MOU sets out the areas of forest research each level of government will pursue, so duplication of effort is eliminated and specialists' expertise can be used to the best advantage. Through

the MOU, efforts are also made to ensure that research results reach practicing foresters and forest managers. (A similar Memorandum between Canada and Alberta was signed May 8th at the Northern Forestry Centre in Edmonton. Putting their signatures to that document were Mr. Merrithew and Alberta's forestry minister, Mr. Don Sparrow.)

On June 2nd, a Winnipeg television station aired 6-minute features of the Pineland Nursery opening at 6 p.m. and 11 p.m. -- good press covering some good news for Manitoba's forest renewal efforts.

LIGHT WAVES MAKE LIGHT WORK OF FOREST INVENTORY



LEGEND:

Purple – white or black spruce

Green – pine

Blue – larch

Orange – pure aspen

Magenta – aspen with spruce or pine understorey

(left) Normal color image of forested area produced from data acquired by the MEIS II scanner.
(right) Same image after "enhancement" highlights different species in the area.

Click! There you are, immortalized on film. A camera is so familiar we don't think twice before we focus and shoot. But think about what a camera does – it captures and preserves an image. It does that by using light to record the essence of an object without actually touching it. A camera is a remote sensing device.

A camera responds to and uses light in a specific way. Other instrument systems, scanners and sensors have different ways of responding to the electromagnetic spectrum to produce images. These remote sensing devices have almost unlimited uses. In forestry, some, like satellite sensors, have proven extremely useful in showing the location and extent of our forest resources. This information is being used increasingly in

forest management and protection planning.

MEIS II SCANNER PRODUCES "SNAPSHOTS"

However, the nature of technology is such that "new and improved" inevitably seems just around the corner. That's why the Canadian Forestry Service, in cooperation with other agencies, is pioneering study of the potential of the MEIS II scanner for forestry uses. This scanner works by recording the amount of light that's reflected back from an object. As the scanner is flown over an area, information is recorded in digital form. Later, the information is converted by computer to an image that looks somewhat like a satellite map. This image is then reproduced onto photographic film to give a "snapshot" of the area scanned.

Forestry studies of MEIS imagery have taken place in almost every province. Currently research is underway to develop methods to use MEIS data for forest inventory mapping, to determine tree heights, to assess insect damage and to monitor changes to forested areas. Results have been dramatic; so much so, that the Canadian Forestry Service is investigating the possibility of working with private industry and the Canada Centre for Remote Sensing to design and manufacture a new MEIS scanner specifically for forestry uses.

A major part of the investigative effort into the MEIS is being done in Alberta. Ron Hall of the Northern Forestry Centre is coordinating the Alberta research. His partner agencies include Alberta Forestry, Lands and Wildlife, Petawawa National Forestry Institute, Canada Centre for Remote Sensing and the Alberta Remote Sensing Center. The staff at Petawawa play an invaluable role. Besides collaborating on the general "how to" for the project, the staff there perform atmospheric correction of the data before Mr. Hall receives it. Atmospheric particles scatter light waves, making fine detail from the MEIS data impossible to see. Because the MEIS is light-sensitive, without this work to take out the distortions analysis of the data would be impossible. Work with the MEIS II scanner forms part of a cooperative five-year pilot program testing all forms of remote sensing and mapping over 14,000 square kilometres in Alberta.

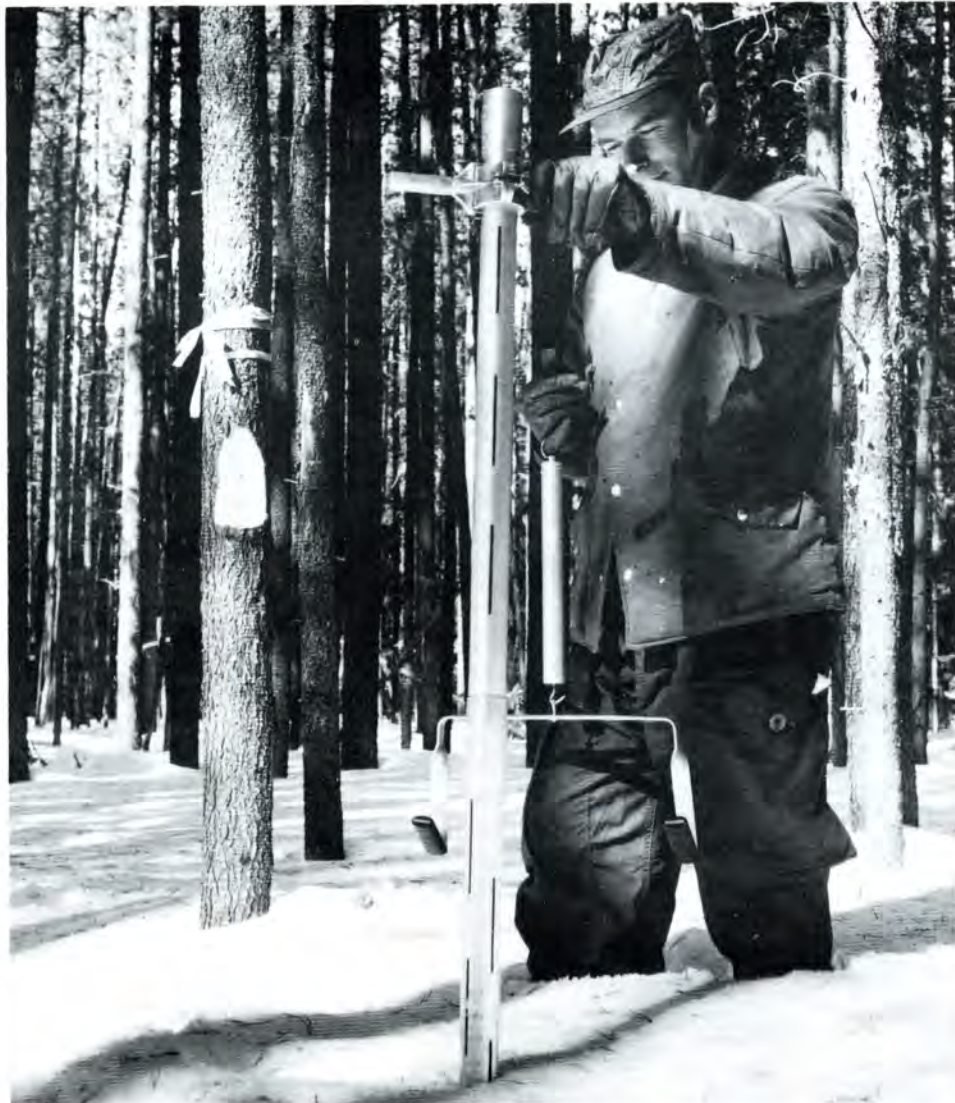
The information Mr. Hall is currently working with was obtained during flights over the Whitecourt area, at a height of about 4,700 feet above ground. This area is primarily boreal mixedwood forest, forest which is a real challenge to inventory. Instead of relatively pure stands of certain species which are easy to identify, the Whitecourt forest, and, in fact, much of Alberta's forested area is a jumble of softwoods and hardwoods of various species, ages, heights, diameters and densities. It's very difficult in some areas to tell how much of what is where, and whether or not there's enough of a certain species to make it worthwhile to harvest.

COMPUTER "PALETTE" A USEFUL TOOL

Part of Mr. Hall's work is to "enhance" the image generated by the MEIS II data so that it more clearly highlights certain features.

LIGHT WAVES continues on page 7

MARMOT MAKES WAY FOR OCO '88



Measuring the water equivalent of snow with a Mount Rose snow tube.

As Alberta braces for the avalanche of world attention when the Winter Olympics open next February, Dr. Robert Swanson of the Northern Forestry Centre is closing his books on a research project inextricably tied to the sportfest. For 19 years, Dr. Swanson and his associates, including Dr. Graham Hillman and Denny Fisera of the Northern Forestry Centre, visited the Marmot Creek experimental watershed about sixty kilometres west of Calgary, Alberta. Their work was a continuation of a project which had been set up ten

NOTE

The exclusion of certain manufactured products or company names does not necessarily imply disapproval, nor does the mention of other products or company names necessarily imply endorsement by the Canadian Forestry Service.

years before by the late Dr. Walt Jeffrey to monitor snow, rain and streamflow. Every season, Dr. Swanson's group monitored their experiments, in which small areas of forest had been clearcut in specific ways to try to increase the amount of streamflow from the snow that accumulated and eventually melted. The experiments were successful, but not fully evaluated. More studies were planned. But with the Marmot experimental watershed having been chosen as the site of the 1988 Winter Olympic games, the experimental station was forced to close its doors last October. Although the ski runs for the Games themselves wouldn't have interfered with the monitoring equipment positioned within the basin, the area has been earmarked for recreational skiing development once the Games are over.

So, the snow samplers, snow pillows, stream gauges and snow courses, all the tools

of the hydrologist's trade, are gone from Marmot Creek basin. What remains are the fascinating results of the study, which had its beginnings in 1947. That year, Parliament established the Eastern Rockies Forest Conservation Board (ERFCB). It was a formal recognition of the eastern slopes' importance as the headwaters of the Saskatchewan River, which threads its lifeline through a basin covering central and southern Alberta and Saskatchewan, right through The Pas, Manitoba. Ninety per cent of the prairies' surface water supply originates on the eastern slopes. Forests there play a critical role in the Saskatchewan River waterflow. By acting as catchments for the snow, they regulate the rate at which it melts and flows down across parkland and prairie through the spring and early summer.

The ERFCB was charged by Parliament in 1947 with "the conservation, development, maintenance and management of the forests in such area [the eastern slopes watershed] with a view to obtaining the greatest possible flow of water in the Saskatchewan River and its tributaries". A weighty task, indeed. At the request of the ERFCB, the federal-provincial Alberta Watershed Research Program got underway at Marmot Creek. The purpose of the Marmot experimental watershed was to examine the effects of forest cutting on streamflow in the subalpine spruce-fir forest.

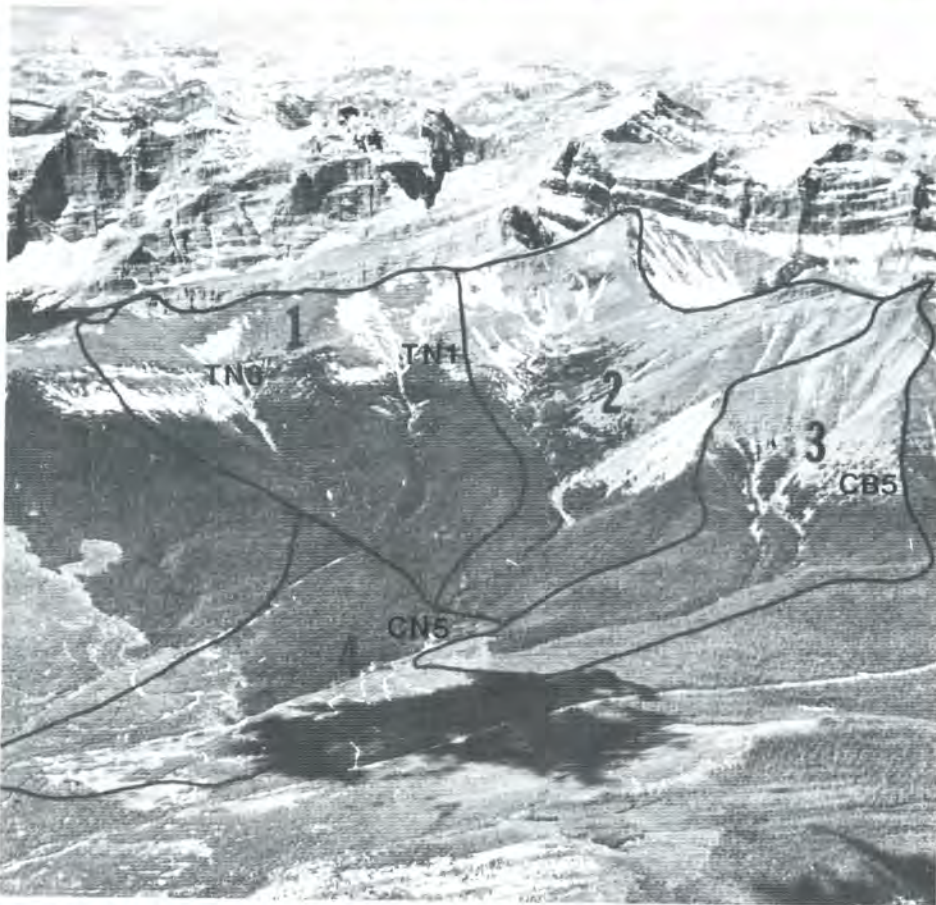
Three subbasins known as Twin, Middle and Cabin make up the Marmot Creek experimental watershed. Major streams form in each of the subbasins, joining at an area called the confluence. Trees in the Marmot Creek basin are generally more than 200 years old, and range from about 30 metres high near the confluence to 5-10 metres just below the treeline. The taller trees are considered to be prime timber by logging interests.

CABIN CREEK IS CLEARCUT

In 1974, part of the Cabin Creek subbasin was clearcut in a joint Canadian Forestry Service-Alberta Forest Service experiment. Researchers wanted to find out if guidelines then in use for commercially harvesting spruce-fir forests were maintaining the same volume of high quality water as before harvest. The Cabin Creek subbasin gets about 840 millimetres (33 inches) of precipitation each year, 70 to 75 per cent of which falls as snow. About half the annual precipitation becomes streamflow.

Although the harvest was designed to simulate a commercial clearcut operation, the major difference was that about one-third of

MARMOT MAKES WAY FOR OCO '88



The three subbasins of the Marmot experimental watershed, Twin (1) Middle (2) and Cabin (3). The area where the three streams join (4) is the confluence.

the commercial trees were higher than 1,980 metres (6,500 feet) above sea level. Normally, clearcutting is not permitted above that elevation, but for the purposes of this experiment it was allowed. Logging started in July of 1974, and by that September six cutblocks ranging from three to thirteen hectares in area were visible on the Cabin Creek subbasin. Minimizing disturbance of the environment played a key role in the size and layout of these cutblocks. The Middle Creek subbasin was left untouched for comparison purposes.

With the cutblocks established, the next step was the consistent measuring and monitoring of streamflow and of the snowpack over several years. A variety of tools and techniques are used to measure snow depth and its water equivalent. The snow water equivalent present at any time during the winter or spring is important in forecasting the anticipated amount of spring runoff. Dr. Swanson and his associate, Dr. D. L. Golding, regularly compared the water equivalent of snow in and around natural clearings with that of the harvested areas, to see how effective these specially designed areas were in increasing local or downstream water supply.

BIGGER IS NOT NECESSARILY BETTER

The results? Only a 6 per cent increase in water yield for the cutblocks over the unharvested areas. Dr. Swanson's research group feels the increased flow on Cabin Creek was reasonably high, considering that only 23 per cent of the total experimental area was clearcut. Results of the study were in line with those of similar studies in North America. The reason for the small increase? The cutblocks were too big -- much of the snow was lost to evaporation through exposure to the sun and wind.

Is there a "best size" of clearcut area to increase water yield? The researchers feel that in Alberta's subalpine and foothills forests (where trees are about 20 metres tall), the optimal clearing size would be one hectare in area. That's less than one-tenth the size of some of the clearcuts on the Cabin Creek subbasin. And, many commercial clearcuts are much larger than those on Cabin Creek.

The data have been gathered, analyzed, interpreted and reports published. Although

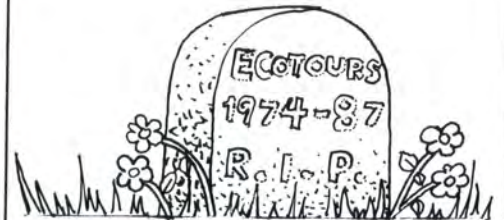
some results have been used in management planning, the project participants acknowledge that the size of clearcuts they recommend to increase water yield translate into increased harvesting costs for commercial operators. The decision to put the results of the Marmot Creek experimental watershed project into practice on a large scale depends very much on political and public priorities in Alberta over the next few decades.

Sources: Hydrologic effects of clear-cutting at Marmot Creek and Streeter watersheds, Alberta

R. H. Swanson, D. L. Golding, R. L. Rothwell and P. Y. Bernier

Northern Forestry Centre Information Report NOR-X-278, 1986

Forests, snow and water, a Northern Forestry Centre Forestry Report, coordinated by R. H. Swanson, 1986.



Did you know that buffalo overturned many of the poles on the original 1,600 kilometre telegraph line from (then) Fort Garry to Edmonton? That's just one of the many fascinating tidbits to be found in ECOTOURS, a series of booklets describing natural and human history along the Trans-Canada highway. Almost all sections of the highway, from St. John's Newfoundland to Victoria, British Columbia, were brought to life by the Canadian Forestry Service in 19 booklets for Canadian and foreign visitors travelling the Trans-Canada. The Northern Forestry Centre researched, wrote, photographed, illustrated and printed ECOTOURS for Regina-Winnipeg, Calgary-Regina and Calgary-Golden. Enormously popular, they certainly gathered their share of roses (and thorns, when residents of one particular region felt coverage had been less than complimentary!) The three publications went through several reprints; in all, more than half a million English and French copies were distributed.

It's our unfortunate duty to advise you that ECOTOURS have been discontinued. Dwindling supplies coupled with financial restraint simply won't permit the distribution of this series any longer.

ECOTOURS will be missed.

MARMOT MAKES WAY FOR OCO '88



The three subbasins of the Marmot experimental watershed, Twin (1) Middle (2) and Cabin (3). The area where the three streams join (4) is the confluence.

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PRIVATE WOODLOTS GAIN GROUND IN SASKATCHEWAN

Private woodlots have long been strong contributors to the forest industry in central and Atlantic Canada. But in the prairie provinces, where forest land is almost wholly government owned, timber management at the individual woodlot level is just now starting to come into its own. The notion of the lone entrepreneur earning income from the forest is finding ready acceptance from people accustomed to seeing the farmer seeding and harvesting his crops.



Helping a private woodlot owner prune spruce on his property.

Now, private woodlot owners in Saskatchewan are getting encouragement from the Canada-Saskatchewan Forest Resource Development Agreement. A "fill-in-the-blank" management plan is now available from the Canadian Forestry Service's district

office in Prince Albert. The owner simply collects the basic information on his woodlot and sends it with an aerial photo to the office. Our staff then field check the plan, and provide management and marketing suggestions.

Demonstration woodlots have been set up at Rapid View (west of Meadow Lake), Belbutte, Paddockwood and Gronlid, and the Big River and Hudson Bay demonstration woodlots will be in operation by the end of August. Already, 29 thousand trees have been planted, over 80 hectares set up to demonstrate various management activities, and almost 30 kilometres of trails and fences are in place on these demonstration sites. The fact that private woodlot owners are paying some of the costs to run these demonstration lots shows there is a lot of excitement about and commitment to private woodlot management.

Private woodlot owners are also being encouraged to see what the recently-established library at the Prince Albert office has to offer. Information on insects and disease, woodlot management techniques and equipment is being collected all the time, and a list of available information can be obtained now from the Prince Albert office. And, new fact sheets to cover local topics of interest are being prepared.

The Private Woodlot Extension Program under the Agreement is ambitious. A committee of representatives from our Prince Albert district office, Saskatchewan Parks, Recreation and Culture, the forest industry, Saskatchewan Wildlife Federation and the owners themselves has fleshed out plans to:

1. acquire more information on woodlot inventory and possible markets;
2. look into the feasibility of group ventures of woodlot owners;
3. promote the program through various media to make it more visible;
4. contact more private woodlot owners;
5. set up self-guiding trails and prepare pamphlets describing various management activities on the demonstration woodlots, and;
6. continue preparing and printing woodlot fact sheets.

If you'd like to find out more about the Private Woodlot Extension Program, write or call:

Canadian Forestry Service
Saskatchewan District Office
101 - 15 Street East
Prince Albert, Saskatchewan
S6V 1G1
(306) 764-5627

STEVE ZOLTAI HONORED *continued from page 2*

wetlands began in the 1950's, working for the province of Ontario in forest land classification. "At that time," he says, "wetlands were perceived as areas to try to avoid." Mr. Zoltai joined the Canadian Forestry Service in 1965, and began studying the permafrost peatlands in the Flin Flon area in 1969. He has observed them from an academic standpoint, noting how over successive generations peatlands can influence their own environment (for example, by changing watercourses). And from a practical standpoint, seeing that 40 per cent of Manitoba, 16 per cent of Saskatchewan and 28 per cent of Alberta are primarily peatlands, he notes, "First you understand them. Then you do something with them."

Mr. Zoltai has many achievements to his professional credit. He spearheaded efforts to complete the National Wetland Classification System for Canada, a system that has found many national and international applications, and is recognized worldwide. He has seen

through from concept to completion two major wetlands maps, which were published by the National Atlas of Canada last year. And the publication of THE WETLANDS OF CANADA this fall will mark another milestone. Mr. Zoltai has been lead author and/or chapter coordinator for chapters on "Wetland Environments and Classification", "Wetlands of the Subarctic Regions of Canada" and "Wetlands of the Boreal Regions of Canada". The book has been developed as a textbook at the high school to undergraduate level.

Mr. Zoltai is an internationally recognized expert in boreal and northern peatland ecology and soil science, and has frequently represented Canada in international forums. His Merit Award came just weeks before a major symposium on wetlands ecology and conservation opens in Edmonton (August 23-27). Not surprisingly, Mr. Zoltai is the symposium's coordinator. The commitment to wetlands research is just as strong as ever.

NORTHERN ALBERTA FORESTRY SHOW A SUCCESS



Photo courtesy of B.C. Lumberman magazine

The Northern Alberta Forestry Show was a jam-packed 3-day event.

Entertaining, informative and a break-even deal -- not bad for the first Northern Alberta Forestry Show held in Grande Prairie, Alberta during National Forest Week. A balanced mix of activities at Evergreen Park just south of the city pulled in more than five thousand visitors May 7th, 8th, and 9th.

The show, which will be held every two years alternating with the Prince George, B.C. Regional Forestry Exhibition, was primarily a chance for forestry equipment manufacturers to show what they could do. Each day during the grandstand show, trees were set up to challenge the feller bunchers, delimiters, skidders and loaders. These demonstrations really showed the latest innovations in harvesting equipment operating to their best advantage. There was also some scarification equipment, like disc trenchers and chain

drags, being given a workout. One of the most popular attractions at the grandstand show was Grande Prairie resident John Starks. Mr. Starks is a well-known figure on Grande Prairie's forestry scene, and he kept the crowds coming in to see his old time logging demonstrations using a crosscut saw, and horses to haul away the logs.

The approximately 80 exhibitors covered a cross-section of forestry interests. In addition to equipment dealers, various forest industries had set up booths, plus representatives from the Canadian Forestry Service, Alberta Forest Service, Canadian Institute of Forestry and Alberta Forestry Association.

A quick rundown of other highlights of the three days -- on Thursday, Alberta's forestry minister, Don Sparrow, opened the show. On

Friday, seminars were held on obtaining crown timber in Alberta, on reforestation methods in use in Grande Prairie area, and on forest management planning, with the emphasis on integrating other uses of the forest. A panel discussion, "Beyond Basic Forestry", drew many interested onlookers Friday afternoon. First, Hugh Ross of Stora Forest Industries and Peter Affleck of MacMillan Bloedel talked about how and why their companies had made money available for intensive forest management, and then described how intensive management techniques might be applied in Alberta. Representatives from the Alberta Forest Service, Canadian Forestry Service, Procter and Gamble Ltd. and Canadian Forest Products Ltd. (CANFOR) then took up where the two speakers had left off. Saturday was again devoted to the exhibit booth viewings and the grandstand show. And, the "Alberta's Managed Forests" forestry exhibit trailer, which is becoming a well-known sight around Alberta, lent some colorful visual interest to round out the 3-day show.

The Canada-Alberta Forest Resource Development Agreement provided funds for Friday's panel discussion. Other sponsors for the event as a whole included the Alberta Forest Service, CANFOR, Procter and Gamble Ltd. and major equipment dealers.

Not only did the inaugural Northern Alberta Forestry Show break even, "we even made a few dollars," according to one of the show's chief organizers, Jerry Bauer of CANFOR. Mr. Bauer says the money will go into improvements and more promotion for the second Northern Alberta Forestry Show in 1989.

WAVES continued from page 3

Specifically, he is adding color to the image in an attempt to more sharply distinguish the hardwood and softwood species in the Whitecourt area. His second major objective is to come up with an "image enhancement recipe", a formula that will result in this kind of discrimination between hardwoods and softwoods in any image, no matter where the original data come from. Third, Mr. Hall would like to take this discrimination process one more step, to distinguish between the two hardwood species of balsam poplar and trembling aspen. That particular project will get underway before the end of this summer. With aspen the up-and-coming contender on Alberta's forestry scene, the economic incentives are there for this kind of research.

The overall goal is to improve upon current aerial photo-interpretation and satellite image interpretation techniques. It all translates into improved economic performance from Alberta's forests. The major difference between the MEIS II scanner and satellites is the degree of detail that can be shown. The MEIS II is a high-resolution scanner, able to produce detailed images of areas smaller than one metre by one metre. Another advantage of the MEIS II is that three-dimensional imagery, called stereo, can be produced. That degree of refinement is not yet available from another any other non-photographic remote sensing device.

Alberta Forestry, Lands and Wildlife, as initiator of the MEIS II project in Alberta, has a

big stake in the results. At this stage, it looks promising. Mr. Hall says he's almost accomplished his first objective, producing an image which distinguishes the hardwood and softwood species. Hardwoods like balsam poplar and trembling aspen reflect more light back in the atmosphere than softwoods like spruce and pine, a characteristic that's easily seen in the MEIS II images. His second objective, to replicate the process of producing that image, will take many patient hours of trial and error, working both at the Alberta Remote Sensing Center and with Petawawa's computer image analysis system. It's a challenge that, once met, could vastly improve the way forest inventories are done in Alberta and the rest of Canada.

PEOPLE



CONGRATULATIONS to GUY FAWCETT on his promotion. Guy is now our new purchasing officer.



WELCOME to CLAIRE ABMA and JAN PALMER. Claire joins Regional Development as Secretary, and Jan is the new Secretary to our Regional Director General, DAVE KIIL. ANDU YOHANNES is our new stores person, and DR. KEN MALLET joins us as a Forest Pathologist. DEAN PATTERSON is our new Remote Sensing Technician.



BACK ON BOARD are BRYAN LEE and ELAINE SCHIEWE. Bryan has returned from a year and a half of development leave at the University of Washington. He brings with him DR. STEWART PICKFORD, who will spend a year at Northern as a visiting scientist under STEP (the new Science and Technology Exchange Program launched by the Canadian Forestry Service this year). Elaine is back as a word processor operator.



PINK BOOTIES to RON and JUDY HALL, parents of AMANDA MICHELLE, born July 13, 1987. Congratulations also to JUDY SAMOIL and JIM SELBY; ANDREA NICOLLE was born April 8.



GOODBYE to JIM HODGINS, retiring as our Purchasing Officer after 16 years at Northern, and THEDWA AVENELL our Purchasing clerk. And GOOD LUCK to ANNE MAUCH, formerly an economist with the Canada-Saskatchewan Forest Resource Development Agreement. Anne is now with the Federal Economic Development Coordinator's office in Edmonton.



EDMONTON, AUGUST 23-27, 1987
WETLAND DYNAMICS
CLASSIFICATION AND ECOLOGY
NON-CONSUMPTIVE USES OF WETLANDS
WETLAND CONSERVATION POLICIES
AND PROGRAMS

CONTACT S. ZOLTAI (403) 435-7210
FOR MORE INFORMATION

Proceedings of the 1987 Geographic Information Systems Workshop are now available! Please address your requests to:

Regional Development
Northern Forestry Centre
5320 - 122 Street
Edmonton, Alberta
T6H 3S5

NEW PUBLICATIONS

Listed below are recent publications of the Northern Forestry Centre. Copies may be obtained by writing to us.

Bella, I. E. 1986. Spacing effects 20 years after planting three conifers in Manitoba. For. Manage. Note 39.

Chrosciewicz, Z. 1987. Evaluation of postburn seeding of jack pine in central

Saskatchewan. For. Manage. Note 41.

Edwards, I. K. 1986. Review of literature on fertilizer and conifer seed production. For. Manage. Note 40.

Emond, F. J.; Wong, H. R. 1987. Common insects attacking poplar stooling beds in the prairie provinces. For. Manage. Note 42.

Harvey, E. M. 1987. Proceedings of the 1986 Prairie Federal-Provincial Nurserymen's Meeting. Inf. Rep. NOR-X-287.

McAlpine, R. S. Two BASIC programs for fire danger and fire behavior computations. For. Manage. Note 43.

Samoil, J. K.; Boughton, B., editors. Saskatchewan's Forests. For. Rep. 33.

TIMBERLINES is written and edited by A. Ascher
Graphic Design by D. Lee

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