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Climate Input to Forestry Courses

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The strength of a subject can often be gauged by the amount of time devoted to its instruction at the postsecondary level. Forest climatology or meteorology cuts across two major discipline areas and, as the name implies lies at the interface between biological and physical sciences. Students therefore require training in these two areas to adequately appreciate the value of courses in forest climatology. Available courses are not always given in the one discipline area and rarely in them both. Also, forest climatology may not be identified separately from other general or more wide-ranging courses in forestry or climatology. Often a general climatology course will provide examples from a whole range of disciplines or sectors of the economy.

To gain a better handle on the amount of forest climatology taught at the postsecondary school level and to gain information on its visibility, a survey was carried out over the last few months. A request letter sent in October asked institutes to provide a list of all climate or closely related courses that are available for their students, including courses in another forestry subject area with lectures relating these areas to climate or meteorological factors. They also were asked to provide a brief calendar outline of the course or an indication of the aspect(s) of climate dealt with as well as the length of the course or number of hours devoted to the climate-related aspect(s). In addition, equipment and other facilities used in the courses were to be listed.

For the survey, all institutions listed in the August 1979 issue of The Forestry Chronicle that give degree, diploma, certificate, or other forestry programs were asked to respond. The list included, therefore, the six universities in Canada giving degree courses, the preforestry program at Memorial University of Newfoundland (which prepares students for admittance with advanced standing to the forestry degree program of the University of New Brunswick), and a further 14 institutions giving other programs of instruction. The School of Forestry at Lakehead University is listed as providing a Diploma in Forest Technology, but this program was not covered separately in its' response, although information for this program later was obtained from the 1978/79 course calendar. Geographically, six institutions were contacted in Ontario, five in British Columbia four in Alberta (two institutions share one program), two in Newfoundland, New Brunswick, and Quebec, and one in Saskatchewan. Further mailings were sent in December and February to those institutions that had not responded to the first mailing. The forestry technician schools in Quebec, apart from John Abbott College, were not surveyed separately, as they are not listed in The Forestry Chronicle; however, Dr. A Plamondon of Laval University was kind enough to supply information about the climate content in the forest technology programs at seven general and vocational colleges (CEGEP).

Responses were received from all universities giving forestry degrees and are briefly summarized in Table 1. Four of the universities have

half-year courses that are called Forest Climatology or Forest Meteorology. Two of these also have half-year courses called Meteorology and Climatology or Environnement atmosphérique. At UNB there are two undergraduate half-year Forest Meteorology courses, a second-year and a fourth-year course. The advanced course is a detailed analysis of the mass, momentum and energy relationships in forested environments. At Memorial University, two Forest Meteorology Courses are also provided in the preforestry program for all students; the second course relates weather and climate to the microenvironment of the forest community. Laval also provides a Biometeorology course. At UBC it is a combined Forest and Agriculture Climatology course given by other than a forestry faculty member; at Lakehead also instruction is provided by another department. UBC listed a large number of related climate courses available in a number of departments, including graduate courses. Toronto has a first-year course called Biosphere, and I note that Dr. R. Treidl of AES was listed as an adjunct professor of Forest Meteorology and Hydrology, presumably assisting with this and possibly other courses. Alberta until this year used to require its student to take a Geography Department weather and climate course. The chairman said that the course is given through multiple sections, and the treatment of the material is both varied and often lacking in substance. This requirement was removed this year with the understanding that the equivalent knowledge as relates to forestry would be covered in parts of four of the core courses - Forest Soils, Silviculture I and II, and Forest Fire Management. In addition weather and climate is covered in the Forest Hydrology and Watershed Management courses. It is recommended, however, that students, particularly those interested in forest hydrology or forest fire management, take available climate courses in the Geography Department.

Five of the universities list two or more courses in the areas of forest hydrology and watershed management that have strong climate-related content. Only Lakehead does not give courses in this area. Climate-related input in these courses varies from three hours in a watershed management course to a third of a half-year course in forest hydrology, or a range of 10 to 40%.

All universities have some climate input in their forest fire management or control courses. Input usually concerns weather factors affecting fire behavior, and the effects of weather and climate on fuels, particularly as they are related to the fire weather index system.

Some universities indicated climate input in their forest ecology, forest soils, and silviculture courses, and this is probably so at other universities. The major emphases in silviculture courses are the climate and microclimate factors affecting seedling survival and growth and those climate factors affecting and affected by forest stands. Similar concerns are considered in forest ecology courses, especially how climatic factors affect distribution of species (macro and micro levels) and the zonation of vegetation. The biogeoclimatic ecosystem classification is discussed in some of these courses. In forest soils courses, the main input relates to soil temperature and soil moisture, especially energy transfer in the atmosphere and in the soil, and the hydrologic cycle. I expect some climate- or weather-related information is provided in other courses, such as forest protection, entomology, pathology, harvesting, logging, and road construction, but is less easily identified, and this was not done by the universities responding to the request. All forest pathology courses include

lectures on the noninfectious diseases caused by abiotic or physiological factors. High and low temperatures, water excess or deficiency, mechanical injuries from snow, ice, hail, etc., and airborne pollutants all play a role in causing injuries or predisposing trees to other diseases. Of interest is the mention of acid rain in the UNB calendar outline for its course Survey of Environmental Problems, another indication that climate plays a role in many forestry courses.

Three of the universities mentioned use of locally available climate or meteorological observing stations, in one case on its own experimental forest and in another the university climate station. They also make extensive use of other available equipment. Lakehead only mentioned weather maps, but this may not represent the total exposure of forestry students to climatological stations and equipment, as I expect the silviculture course may include some of these since the effects of solar radiation, temperature, and atmospheric and soil moisture on seedling establishment and growth are covered. One university (UBC) supplied the text and recommended reading list for its Forest and Agricultural Climatology course. The text is Boundary Layer Climates (T.K. Oke), and recommended reading included An Introduction to Environmental Biophysics (G.C. Campbell), Climate and Agriculture (J.H. Chang), The Climate Near the Ground (R. Geiger), Climate Canada (F.K. Hare and M.K. Thomas), Forest Microclimatology (R. Lee), Essentials of Meteorology (D.H. McIntosh and A.S. Thom), Descriptive Micrometeorology (R.E. Munn), Agricultural Physics (C.W. Rose), and Fire Weather (M.J. Schroeder and C.C. Buck). The Biosphere course at Toronto has Boundary Layer Climates (T.R. Oke) and Communities and Ecosystems (R.H. Whittaker) as texts. The recommended reading list includes three on the UBC list (R. Geiger, R. Lee, and M.J. Schroeder and C.C. Buck) and in addition, the following climate-related texts: Energy Exchange in the Biosphere (D.M. Gates), Forest Influences (J. Kittredge), Water: a primer (L.B. Leopold), Weather and Life (W.P. Lowry), Introduction to Meteorology (S. Peterson), Microclimate: the Biological Environment (N.J. Rosenberg), The Biosphere (Scientific American), and Principles of Hydrology (R.C. Ward). It would be interesting to know what is used and recommended at the other universities. A 1978/79 calendar for UNB does indicate that Geiger is the basic text for one Forest Meteorology course.

Responses were received from 11 of the 14 other postsecondary institutions surveyed; these ranged from regional colleges and provincial institutes of technology to the Forest Technology School, Hinton, and the Maritimes Forest Ranger School. Information was also obtained for the Forest Technician Course at Lakehead University from the 1978/79 calendar, thus resulting in information from 12 sources giving other than degree programs. No responses were received from College of New Caledonia, Prince George, B.C.; Selkirk College, Castlegar, B.C. and the Lethbridge Community College, Lethbridge, Alberta.

At all the institutions that responded, except one (Kelsey Institute, Saskatoon), a forest fire control or forest protection course with major emphasis on fire is given. These courses involve major climate-related information, including instruction on maintaining a fire weather station and exposure to the use of various weather recording instruments. At five of these institutions this was the only climate-related course listed (Malaspina College, Nanaimo, B.C.; Algonquin College of Applied Arts & Technology, Pembroke, Ont.; Forest Technology Program, Lakehead University, Thunder Bay, Ont.; Maritimes Forest Ranger School, Fredericton, N.B.; and College of Trades and Technology, St. Johns, Nfld.). Where information

was provided, a minimum of 6 hours of a 42-hour course to 30 hours of one course was indicated as involving climate information. At the Forest Technology School at Hinton, separate Fire Weather Officer, Lookout, and Fire Suppression courses are provided, extensively using climate data.

At NAIT in Edmonton a 44-hour Introduction to Meteorology course is provided for the students, and the use of climate is mentioned for a host of other courses besides the two in fire control. These are Timber Management, Silvicultural Management, Silviculture (four course), Forest Engineering, Watershed Management, Range Management, Forest Soils, Reclamation Techniques, Harvesting, Wildlife (two), Fisheries (two), Wildland Recreation (two). Forest Insects and Diseases, and Construction and Improvements. Several of these courses are actually given during the second year of the program at the Hinton school. At BCIT in Vancouver, 6 hours of the Ecology course is devoted to climate (air masses and vegetation zones; precipitation and biogeoclimatic zones; insolation, degree-days, winds, evapotranspiration, and microclimate), and an hour is devoted to climate in the Botany, Soils, Environmental Measurement Techniques, and Roads and Transportation (drainage structures) courses. At Kelsey Institute in Saskatoon, 2 to 6 hours are devoted to climate in the Forest Ecology, Water Management, and Logging-Harvesting-Roads courses. It also provides a 2-hour unit on general meteorology in the program.

At the Sault College of Applied Arts and Technology, the AES text Weather Ways is used as a means of teaching introductory meteorology in the third-year Environmental Measurements course. Climatology, especially microclimate as it affects natural ecosystems, is part of the first-year Forest Ecology course, and climate is also involved in the Dendrology, Silviculture, Wildlife Management, and Fisheries Management courses. At Sir Sandford Fleming College, 30 hours are spent on weather and meteorology in the Forest Fire Science course, but it also mentions "that in all forestry courses, be it harvesting or whatever, references is made to the effect weather has on operation. This occurs in Silviculture, Forest Soils, Mensuration, Harvesting, Entomology, and overall Management". It further mentions that the "weather station provides information to AES once a month".

At the John Abbott College in Ste. Anne de Bellevue, P.Q., which gives the first 2 years of a 3 year Forest Technology program (third year is given at CEGEP Ste. Foy), some climate information is included in the Introduction to Forestry and Silviculture courses; however, electives are available to forestry students in the following courses: Climatology and Hydrosphere (Geography) and Solar Energy and Meteorology (Physics). Elsewhere in Quebec, a 2 year forest technology program is given at Chicoutimi, Gaspé, Manicouagan, Matane, Rimouski, and Rouyn, and a 3 year program at Ste Foy. At the 2 year program colleges the only climate-related content is about 6 hours of hydrology in the Multiple Use Management course in the Forest Management option. At Ste Foy, in addition to the Multiple Use Management course, a few hours of climatology is included in Forest Ecology I, and a few hours of hydrology in Forest Ecology II, both courses in the Forest Management option. No climatological content is included in the Logging or Forest Products Transformation options at the colleges.

The postsecondary institutes, other than the universities, therefore tend to fall into two groups: 1) those that only include climate in a

forest fire course (or in Quebec in a multiple use management course) and 2) those that also employ climate information in a range of other courses, including in some cases a separate or a large portion of a course on introductory meteorology.

Although not part of the survey, mention should be made of a course given at Lakeland College, Vermilion, Alberta, on Agricultural and Forestry Aviation, which included some macroclimates that affect flying and particularly microclimate conditions that affect spray dispersal, drift, deposit, etc. (Powell 1976).

#### Reference

Powell, John M., 1976. A directory of climate and related courses and persons interested in Climatology in Alberta. Environ. Can., For. Ser., Northern Forest Research Centre. Edmonton, Alta. Inf. Rep. NOR-X-172. 63pp.

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