



FORECASTING FOREST FIRE DANGER IN QUEBEC

by
L. Pouliot

**FOREST FIRE RESEARCH INSTITUTE
OTTAWA, ONTARIO
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FORECASTING FOREST FIRE

DANGER IN QUEBEC

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FOREWORD

The Forest Fire Research Institute, Department of Forestry and Rural Development is now providing a Forest Fire Danger Forecast Service for Quebec.

The control office for this new service is located at Montreal International Airport, Dorval, adjacent to the main Weather Forecast Office, and the service thus has access to all the latest weather information available. This has been made possible, thanks to the kind collaboration of the Department of Transport.

The main function of the Quebec Forest Fire Danger Forecast Service will be to provide special fire weather forecasts and forecasts of forest fire danger indices to the Quebec forest protection organizations, for specific divisions of their forest areas.

I. INTRODUCTION

The development of "Forecasting Fire Danger in Quebec" is based partly on the system initiated by P.M. Paul (7) for the Maritime provinces and partly on a program of Weather Advisory Reports. The latter were issued by the main Weather Forecast Office in Dorval and sent to forest protection organizations in Quebec, during the past two fire seasons. In the light of these two experiments and of other studies on weather forecasting applied to forest fire control, it has been possible to develop the present method of forecasting forest fire danger in Quebec. It is proposed to operate the present system on a trial basis while keeping an open door to improvements and changes resulting from the comments and suggestions received from the foresters as they become more acquainted with it.

The author wishes to take the opportunity, in this first printing of "Forecasting Forest Fire Danger in Quebec", to thank all those who have contributed to the success of this project. It is our hope that this new Service will help the foresters engaged in forest fire control.

II. FOREST FIRE DANGER

Fuels usually found in the forest can be classified in two types. The first type consists of fuels such as grass, leaves, etc. which, when dry, ignite readily and are consumed rapidly. They are known as flash fuels and are often the starting point of numerous fires. The second type includes fuels of large diameter or peaty nature which ignite and are consumed slowly; they are called heavy fuels. The moisture content of the latter will affect not only the amount of energy set free by the fire but also the difficulty encountered in putting it out.

The Drought Index reflects the effect of precipitation on the moisture content of Heavy Fuels and is given according to a scale going from 0 to 25. The "0" index represents a high moisture content in the heavy fuels. This index will increase or decrease, depending upon the amount of rain that has fallen. Extended experiments have shown that after 25 consecutive days without significant precipitation, most heavy fuels will have a very low moisture content.

The Fire Danger Index represents the danger of fires starting and spreading in an administrative area where there are a number of different fuel types. It is computed from values of weather factors: relative humidity, wind and precipitation; modified by the Drought Index.

The Forest Fire Danger Forecast Service will issue forecasts of the Drought Index and Fire Danger Index. From these indices, the forester will be able to calculate the Fire Hazard Indices for other fuel types such as slash or fast-drying forest which may exist in his area.

Specific instructions concerning the proper way to record weather readings and the proper procedure to follow in computing the danger of fires starting and spreading, are given in Quebec Forest Fire Danger Tables. (1)

III. FOREST FIRE-WEATHER STATIONS

The effectiveness and usefulness of the forecasts issued by the Forest Fire Danger Forecast Service will depend greatly upon the accuracy of reports received from the forest fire-weather stations. When computing forest fire danger indices accurate weather measurements are essential. Thus, more importance is attached to insuring the accuracy of the observations at a weather station than to an increase in the number of stations. It is known that the choice of a location for a forest fire-weather station depends mainly upon its accessibility and the facility to staff it with personnel. However, according to D.E. Williams (14) the selection of a representative forest fire-weather station should be done, as much as possible, as follows: -

- (1) Avoid sheltered valleys and exposed mountain - or hilltops. Try to obtain an average condition of exposure on level, or nearly level, ground.
- (2) Do not locate the station among trees or closely spaced buildings. It should be in a clearing freely exposed to the sun throughout the day.
- (3) Proximity to swamps, large bodies of water, artificially watered places and dusty areas should be avoided.
- (4) The ground near the instruments should be kept free from shrubs, weeds and high grass. The standard ground cover for a weather station is close-cropped grass.
- (5) If necessary the weather station may be enclosed by a fence, preferably not more than 3 1/2 feet high.

IV. FOREST FIRE-WEATHER STATIONS NETWORK

The forest fire-weather station network should have sufficient coverage so that no major weather system can cross the area without being noticed. It consists of Primary and Secondary Weather Stations which record and send weather reports to Central Offices, usually the head-quarters of the forest protection organizations. The Central Offices transmit a daily weather report, covering all stations in their area, to the Forest Fire Danger Forecast Service Office at Dorval, at about 1:30 p.m.

The Primary Weather Stations are stations where the forest fire danger indices are calculated daily at sun noon, using complete weather reports. These indices are valid for a radius of 25 miles. The Secondary Weather Stations are stations where the forest fire danger indices are not calculated, the observer recording only the amount of precipitation. As the amount of precipitation may vary greatly within a given zone, the Secondary Weather Stations are important since the information they provide makes possible a fire danger forecast which reflects fuel moisture conditions in the area more accurately.

V. FOREST FIRE-WEATHER STATION REPORTS

At sun noon, the observer will record on a form, the weather data needed by the Forest Fire Danger Forecast Service. These data are as follows: -

STATION NUMBER: Station number is indicated by a three figure group and is used on the weather forecast map to identify the forest protection organization and the forecast region.

WEATHER: Using the WMO weather code, the observer records the cloud cover, drizzle, rain, showers or thunder-showers.

PRECIPITATION: The amount of rain fallen since sun noon the preceding day, is measured in hundreds of an inch.

WIND: Wind direction (DD) and speed (VV) is coded.

TO: Air temperature (TT) is noted.

RH: Relative humidity (RH) is computed.

INDICES: To-day's Drought Index and Fire Danger Index are calculated using the Quebec Forest Fire Danger Table.

These data are collected by the Central Offices and transmitted by teletype to the Forest Fire Danger Forecast Service. The evenly spaced order used for transmission of data will facilitate coding, transmission and interpretation of the weather report. Please note that each section of the coded weather report is separated from the next one by two spaces. Ex.:

231 02 08 0408 68 48 07 06

Representing: NO tt QQ DDVV TT HH Indices

VI. EXPLANATION OF THE FIRE DANGER FORECAST MAP

As soon as they are received at the Forest Fire Danger Forecast Office, the coded weather reports are plotted on the Fire Danger Forecast Map. This map shows the locations of the weather station, the forest regions and sections, the weather forecast regions and the index forecast areas.

Forest Regions and Sections:

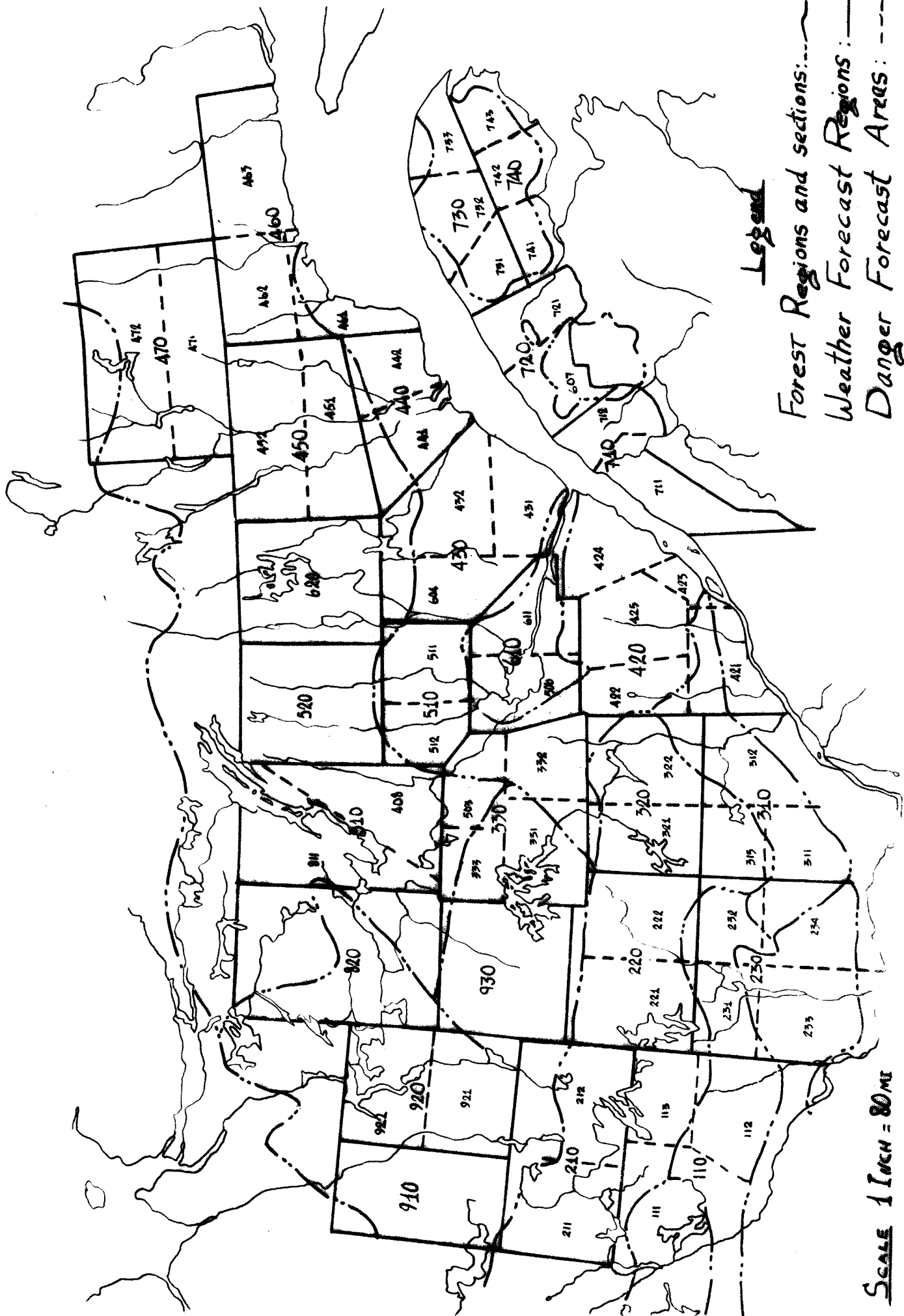
The definitions for Forest Regions and Sections are those given by Rowe (9). They contain a distinctive patterning of vegetation and physiography.

Weather Forecast Regions:

The weather forecast regions have been divided to facilitate the exchange of data, the issue of forecasts and forest fire control. In determining the boundaries of these regions consideration was given to the demarcation of forest regions and sections and also to the limit boundaries or divisions used by the agencies concerned with forest fire control.

Index Forecast Areas:

The index forecast areas are subdivisions of the weather forecast regions. They have been established on the basis of forest sections, ownership divisions or limits within the protection organizations and the number of existing fire-weather stations in an area.



VII. EXPLANATION OF THE FIRE DANGER FORECAST FORM

Once the data have been plotted on the map, the daily drought index and fire danger index for each forecast area are evaluated by the Fire Danger Forecast Service. Then follows an interpretation or adaptation of maps and weather bulletins received from the weather forecast office in Dorval and an index forecast for the following day is issued for each area.

The fire danger forecast form is divided in two sections: the left section is used to record the weather forecast and its interpretation, the right section being used to compute the fire danger forecast.

On both parts of this form, the forecast regions are shown with heavy lines, and the forecast areas with fine lines. The regions and the areas are designated by a three figure group, the first figure being the identifier of the concerned forest protection organization. Groups ending with "0" show the regions, the other figures being used to identify the index forecast areas.

Each day, at about 4:00 P.M. a teletype message containing a weather bulletin and a daily fire danger forecast will be sent to the forest protection organizations for their different forest areas. The next morning, at about 8:00 A.M., these organizations will receive a revised fire danger forecast and a weather forecast valid until 6:00 P.M. of the current day. A 72 hour weather outlook for the different weather forecast areas will also be issued.

FOREST FIRE DANGER FORECAST SERVICE
PROVINCE OF QUEBEC
DEPARTMENT OF FORESTRY AND RURAL DEVELOPMENT

WEATHER FORECAST ISSUED BY WEATHER OFFICE MONTREAL																		FIRE DANGER FORECAST					
PERIOD : TO : time - date time - date																		FOR : NO : day - month - year					
AREA	WEATHER				RAIN				WIND				T ^o	RH	DROUGHT	AREA	DANGER		AREA				
N ^o	WW	hh	WW	hh	16Z	16Z-16Z	16Z	16Z	16Z	16Z	16Z	16Z	16Z	16Z	16Z	INDEX	NAME	INDEX	G	NO			
100	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	-THE OTTAWA FOREST PROTECTIVE ASSOCIATION	--	--	100			
110																--	ALLUMETTES	--		110			
111																	Kipawa			111			
112																	South Coulonge			112			
113																	North Coulonge			113			
200	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	-THE GATINEAU FOREST PROTECTIVE ASSOCIATION	--	--	200			
210																--	ROBYN - VAL D'OR	--		210			
211																	Rouyn			211			
212																	Val d'Or			212			
220																--	NORTH GATINEAU	--		220			
221																	Landron			221			
222																	Parent			222			
230																--	SOUTH GATINEAU	--		230			
231																	Baskatong			231			
232																	Mont-Laurier			232			
233																	Maniwaki			233			
234																	Simon Lake			234			

METEOROLOGICAL CODE

WEATHER		PRECIPITATION		WIND	
WW		QQ	Amount inches	DD	Direction, true north
00	clear no cloud			00	Calm
01	scattered 5/10 or less cloud	01	.01 - .10	02	NNE
02	broken 6/10 to 9/10 cloud	25	.11 - .25	04	NE
03	overcast 10/10 cloud	50	.26 - .50	07	ENE
		10	.51 - +	09	E
05	haze			11	ESE
41	fog paths			14	SE
50	drizzle, intermittent light	PP	Probability	16	SSE
51	" continuous light	11	10%	18	S
52	" intermittent moderate	22	20%	20	SSW
53	" continuous moderate	33	30%	22	SW
58	drizzle and rain, light	44	...	25	WSW
59	" moderate	00	100%	27	W
60	rain, intermittent light			29	WNW
61	" continuous light			32	NW
62	" intermittent moderate			34	NNW
63	" continuous moderate			36	N
				99	Vble
80	rainshowers, light				
81	" moderate or heavy				
87	" scattered				
88	" widely scattered				
95	thunderstorm, light or moderate without hail				
96	" moderate or light with hail				
97	" scattered				
98	" widely scattered				
99	" heavy with hail				

16Z = Noon

hh = Time of change in weather

:: = Two types of weather at same period of time

T^o = Temperature

RH = Relative humidity

VV Speed
miles per hour

FOREST FIRE DANGER FORECAST SERVICE
PROVINCE OF QUEBEC
DEPARTMENT OF FORESTRY AND RURAL DEVELOPMENT

WEATHER FORECAST ISSUED BY WEATHER OFFICE MONTREAL																		FIRE DANGER FORECAST					
PERIOD : to time - date time - date																		FOR : NO : day - month - year					
AREA	WEATHER				RAIN			WIND						T ⁰	RH	DROUGHT	AREA	DANGER	AREA				
NO	WW	hh	WW	hh	16Z	16Z-16Z	16Z	16Z	16Z	16Z	16Z	16Z	16Z	16Z	16Z	16Z	INDEX	NAME	INDEX	C	NO		
300	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	THE ST. MAURICE FOREST PROTECTIVE ASSOCIATION	--	--	--	300	
310																	--	ST. MICHEL DES SAINTS	--			310	
311																		St. Donat				311	
312																		St. Alexis				312	
313																		Toro Lake				313	
320																	--	MANOUANE - LA TUQUE	--			320	
321																		Manouane				321	
322																		La Tuque				322	
330																	--	UPPER ST. MAURICE	--			330	
331																		Gouin				331	
332																		Trenche				332	
333																		Cooper				333	
503																		Chigoubiche				503	

Remarks:

Danger class: Low (1 - 4), Moderate (5 - 8), High (9 - 12), Extreme (13 - 16)

METEOROLOGICAL CODE

WEATHER	PRECIPITATION Amount inches	WIND Direction, true north
WW	QQ	DD
00 clear no cloud	01 .01 - .10	00 Calm
01 scattered 5/10 or less cloud	25 .11 - .25	02 NNE
02 broken 6/10 to 9/10 cloud	50 .26 - .50	04 NE
03 overcast 10/10 cloud	10 .51 - +	07 ENE
05 haze	PP Probability	09 E
41 fog pathes	11 10%	11 ESE
50 drizzle, intermittent light	22 20%	14 SE
51 " , continuous light	33 30%	16 SSE
52 " , intermittent moderate	4.. ..	18 S
53 " , continuous moderate	00 100%	20 SSW
58 drizzle and rain, light		22 SW
59 " , moderate		25 WSW
60 rain, intermittent light		27 W
61 " , continuous light		29 WNW
62 " , intermittent moderate		32 NW
63 " , continuous moderate		34 NNW
80 rainshowers, light		36 N
81 " , moderate or heavy		99 Vble
87 " , scattered		
88 " , widely scattered		
95 thunderstorm, light or moderate without hail		
96 " , moderate or light with hail		
97 " , scattered		
98 " , widely scattered		
99 " , heavy with hail		

16Z = Noon
hh = Time of change in weather
:: = Two types of weather at same period of time
T⁰ = Temperature
RH = Relative humidity

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WEATHER FORECAST ISSUED BY WEATHER OFFICE MONTREAL																		FIRE DANGER FORECAST									
PERIOD : to time - date time - date																		FOR NO : day - month - year									
AREA	WEATHER				RAIN			WIND								T ⁰	RH	DROUGHT			AREA	DANGER		AREA			
NO	WW	hh	WW	hh	16Z WW	16Z-16Z QQ	PP	DD	VV	hh	DD	VV	hh	DD	VV	16Z VV	16Z TT	16Z RH		INDEX	NAME	INDEX	C	NO			
400	--	--	--	--	--	--	--	--	--	-THE LAURENTIAN FOREST PROTECTIVE ASSOCIATION										--	--	--		--	--	--	400
810																			--	--	--	CHIROUGAMAU	--		810		
408																						Nicauba			408		
420																			--	--	--	LAURENTIDES	--		420		
421																						South Batiscau			421		
422																						North Batiscau			422		
423																						Côte de Beaupré			423		
424																						Port-Alfred - Charlevoix			424		
425																						Park			425		
430																			--	--	--	TADOUSSAC	--		430		
431																						Escoumins			431		
432																						Sault-au-cochon			432		
604																						Pasmoucachiou			604		
440																			--	--	--	BAIE-COMEAU	--		440		
441																						Outardes-4			441		
442																						Godbout			442		
450																			--	--	--	MANIC-5 - STE ANNE LAKE	--		450		
451																						Mile-90			451		
452																						Mile-135			452		
460																			--	--	--	PENTECOTE - ST. JOHN RIVER	--		460		
461																						Port-Cartier			461		
462																						Aux Roches River North			462		
463																						Manitou River			463		
470																			--	--	--	GAGNON	--		470		
471																						Upper - Toulmoustouk			471		
472																						Barbel Lake			472		

Remarks:

Danger Class: Low (1 - 4), Moderate (5 - 8), High (9 - 12), Extreme (13 - 16)

FOREST FIRE DANGER FORECAST SERVICE
PROVINCE OF QUEBEC
DEPARTMENT OF FORESTRY AND RURAL DEVELOPMENT

WEATHER FORECAST ISSUED BY WEATHER OFFICE MONTREAL															FIRE DANGER FORECAST															
PERIOD : To time - date time - date															FOR : NO day month year															
AREA	WEATHER				RAIN			WIND							TD	RH	DROUGHT		AREA		DANGER		AREA							
NO	WW	hh	WW	hh	16Z WW	16Z-16Z QQ	PP	DD	VV	hh	DD	VV	hh	DD	16Z VV	16Z +VV	16Z TT	16Z HH	INDEX	NAME		INDEX	C	NO						
500	--	--	--	--	--	--	--	-DISTRICT DE ROBERVAL ET DOMTAR NEWSPRINT															--	--	--			--	--	500
510																			--	--	--	MISTASSINI SOUTH		--		510				
511																					Lower Mistassibi				511					
512																					Washimesca				512					
610																		--	--	--	LAC ST.JEAN - CHICOUTIMI		--		610					
611																					Chicoutimi				611					
506																					Lac St.Jean				506					
330																		--	--	--	UPPER ST.MAURICE		--		330					
503																					Chigoubiche				503					
800	--	--	--	--	--	--	--	-DISTRICT DE CHIBOUGAMAU															--	--	--			--	--	800
810																		--	--	--	CHIBOUGAMAU		--		810					
811																					Lac Caché				811					
804																					Nicauba				804					
820																					CHAPAIS				820					
900	--	--	--	--	--	--	--	-DISTRICTS DE LA SARRE-D'AMOS-DE VAL D'OR															--	--	--			--	--	900
910																					LA SARRE				910					
920																		--	--	--	HARRICANA		--		920					
921																					Amos				921					
922																					Matagami				922					
930																					FORSYTHE				930					
210																		--	--	--	ROUYN - VAL D'OR		--		210					
211																					Rouyn				211					
212																					Val D'Or				212					

Remarks:

Danger Class: Low (1-4), Moderate (5-8), High (9-12), Extreme (13-16)

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WEATHER FORECAST ISSUED BY WEATHER OFFICE MONTREAL																		FIRE DANGER FORECAST					
PERIOD : to time - date time - date																		FOR NO : day - month - year					
AREA	WEATHER				RAIN			WIND						T	RH	DROUGHT	AREA	DANGER		AREA			
NO	WW	hh	WW	hh	16Z WW	16Z-16Z QQ	16Z-16Z PP	DD	VV	hh	DD	VV	hh	16Z DD	16Z VV	16Z TT	16Z RH	INDEX	NAME	INDEX	C	NO	
600	--	--	--	--	--	--	--	--	--	-THE PRICE BROTHERS FOREST PROTECTIVE ASSOCIATION										--	--	--	600
610																		--	LAC ST-JEAN - CHICOUTIMI	--	--	610	
611																			Chicoutimi			611	
612																			Lac St-Jean			612	
510																	--	MISTASSINI SOUTH	--		510		
511																			Lower Mistassibi			511	
512																			Washimesca			512	
620																			UPPER PERIBONCA			620	
430																	--	ONATCHIWAY - FORESTVILLE	--		430		
431																			Escoumins			431	
604																			Pamouscachiou			604	
720																	--	RIMOUSKI - MATAPEDIA	--		720		
607																			Rimouski			607	
721																			Matapédia			721	

Remarks:

Danger Class: Low (1 - 4), Moderate (5 - 8), High (9 - 12), Extreme (13 - 16)

METEOROLOGICAL CODE

WEATHER			PRECIPITATION		WIND	
WW			QQ	Amount inches	DD	Direction, true north
00	clear	no cloud			00	Calm
01	scattered	5/10 or less cloud	01	.01 - .10 "	02	NNE
02	broken	6/10 to 9/10	25	.11 - .25	04	NE
03	overcast	10/10	50	.26 - .50	07	ENE
			10	.51 - +	09	E
05	haze				11	ESE
41	fog pathes		PP	Probability	14	SE
			11	10%	16	SSE
50	drizzle, intermittent light		22	20%	17	S
51	" , continuous light		33	30%	20	SSW
52	" , intermittent moderate		44	...	22	SW
53	" , continuous moderate		00	100%	25	WSW
58	drizzle and rain, light				27	W
59	" " , moderate				29	WNW
					32	NW
60	rain, intermittent light				24	NNW
61	" , continuous light				26	N
62	" , intermittent moderate				99	Vble
63	" , continuous moderate					
80	rainshowers, light				VV	Speed
81	" , moderate or heavy					miles per hour
87	" , scattered					
88	" , widely scattered					
95	thunderstorm, light or moderate without hail					
96	" " " with "					
97	" scattered					
98	" widely scattered					
99	" heavy with hail					

16Z = Noon
hh = Time of change in weather
:: = Two type of weather at same period of time
T^D = Temperature
RH = Relative humidity

FOREST FIRE DANGER FORECAST SERVICE
PROVINCE OF QUEBEC
DEPARTMENT OF FORESTRY AND RURAL DEVELOPMENT

WEATHER FORECAST ISSUED BY WEATHER OFFICE MONTREAL																		FIRE DANGER FORECAST													
PERIOD TO Time - date Time - date																		FOR NO day month - year													
AREA	WEATHER					RAIN		WIND								TEMP		DROUGHT		AREA		DANGER		AREA							
NO	WW	hh	WW	hh	16Z	16Z-16Z	QQ	PP	DD	VV	hh	DD	VV	hh	DD	VV	16Z	16Z	16Z	INDEX	NAME		INDEX	C	NO						
700	--	--	--	--	--	--	--	--	--	--	-THE GASPEIAN FOREST PROTECTIVE ASSOCIATION												--	--	--	--	--	--	--	--	700
710																				--	--	--	KAMOURASKA-TÉMISCOUATA	--		710					
711																							Kamouraska			711					
712																							Témiscouata			712					
720																				--	--	--	RIMOUSKI-MATAPEDIA	--		720					
721																							Matapédia			721					
607																							Rimouski			607					
730																				--	--	--	GASPE-SOUTH	--		730					
731																							La Croix			731					
732																							Jacques-Cartier			732					
733																							Madeleine - St-Jean			733					
740																				--	--	--	GASPE-SOUTH	--		740					
741																							Nouvelle			741					
742																							New-Richmond			742					
743																							Chandler			743					

Remarks:

Danger Class: Low (1 - 4), Moderate (5 - 8), High (9 - 12), Extreme (13 - 16)

MÉTÉOROLOGICAL CODE

WEATHER			PRECIPITATION			WIND		
WW			QQ	Amount	Inches	DD	Direction, true north	
00	clear	no cloud				00	Calm	
01	scattered	5/10 or less cloud	01	.01 - .10		02	NNE	
02	broken	6/10 to 9/10	25	.11 - .25		04	NE	
03	overcast	10/10	50	.26 - .50		07	ENE	
			10	.51 - +		09	E	
05	haze					11	ESE	
41	fog	pathes	PP	Probability		14	SE	
			11	10%		16	SSE	
50	drizzle, intermittent	light	22	20%		17	S	
51	"	continuous	33	30%		20	SSW	
52	"	intermittent	44	40%		22	SW	
53	"	continuous	00	100%		25	WSW	
58	drizzle and rain, light					27	W	
59	"	moderate				29	WNW	
						32	NW	
60	rain, intermittent	light				24	NNW	
61	"	continuous				26	N	
62	"	intermittent				99	Vble	
63	"	continuous						
80	rainshowers, light					VV	Speed	
81	"	moderate or heavy					miles per hour	
87	"	scattered						
88	"	widely scattered						
95	thunderstorm, light or moderate	without hail						
96	"	"						
97	"	scattered						
98	"	widely scattered						
99	"	heavy with hail						

16Z = Noon
hh = Time of change in weather
-- = Two type of weather at same period of time
D = Temperature
RH = Relative humidity

VIII. CONCLUSIONS

Everyone is aware of the very important role played by the weather conditions in forest fire control; thus the forecasting of natural phenomena, such as drought, wind, rain and thunder-showers will act as an advance warning to the foresters so that they can either prepare a proper fire control plan in periods of high danger or utilize manpower more effectively during periods of low danger. At the time of conflagration, the Fire Boss, in the light of the latest weather forecast, can decide the best method of fire suppression and the number and disposition of his forces. For instance, if a substantial wind shift has been forecast, he will be ready for a situation that he might not otherwise have foreseen.

The fire danger forecast for the different forest areas is a very valuable tool for those engaged in forest protection. With it, they can apply more efficient prevention methods which might prove less costly. They will also be much better able to prepare daily assignment for employees, to intensify the frequency of air patrols, to mobilise standby crews or to arrange off-duty periods.

The indices transmitted by the Forest Fire Danger Service might be broadcast daily for the public. This adds a publicity aspect to the value of these forecasts.

The Forest Fire Danger Forecast Service has been established following requests received from the different forest protection organizations. Their everyday collaboration is necessary in order to assure the proper usefulness and effectiveness of the Service.

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