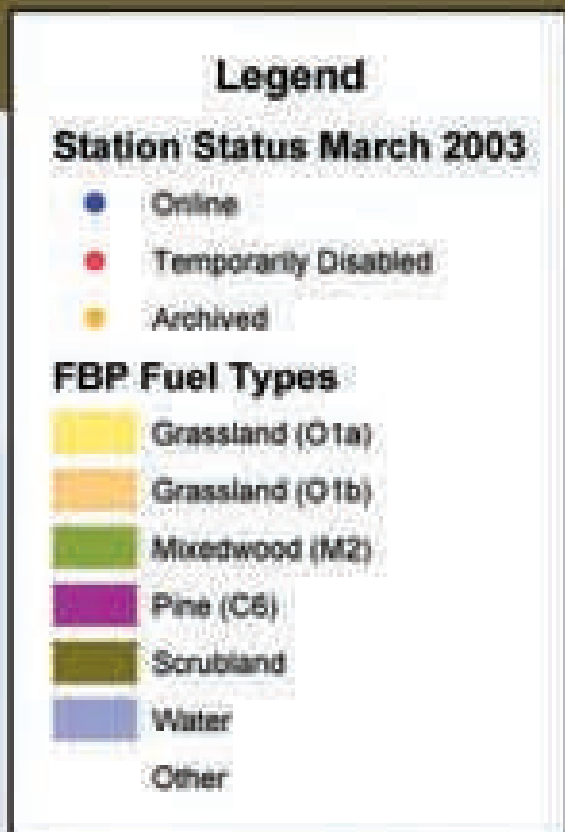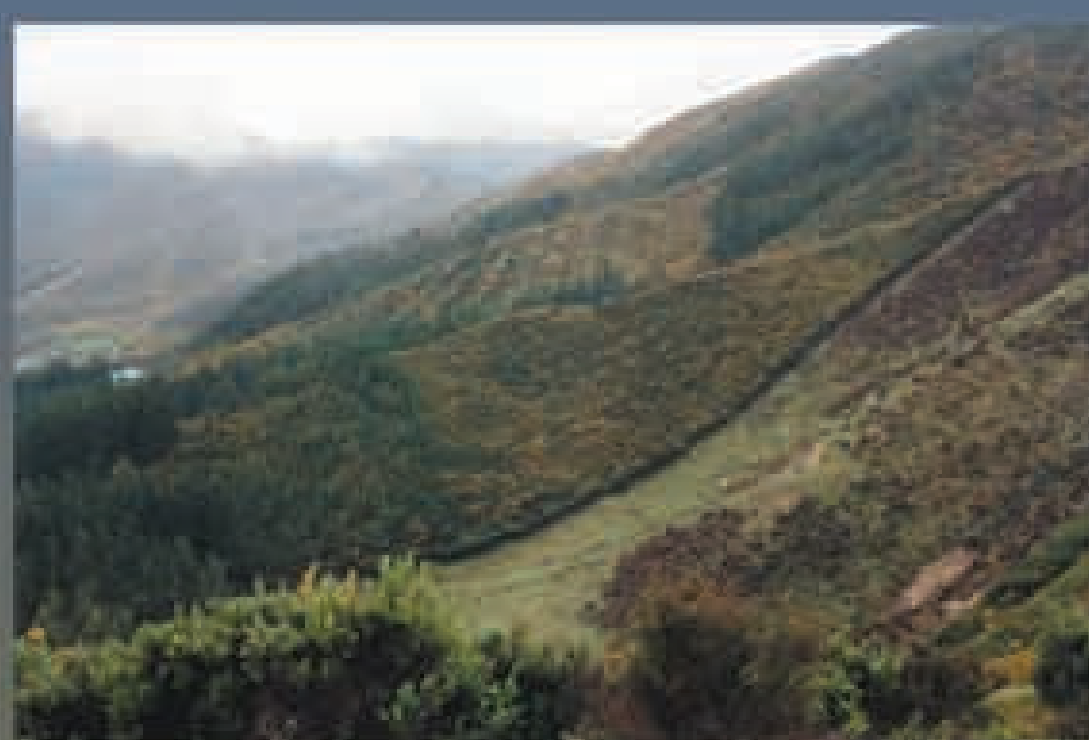# A Fire Danger Climatology for New Zealand

H.G. Pearce, J.R. Moore, K.L. Douglas and S.A.J. Anderson

Forest Research
PO Box 29-237, Christchurch, New Zealand
Phone +64-3-364 2949
Email grant.pearce@forestresearch.co.nz
www.forestresearch.co.nz/fire

FOREST AND RURAL FIRE RESEARCH

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Legend

Station Status March 2003
- Online
- Temporarily Disabled
- Archived

FBP Fuel Types
- Grassland (O1a)
- Grassland (O1b)
- Mixedwood (M2)
- Pine (C6)
- Scrubland
- Grass
- Water
- Other

Network of fire weather monitoring stations administered by the National Rural Fire Authority (NRFA), including station status as at March 2003. Station names are indicated by the 3-letter codes (e.g., Le Bons Bay, LBX).

Rainfall   CDSR   FFDC   SFDC

Comparisons of fire season severity across New Zealand, based on long-term average Cumulative Daily Severity Rating (CDSR) and the combined number of days of Very High and Extreme (VH+E) fire danger class for Forest (FFDC) and Scrubland (SFDC), where severity tends from high (red) to low (green). Mean annual rainfall is also included for comparison, tending from low (light blue) to high (dark blue).
Maps were produced by interpolating point data for individual weather stations (using Inverse Distance Weighting), and do not include any topographic adjustment.

Introduction

Although not having one of the most severe fire climates in the world, New Zealand still experiences 2500 vegetation fires each year that burn 7000 ha of rural lands. Strong winds, high temperatures, low humidities and seasonal drought can combine to produce dangerous fire weather situations. To effectively manage this risk, New Zealand fire managers require knowledge of these extremes and their likelihood of occurrence, in relation to long-term averages of fire weather and fire danger conditions.

Methods

A study was undertaken to extend and improve a previous analysis of New Zealand fire climatology conducted in 1996, which summarised long-term averages and extremes of fire weather and fire danger rating system components for 20 weather station locations throughout New Zealand. The present study involved updating the 1996 analysis to include more recent data (to May 2002), and extending it to include archived data from the 170+ weather stations contained in the National Rural Fire Authority's (NRFA) fire weather network.

The study comprised three main steps:
- compilation of a database of daily fire weather records for each weather station by replacing missing or erroneous values with suitable data from appropriate substitute stations;
- recalculation of Fire Weather Index (FWI) System and associated fire danger class values from the completed weather input datasets; and
- statistical analysis of long-term average and extreme (maximum and minimum) values of weather and fire danger components for each weather station.

Results

Summary statistics for each station were used to identify the individual weather stations and geographic regions with the most severe fire climates. Stations in Canterbury and Marlborough demonstrated the highest values of the three fire climate severity measures examined. Awatere Valley (AWV), Woodbourne (Blenheim) (WBA) and Molesworth (MLX/MOL) in Marlborough were three of the stations with the most severe fire climates, with Christchurch Aero (CHA) and Castle Point (CPX) making up the top 5, the latter more as a result of the windiness of the site compared to seasonal dryness as the principal factor at the other locations. In general, stations characterised by the highest annual rainfalls had the least severe fire climates, including all three stations – Westport (WSA), Hokitika (HKA) and Haast (HTX) – from the South Island's West Coast.

Table 1: Example of station output table containing summary statistics for weather elements and FWI System components, with descriptive comments on statistics and format.

The principal output from the analysis was a summary table for each of the 127 stations containing the long-term average and extreme values of each of the weather and FWI System components summarised by month, fire season and year. The summary tables also include fire danger class frequencies for Forest and Scrubland vegetation types by month, fire season and year.

In total, some 20,000 weather values were substituted to complete the more than 535,000 records (1464 years) of weather and fire danger components for 127 weather stations that had greater than 5 years of record available. The data quality issues encountered highlight a number of problems with weather station maintenance, as well as the accuracy and completeness of data contained within the NRFA's fire weather archive.

Table 2: Ranking of regional fire climate severity based on stations included in the fire climatology analysis, using the average of rankings for long-term mean Cumulative Daily Severity Rating (CDSR) and combined number of days of Very High and Extreme (VH+E) fire danger class for Forest (FFDC) and Scrubland (SFDC). The average length of record (years) and annual rainfall (mm) for each region are also included for comparative purposes.

No.	Region	No. Stations	Annual Rainfall (mm)	Length of Record (years)	CDSR	VH+E FFDC (days)	VH+E SFDC (days)	Rank CDSR	Rank FFDC	Rank SFDC	Average Rank
1	Canterbury	10	741	10.4	900	12.4	234.2	1	1	3	1.7
2	Marlborough	7	1101	11.4	795	21.1	237.7	2	2	2	2.0
3	Otago	10	677	11.3	762	16.1	223.8	3	3	6	4.0
4	South Cant'y	4	667	9.3	636	14.6	228.2	5	4	5	4.7
5	Eastern	13	1383	9.2	579	14.3	231.3	6	5	4	5.0
6	Wellington	4	1070	23.3	435	6.8	248.2	8	7	1	5.3
7	Wairarapa	7	1213	7.7	745	13.3	216.2	4	6	8	6.0
8	Nelson	4	1255	15.8	576	5.2	211.1	7	8	10	8.3
9	Northland	10	1374	11.8	285	4.7	217.8	11	10	7	9.3
10	Wang/Man	13	1126	9.8	306	4.9	205.1	10	9	11	10.0
11	CNI	13	1493	12.8	284	4.6	211.9	12	11	9	10.7
12	Southland	9	1106	11.7	346	3.3	181.8	9	12	15	12.0
13	Auckland	9	1297	9.9	209	2.2	194.8	13	13	13	13.0
14	Waikato	9	1712	10.8	180	1.7	191.2	14	14	14	14.0
15	Taranaki	5	1447	10.8	157	0.9	196.7	15	15	12	14.0
16	West Coast	3	2900	25.3	44	0.0	135.0	16	16	16	16.0
	South Island	47	1026	12.3	644	13.5	213.7				
	North Island	80	1346	11.1	359	6.4	212.7				
	National	127	1228	11.5	463	9.0	212.9				

Conclusions:

The compilation of a comprehensive database of daily fire weather and fire danger information for 127 weather station locations has significantly added to the knowledge and understanding of New Zealand's fire climate. The database is an essential component of associated research being conducted on prediction of fire season severity. In its own right, it also provides an extremely useful tool that will enable rural fire managers to make more informed fire management decisions on prevention, preparedness, and prescribed burning activities, by:

- highlighting extremes of fire weather
- defining fire climate regions
- allowing fire season comparison
- indicating seasonal trends in fire danger
- defining length of fire season
- providing fire danger class frequencies
- testing and validation of fire danger rating
- describing potential impacts of ENSO events and climate change

- improving fire danger forecasting and prediction of fire season severity
- indicating likely level of fire activity
- improving timing of prevention activities
- predicting resource requirements and fire suppression budgets
- providing input for economic analyses prevention and preparedness systems
- defining "windows" for prescribed burning
- improving firefighter safety