North Island Monthly Fire Danger Outlook (2020/21 Season)

ISSUE: March 2021

Current fire danger situation

Hot and dry conditions over summer have led to very dry soils and vegetation fuels across the North Island. Most locations are at or near the peak of the fire season (typically Feb/March). In general, February monthly fire dangers and fire climate severity were High to Extreme across much of the North Island (Figures 4, 5 & 9). In contrast, a thin band from Taranaki to East Cape and Wellington experienced generally Low to Moderate conditions.

Fuel and soil moisture status

This is reflected in the current FWI System codes and indices (FFMC, DMC, DC, and BUI) in Figures 5 and 7. These codes indicate the ease of ignition, the amount of fuel available for combustion, and how deep-seated and prolonged mop-up could be.

Stations across the island are recording a mix of above and below trend BUI and DC values for this time of the year. Rainfall for some locations during the middle of February and early March is impacting the heavy and medium fuel moistures in different ways. Auckland, Central North Island, Gisborne and Whanganui/Manawatu regions have DC values above or on trend. In contrast, Taranaki is generally recording DC values below the historical average. Other locations (Hawke's Bay, Northland, Waikato, Wairarapa, Wellington and Bay of Plenty) have a mixture of stations recording DC values either above or below the historical average. BUI values are not following a similar trend as the DC for the above regions, indicating medium fuels are being impacted. Graphs tracking daily trends for individual station are available on the Scion website: www.ruralfireresearch.co.nz/tools/trends

Nearly all of the North Island is in soil moisture deficits (Figure 2) and drier than normal for this time of the year (Figure 3). In contrast, soils in the Far North are currently about 50% storage capacity, which is about normal for this time of the year.

Forecast climate and weather

Non-traditional La Niña conditions remain in the tropical Pacific and international models indicate it has reached its peak strength and has been weakening the past few weeks. Despite this weakening pattern, this La Niña event is still expected to influence our climate over the next three months.

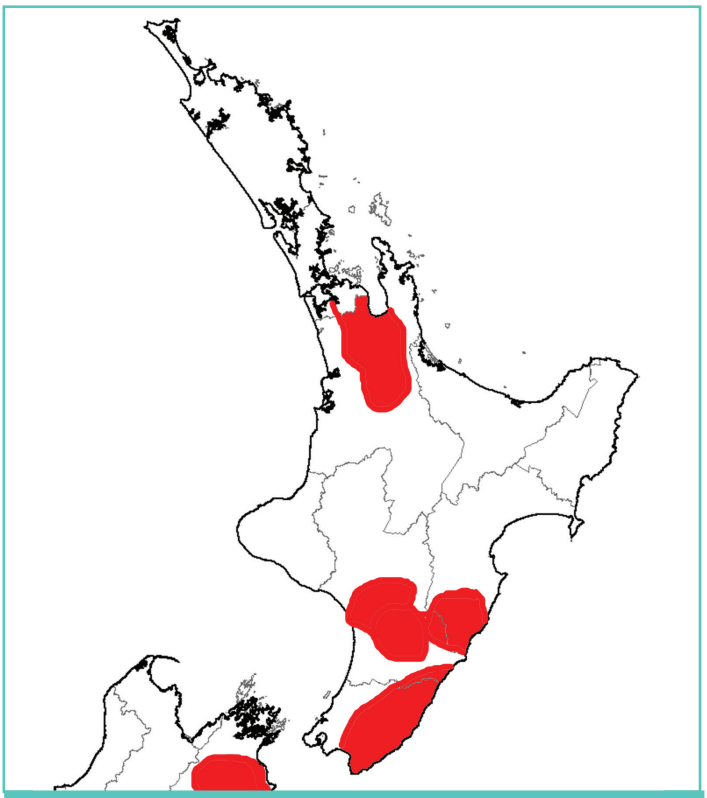
Over the next three months (March – May 2021), weather patterns are expected to become more variable as the effects of the 2020/21 La Niña event eases and we progress into autumn. Low-pressure systems are forecast to become more common during autumn.

March marks the start of meteorological autumn for New Zealand, and the likelihood of extreme heat has passed. In general, the weather generally remains settled, but leans towards cooler days for March and into autumn. March is forecast to be another month of two halves. The first half is forecast to experience more south-westerly winds and run a little cooler than last month, with occasional cool snaps also expected. An increase in cyclone activity may impact New Zealand in the first half of the month. This could result in heavy rainfall and flooding for impacted regions (more likely for the North Island). The second half of the month will feel more summer like, with a return of high pressure, westerly winds and settled weather. Overall, the month will lean towards warmer than average, with eastern and northern locations leaning drier than average.

Locations to watch

In general, fire danger and fire climate severity typically peak in February/March and decline over March/April. This decline is expected to occur over the months of autumn. However, the risk of further fire outbreaks remains high for some locations.

Based on the forecast for warm and drier conditions to continue in March for northern and eastern locations, plus the current soil moisture status and elevated FWI codes and indices, areas to keep an eye on for High to Extreme fire dangers are: northern Waikato, central Hawkes Bay, Manawatu and Wairarapa (Map 1). However, this may change with any major rain events that will improve soil and fuel moistures and consequently reduce the potential for wildfire outbreaks. With very dry soils across the North Island currently, rainfall is less easily absorbed into the ground, increasing the possibility of flooding if experiencing heavy rainfall.



Map 1. Locations identified as specific areas of interest that have or may develop an elevated risk of High to Extreme fire danger over the next three months.

Background

The purpose of these monthly outlooks is to provide a heads up on current and potential fire danger as we transition from spring to summer and, later, into autumn. This is not a detailed fire seasonal outlook for specific localities, nor does it summarise fire potential (which depends on fuel conditions (i.e. grass curing), risks of ignitions, recent fire history and fire management resources available in an area, as well as weather and climate).

It aims to forewarn fire agencies of current and potential fire danger conditions that can be used as a prompt for local and regional discussions on fire potential. Continue your pre-planning, by discussing where conditions are at, where they are heading, and what this might mean for fire risk in your patch and for your neighbours.

EXPECTED CLIMATE OUTLOOK:

The ENSO outlook for March remains at non-traditional La Niña conditions. This season's La Niña has passed its peak and has been weakening over the last few weeks. International models are forecasting La Niña to continue over the next three months (56% during March - May). The probability drops further during June to August (33%) with a return to ENSO-neutral conditions favoured (56%). Neutral and La Niña conditions are equally favoured (40-45% chance) for spring (September – November).

Regardless of a weakening La Niña, it is still expected to impact New Zealand's weather patterns into autumn. A negative Southern Annular Mode (SAM) is forecast, resulting in cooler, unsettled weather and westerly winds for the first half of March. During April and May, convective activity may become more frequent in the eastern Pacific and South America, which will contribute to more low-pressure systems around New Zealand, resulting in cooler weather.

Tropical Cyclone outlook

La Niña may have peaked, but we are now in the peak of tropical cyclone season. Tropical cyclone activity is expected to increase this month, which may bring much needed moisture closer to New Zealand.

The tropical cyclone season for the Southern Hemisphere runs from November to April, with the odd one occurring outside this period. On average, about 10 tropical cyclones form in the South Pacific between November and April. To date, five Tropical cyclones have developed in the south west Pacific (Yasa, Zazu, Ana, Bina & Lucas).

The risk for New Zealand to be affected by an ex-tropical cyclone this season remains elevated. The risk is considered above normal, with equal probabilities of an ex-tropical cyclone passing either to the east or west of the North Island. Significant rainfall, damaging winds, and coastal damage by waves are possible in the lead up to and during these events. These cyclone events can reduce the fire risk in affected areas, with effects often being spread over a large area, especially if a decaying storm system interacts with other existing weather systems.

Fire season analogues

To help understand what the fire season could look like during the next three months, fire seasons coinciding with moderate strength La Niña conditions occurred in 2010/11, 2007/08, 1999/00, and 1998/99. Weak La Niña seasons included 2000/01 and 2011/12. These past events (historical analogues) reminiscent of moderate or weak La Niña are potentially good indicators for what to expect this coming fire season (Figure 11).

This fire season (2020/21) has not followed traditional La Niña weather patterns and has resulted in northern locations being unusually drier than normal. Each historical La Niña event has resulted in slightly different weather patterns for New Zealand. Our weather is very dependent on where the high-pressure systems sit (which determines the air flow over New Zealand).

This month: March 2021

With the start of autumn, while temperatures tend to run a little cooler than summer, the weather is usually the most settled with long sunny days. As autumn progresses (during March to May), expect frosts to occur from time to time in cooler locations. Some southern locations have already experienced a few frosts in February.

March is forecast to be another month of two halves. The first half will feel cool, with weather fronts bringing rain and thunderstorms over the country. Winds are likely to shift south-westerly and drag temperatures down. A tropical cyclone (Niran) has formed in the Coral Sea near the Queensland coast, and has the potential to drift near New Zealand and impact weather for the upper North Island. There is uncertainty in how this will track, and whether expected high pressure (that may or may not eventuate) will protect New Zealand from Niran. The second half of the month will feel more summer like, with high pressure returning and settled weather. Winds will shift back to westerlies and bring with it about normal air temperatures.

Further ahead:

During the next three months (March – May 2021), weather patterns are expected to become more variable as the effects of the 2020/21 La Niña event eases and we progress into autumn. Temperatures are likely to be near normal for the east of the North Island, and near normal to above normal in remaining regions. The occasional cool snaps are expected, especially in the first half of March. Near normal rainfall is forecast for the North Island, especially as low-pressure systems become more common. Cyclone activity may impact New Zealand in the first half of the month, that could result in heavy rainfall and flooding for impacted regions. Soil moisture levels and river flows are expected to be below normal in the north of the North Island, near normal in the east and near normal to below normal for remaining locations.

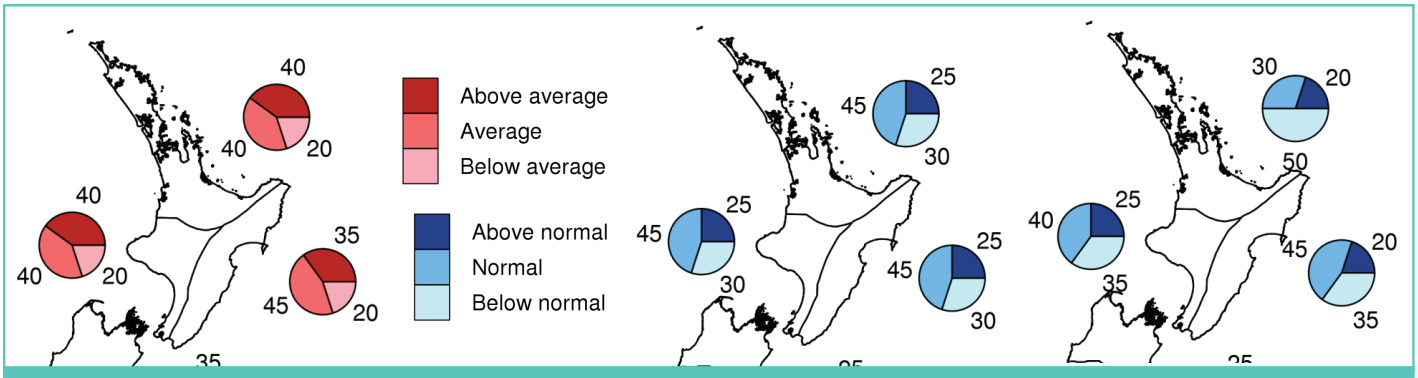


Figure 1. Outlook for March to May 2021: air temperature (left), rainfall (middle), available soil moisture (right). Source: NIWA.

Regional Breakdown (Figure 1):

Temperatures are most likely to be:

- near normal (40% chance) or above normal (40%) for Northland, Auckland, Waikato, Bay of Plenty, Central North Island, Taranaki, Whanganui, Manawatu and Wellington;
- near normal (45%) for Gisborne, Hawke's Bay and Wairarapa.

Rainfall is most likely to be:

- near normal (45% chance) for Northland, Auckland, Waikato, Bay of Plenty, Central North Island, Taranaki, Whanganui, Manawatu, Wellington, Gisborne, Hawke's Bay and Wairarapa.

Soil moistures and river flows are most likely to be:

- below normal (45-50% chance) for Northland, Auckland, Waikato and Bay of Plenty;
- near normal (40%) for Central North Island, Taranaki, Whanganui, Manawatu and Wellington;
- near normal soil moistures (45%) while river flows are near normal (40%) or below normal (40%) for Gisborne, Hawke's Bay and Wairarapa.

Last month: February 2021

Looking back, February was dominated by high pressure and settled weather, with a mid-month low brining gales and rain to places. Much of the North Island experienced a sunnier than average month (the exception being Northland north of Whangarei). The Far North received a respite last month, receiving well above average rainfall for the month. In contrast, most experienced a drier than average February especially Waikato, Manawatu-Whanganui and southern Hawke's Bay. Temperatures were about normal, the exceptions being a warmer than normal month for Waikato, and a cooler than normal month for Taranaki, Wellington and coastal Gisborne. Coastal sea surface temperatures were typically below average to near average during February.

Soil moisture (Figure 2 & 3)

Dry soils are widespread across the North Island. Very dry soils (orange/red) are located in Kaipara, Auckland, much of Waikato, eastern Bay of Plenty, East Cape, Hawke's Bay south to Wairarapa, and much of Manawatu-Whanganui (Figure 2). In contrast, the Far North, Taranaki and along the Kapiti Coast soils are at about water 50% storage levels.

This is also reflected in the soil moisture anomaly map (Figure 3), where soils are much drier than normal across most of the North Island. Soil are only slightly drier than normal in Waikato and Bay of Plenty, while slightly wetter than normal soils for this time of the year are found in the Far North.

NIWA's Drought Index (NZDI) indicates dry to extremely dry soils are present across the North Island. In particular, extremely dry soils are present in small pockets of the East Cape, Hawke's Bay and Wairarapa.

Grass growth & curing:

As we progress through the autumn months, grasslands will start to green up again. However, dead grass remaining from this or previous seasons can contribute substantially to the amount of dead fuel in a grassland and is therefore important to include in your curing estimation. This dead grass is referred to as thatch. Thatch is still capable of carrying a fire through green grass that would not otherwise burn. This influence is particularly important when the current season has curing values around 30%-50%. In the absence of thatch, green grass would not necessarily be able to sustain fire spread. Typical fire behaviour in these grasslands will produce very small flame heights, be smokey, patchy in its progression and will be low intensity.

Depending on where you are in the country, grass curing could be patchy over a series of paddocks/area, especially during the 40-80% curing period. Or if you experienced summer droughts, curing will become more continuous in the dry phase of 70 – 100% curing. Above 80% curing, fuel moisture content begins to be significantly influenced by the environmental factors (humidity, temperature and wind).
For areas experiencing high curing values, wildfires burning under these high grass curing conditions can spread very quickly, produce large to very tall flame heights (2 m+), be very intense and much more difficult to suppress. Some areas would also have experienced abundant grass growth over the last month, increasing the fuel loading.

For some parts of the country still undergoing bouts of rainfall, it's not uncommon to see green landscapes with low curing values. These areas can help reduce or halt a fire's spread (depending on the curing amount). However, be careful with grasslands that have a dense continuous top cover of dry grass, as fires will still race along the tops.

The finer details:

The degree of grassland curing represents the proportion of dead material in a grassland fuel complex, expressed as a percentage. It is an important input for models to predict rate of fire spread and determine fire

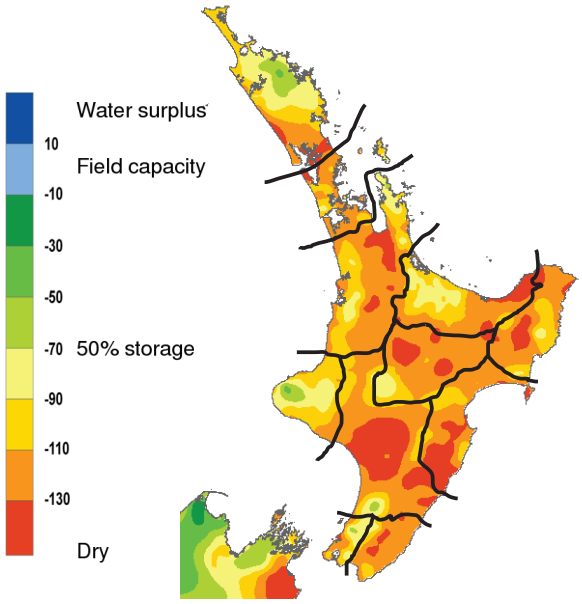


Figure 2. Soil moisture deficits as of 03/03/2021.
Source: NIWA.

Note: Soil moisture deficit means the amount of water needed to bring the soil moisture content back to field capacity, which is the maximum amount of water the soil can hold.

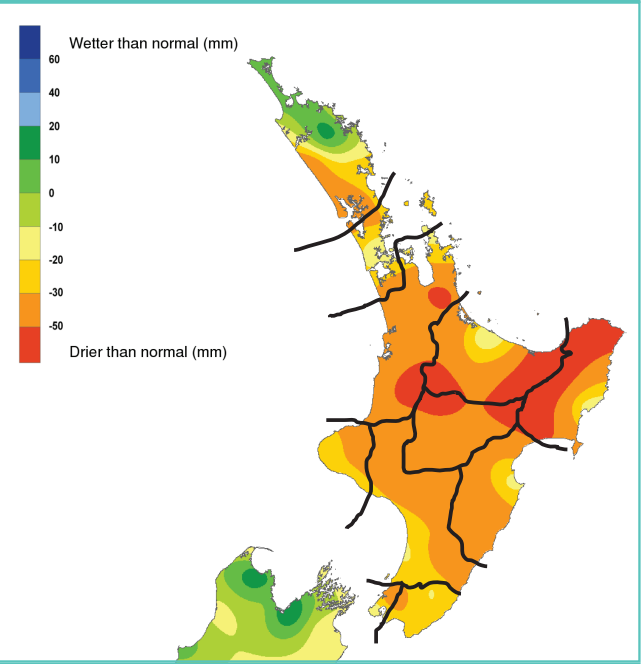


Figure 3. Soil moisture anomaly as of 03/03/2021.
Source: NIWA.

Note: Soil moisture anomaly means the difference between the historical normal soil moisture deficit (or surplus) for a given time of year and actual soil moisture deficits.

danger levels in grasslands.

Grassland curing will affect fire behaviour in several ways: it increases the amount of dead material present and affects fuel moisture content. The result is an increased chance of fire ignition, fire intensity and rates of spread. The moisture content of fine grass fuels (as well as pine litter and other fine fuels) also dramatically affects the ignition potential and ability of a wildfire to spread. High amounts of moisture increase the heat and thermal conductivity of fuel, so that more heat is required for the fuel to reach its ignition temperature. As grasses cure, and become drier, less heat is required to ignite and sustain a fire.

In partially cured grasslands, enough dead fuel needs to be present to ignite and sustain fire spread. Surrounding green grass with higher fuel moisture contents will require substantial heat input to burn off excess moisture and ignite. If there is not enough heat to ignite the greener sections of the grass, fire spread will either be very patchy or not spread at all. Burning under these conditions will produce very small flame heights, be low intensity and easily suppressible.

In some areas, the presence of dead matted material from the previous season's growth (thatch) can contribute to the ease of a fire starting and spreading. The material is often hidden underneath lush green grass that appears to have low curing (30 - 50%). However, thatch can increase a fires ability to carry and sustain a fire. It is often necessary to part the current season's grass to examine how much thatch is underneath. Even if a paddock has been harvested or grazed, there is often a couple centimetres of dead grass remaining.

Fine Fuel Status

The moisture content of fine fuels under forest canopies or scrublands, and grass pastures (as they brown off) dramatically affects the ignition potential and ability of a wildfire to spread. High amounts of moisture increase the heat and thermal conductivity of fuel, so that more heat is required in order for the fuel to reach its ignition temperature. As grasses cure, and become drier, less heat is required to ignite and sustain a fire.

If a heat source is present in fine fuels with a FFMC of 86 or more, or grass curing over 80%, ignition will be easy, and a fire can still spread. Under warm and windy conditions, incredible rates of spread and flame lengths, even with shorter grass can be observed. Light, flashy fuels are one of the common denominators of tragedy fires.

What does typical La Niña mean for NZ?

New Zealand's climate is influenced by two key natural cycles: the El Niño-Southern Oscillation (ENSO) and the Interdecadal Pacific Oscillation (IPO). Both these operate over the Pacific Ocean and beyond, and cause fluctuations in the prevailing trade winds and in the strength of the subtropical high-pressure belt.

El Niño and La Niña are opposite phases of the global ENSO climate cycle. The two phases disrupt the typical wind and rainfall patterns for New Zealand. Neutral conditions encourage far more variability in weather patterns for New Zealand, whereas El Niño or La Niña tend to have more predictable patterns.

It's important to note that ENSO events have an important influence on New Zealand's climate, but account for less than 25% of seasonal rainfall and temperatures. La Niña is only an important climate driver for New Zealand over long durations (2-6 months) when a moderate or strong event is in force. If a weak La Niña occurs, it means our 'local' climate players (the Southern Ocean southerlies and Tasman Sea lows) will continue to take turns ruling our weather.

This is a good reminder that local climate patterns (blocking Highs over or near New Zealand, Lows over the Tasman Sea or to the north of the country, and the Southern Ocean storms) generally 'trump' climate patterns such as El Niño and La Niña.

Typical La Niña effects on New Zealand

La Niña can encourage warmer than average sea temperatures, and fuel cyclones. The north can experience frequent lows and subtropical storms, occasionally stretching down as far as Canterbury. New Zealand is typically warmer than average during a La Niña, although there are regional and seasonal exceptions. During La Niña, more high-pressure systems than normal lie over the east of the country (South Island and Chatham Islands). This generally leads to more north-easterly and easterly winds (as opposed to westerlies).

Typical La Niña effects on the North Island

For the North Island, this means northern and eastern parts are wetter than normal. It can typically mean a wetter, milder and cloudier spring. Summer tends to be warmer and more humid than average. The exceptions being eastern locations experiencing onshore winds and cloudy skies.

Outbreaks of warm north-easterly winds bring rain to areas in the north and east of the North Island, especially Gisborne, Coromandel and Northland. Above normal summer and autumn rainfall often occurs over the far north of New Zealand (Coromandel northwards).

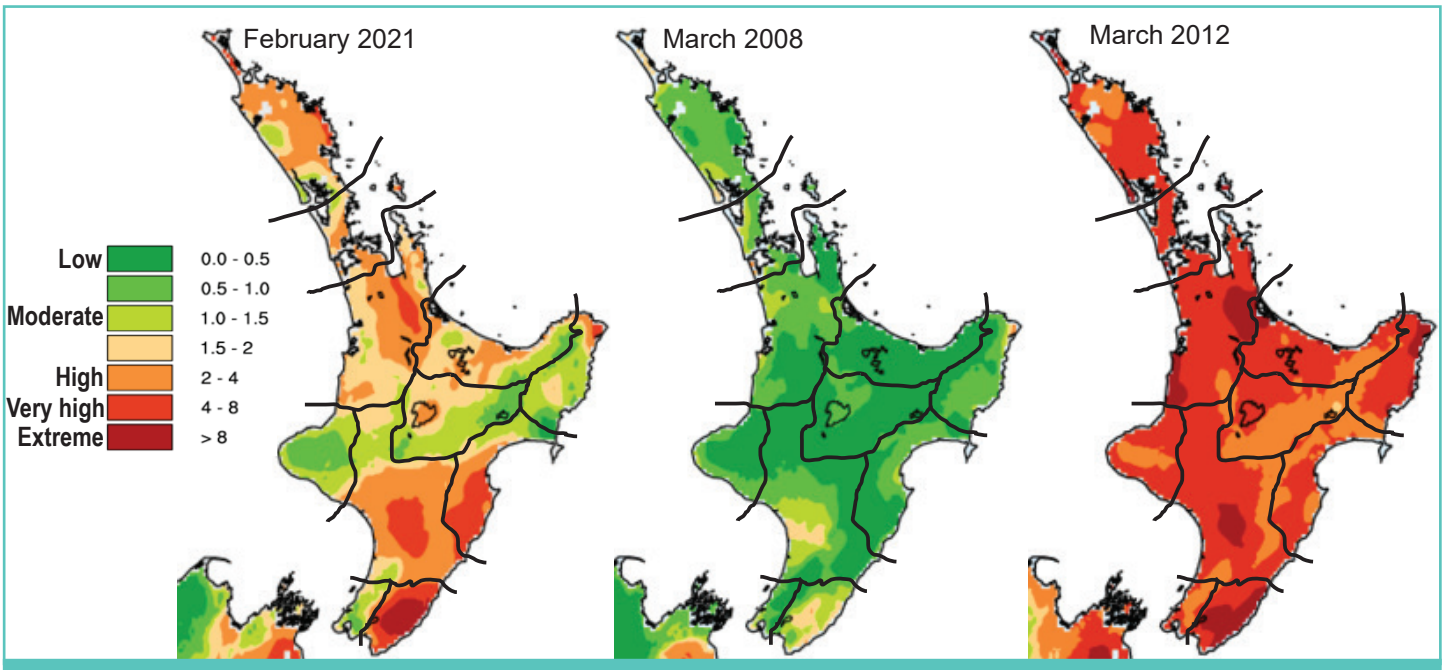


Figure 4. Monthly average Severity Rating for: the previous month (left), and expected average monthly values during the 2007/08 moderate strength La Niña (left) & 2011/12 (right) weak strength La Niña year.

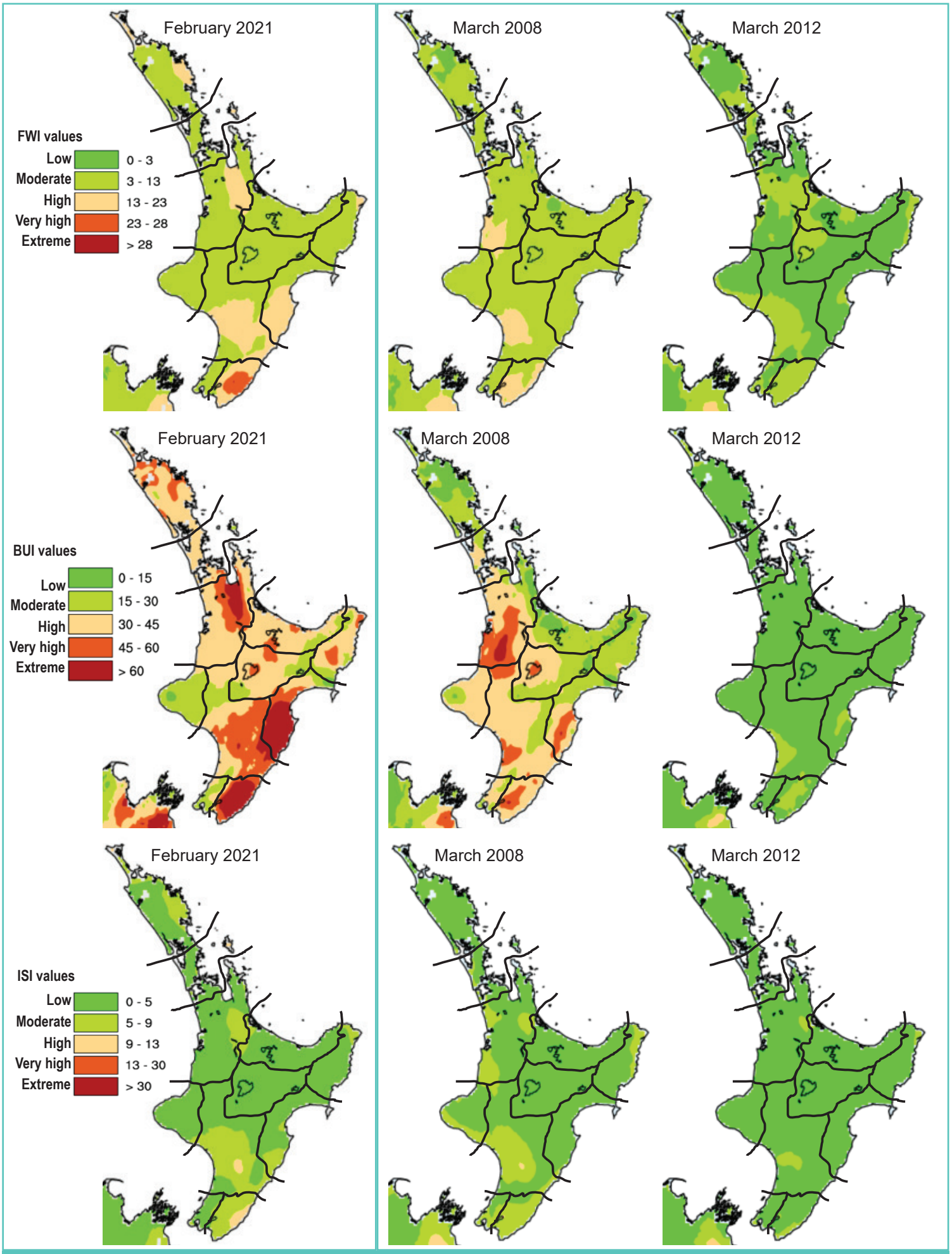


Figure 5. Previous Monthly Average for the: Fire Weather Index (top), Buildup Index (middle) and Initial Spread Index (below).

Figure 6. Expected average Monthly values of: Fire Weather Index (top), Buildup Index (middle) and Initial Spread Index (below); and during the 2007/08 moderate strength La Niña (left) & 2011/12 (right) weak strength La Niña year.

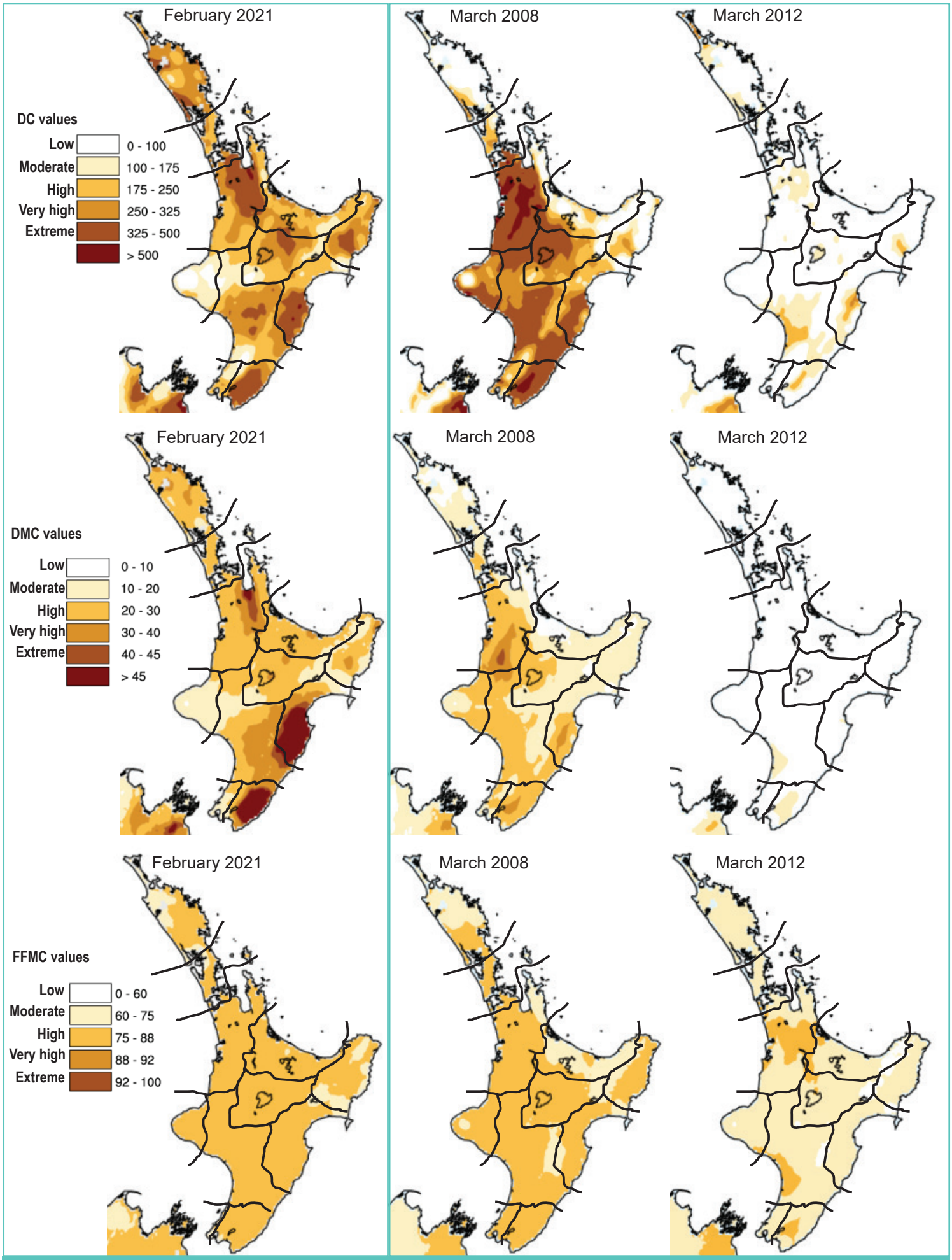
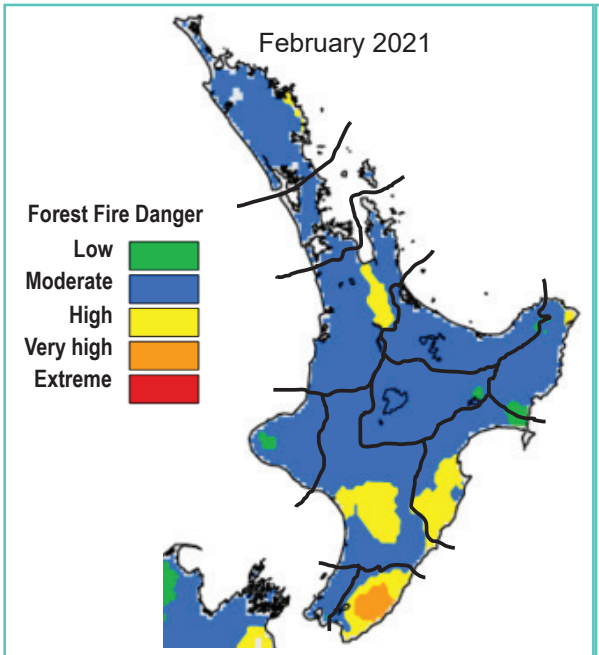
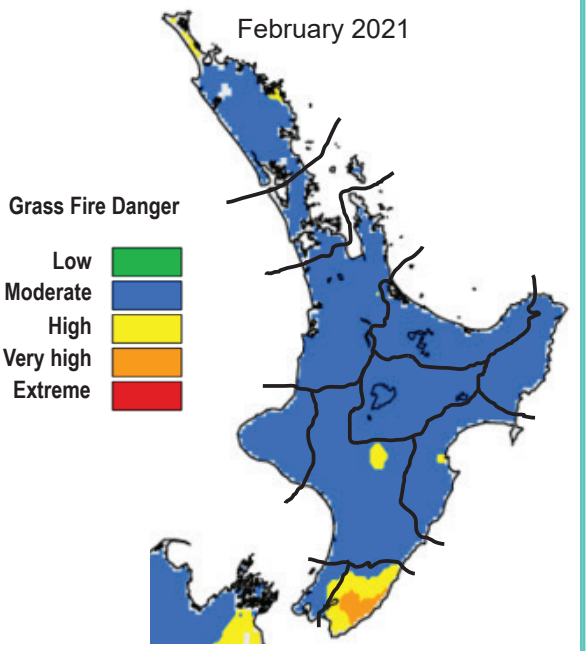


Figure 7. Previous monthly average for the: Drought Code (top), Duff Moisture Code (middle) and the Fine Fuel Moisture Code (below).

Figure 8. Average monthly values of: Drought Code (top), Duff Moisture Code (middle) and Fine Fuel Moisture Code (below); and during the 2007/08 moderate strength La Niña (left) & 2011/12 (right) weak strength La Niña year.





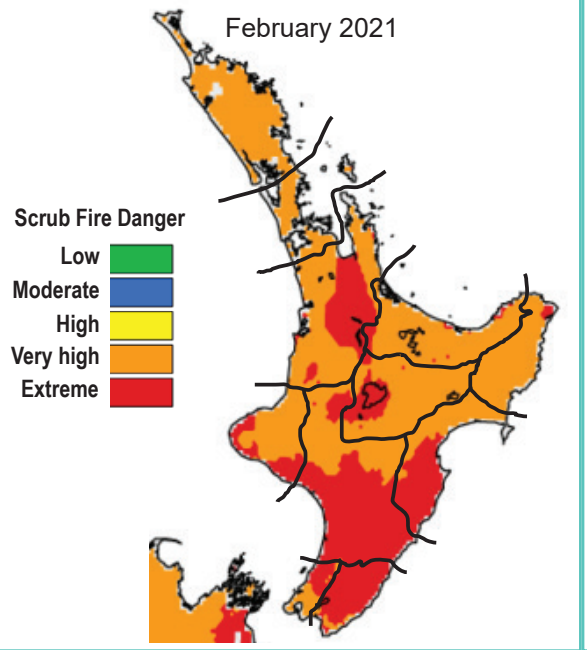
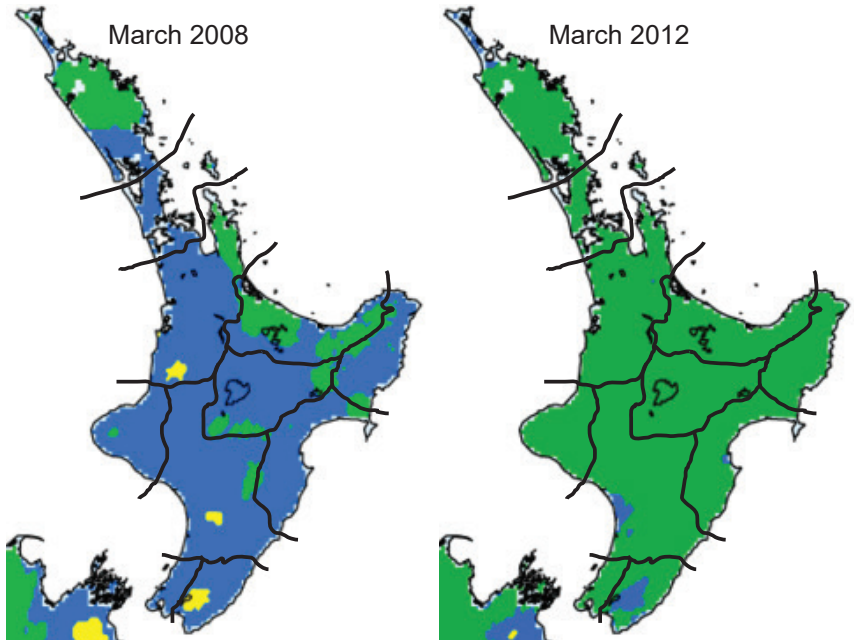
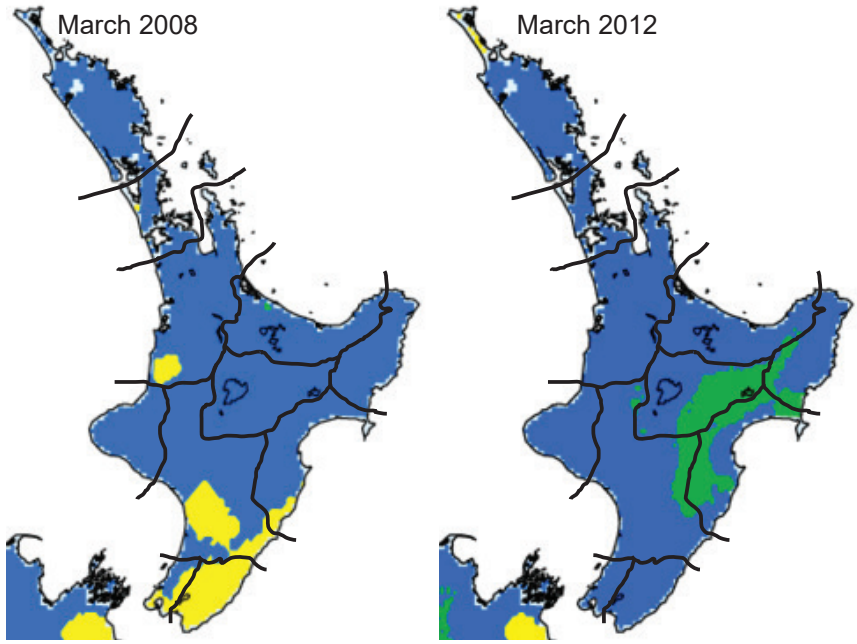


Figure 9. Previous Monthly Average for: Forest Fire Danger (top), Grassland Fire Danger (middle) and Scrub Fire Danger (below).





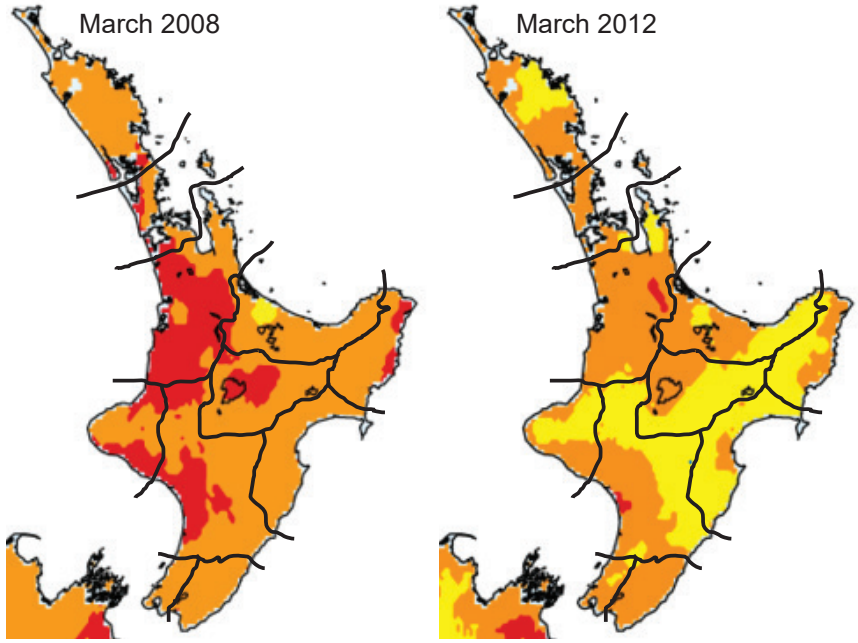


Figure 10. Expected average monthly values of: Forest Fire Danger (top), Grassland Fire Danger (middle) and Scrub Fire Danger (below), during the 2007/08 moderate strength La Niña (left) & 2011/12 (right) weak strength La Niña year.

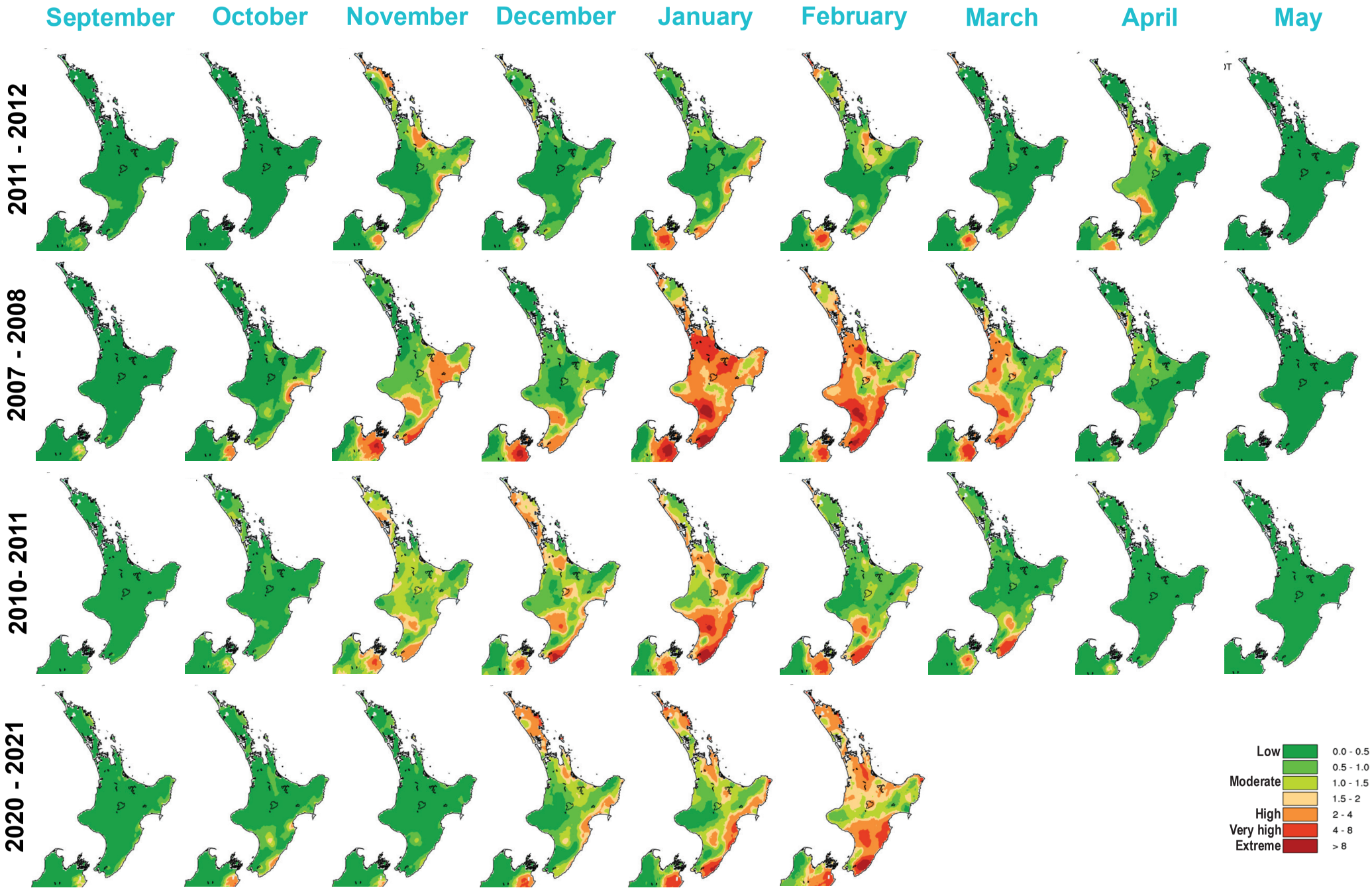


Figure 11. New Zealand Fire Season Severity (monthly)
The years of 2007/08, 2010/11, 1999/00, and 1998/99 and are ideal comparisons for what the North Island might experience over the next few months. These years were moderate strength La Niña years, 2011/12 was a weak La Niña event. DSR values of less than one equates to low fire behaviour potential, 1-3 moderate fire potential, 3-7 high to very high fire potential, and above 7 extreme fire behaviour potential.

Note:

Tracking trends
Comparisons of fire dangers for individual indicator stations for different regions are not shown in this outlook due to the low fire danger and severity across the country. As fire dangers increase, more detailed regional outlooks will recommence highlighting where Buildup Index (BUI), Drought Code (DC) and Cumulative Daily Severity Rating (CDSR) values sit in comparison with previous fire seasons.

For fire managers who are interested in tracking fire season trends for all your weather stations, the graphs are available on the Scion Rural Fire Research website under tools.

Background info on FWI codes and indicies:

Fine Fuel Moisture Code (FFMC)
An indicator of the relevant ease of ignition and flammability of fine fuels.

0 - 74	Difficult
75 - 84	Moderately easy
85 - 88	Easy
89 - 91	Very easy
92 +	Extreme easy

Duff Moisture Code (DMC) A rating of the average moisture content of loosely compacted organic soil layers (duff/humus) of moderate depth, and medium-sized woody material

0 - 10	Little mopup needs
11 - 20	Moderate
21 - 30	Difficult
31 - 40	Difficult & extended
41 +	Difficult & extensive

Drought Code (DC) A rating of the average moisture content of deep, compact, organic soil layers, and a useful indicator of seasonal drought effects on forest fuels and amount of smouldering in deep duff layers and large logs.

0 - 100	Little mopup needs
101 - 175	Moderate
176 - 250	Difficult
251 - 300	Difficult & extended
301 +	Difficult & extensive

Buildup Index (BUI)
Combines the DMC and DC, and represents the total amount of fuel available for combustion.

0 - 15	Easy control
16 - 30	Not difficult
31 - 45	Difficult
46 - 59	Very difficult
60 +	Extremely difficult

Initial Spread Index (ISI) Combines the effect of wind speed and the FFMC, providing a numerical rating of potential fire spread rate.

0 - 3	Slow rate of spread
4 - 7	Moderate fast
8 - 12	Fast
13 - 15	Very fast
16 +	Extremely fast

Fire Weather Index (FWI)
Combines the ISI and BUI to indicate the potential head fire intensity of a spreading fire (on level terrain).

0 - 5	Low fire intensity
6 - 12	Moderate
13 - 20	High
21 - 29	Very High
30 +	Extreme

Daily Severity Rating (DSR) A numerical rating of the daily fire weather severity at a particular station, based on the FWI. It indicates the increasing amount of work and difficulty of controlling a fire as fire intensity increases. The DSR can be averaged over any period to provide monthly or seasonal severity ratings.

Monthly Severity Rating (MSR) is the average of the DSR values over the month. DSR and MSR captures the effects of both wind and fuel dryness on potential fire intensity, and therefore control difficulty and the amount of work required to suppress a fire. It allows for comparison of the severity of fire weather from one year to another.

0 - 1	Low fire behaviour potential
1 - 3	Moderate fire potential
3 - 7	High to very high fire potential
7 +	Extreme fire behaviour potential

Acknowledgements:

Fire Danger interpretation was from information gathered from the Average Monthly Maps for: Severity Rating, FWI, BUI, ISI, DC, DMC, FFMC, Grassland FDC, Scrub FDC & Forest FDC. These maps were obtained from the Fire and Emergency New Zealand's Fire Weather System powered by Eco Connect.

Information on the Expected Climate Outlook was gathered from:

- **MetService, Rural Monthly outlooks:**
  www.metservice.com/rural/monthly-outlook
- **NIWA, Seasonal Climate outlook:**
  www.niwa.co.nz/climate/sco
- **Australian Bureau of Meteorology Climate outlooks**
  http://www.bom.gov.au/climate/ahead/?ref=ftr
- **WeatherWatch.co.nz**
  https://www.weatherwatch.co.nz/

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