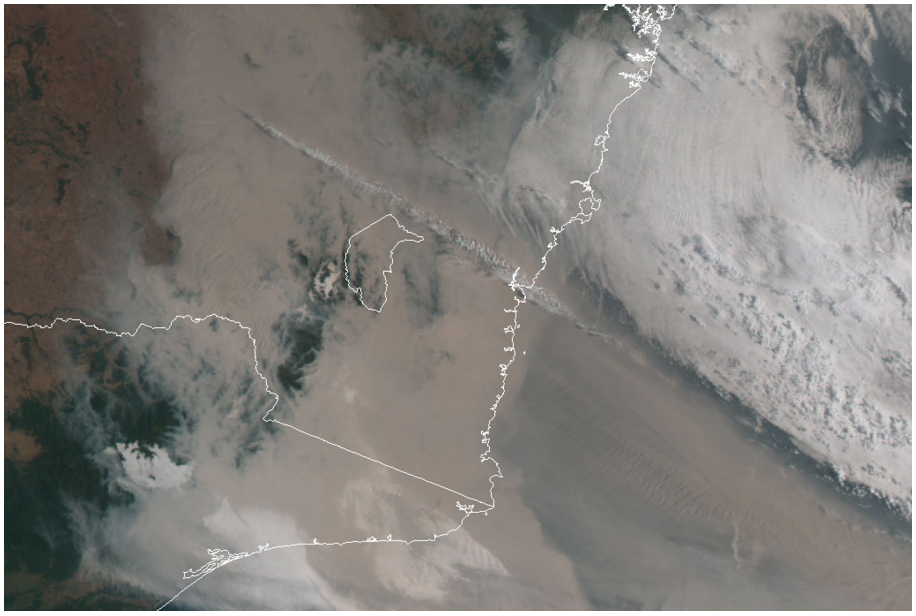
AUSTRALIAN FIRE PATTERN ANALYSES USING MODIS HOTSPOTS



Part 3: Time Series Patterns

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UNSW CANBERRA

UNSW Bushfire

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Dominated by Black Summer | **Longer-term activity swings** | **Dominated by end of Millenium Drought**

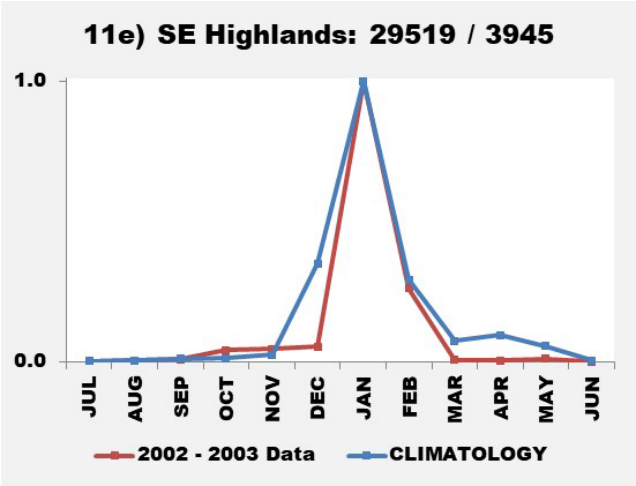
Dominated by various active years | **Major zig-zag swings** | **Uniform**

SECTION 3 – TIME SERIES PATTERNS

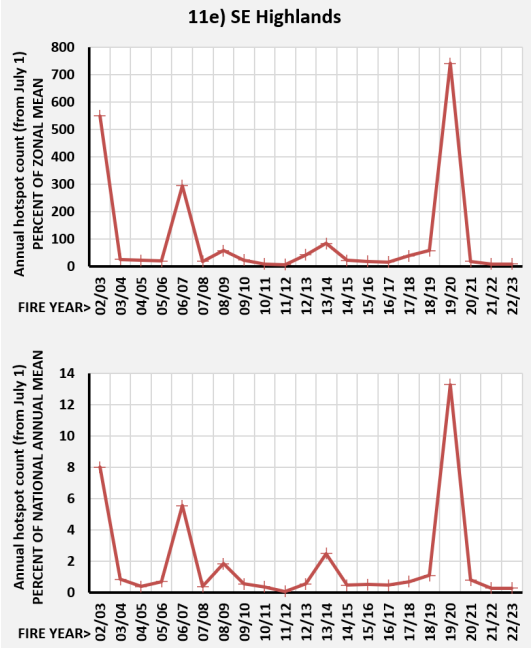
In the maps that follow, annual hotspot counts have been compared to the climatological mean, and plotted as a percentage of the mean. All analyses use fire years – from July 1 to June 30.

In this example from 2002/2003, zone 11e data are presented.

1) The monthly distribution of hotspots across a selected year has been compared to the deade-long climatological average used in *Part 2 – Annual Activity Patterns*. In this example, the seasonality was as expected, but the activity was well over the expectation.

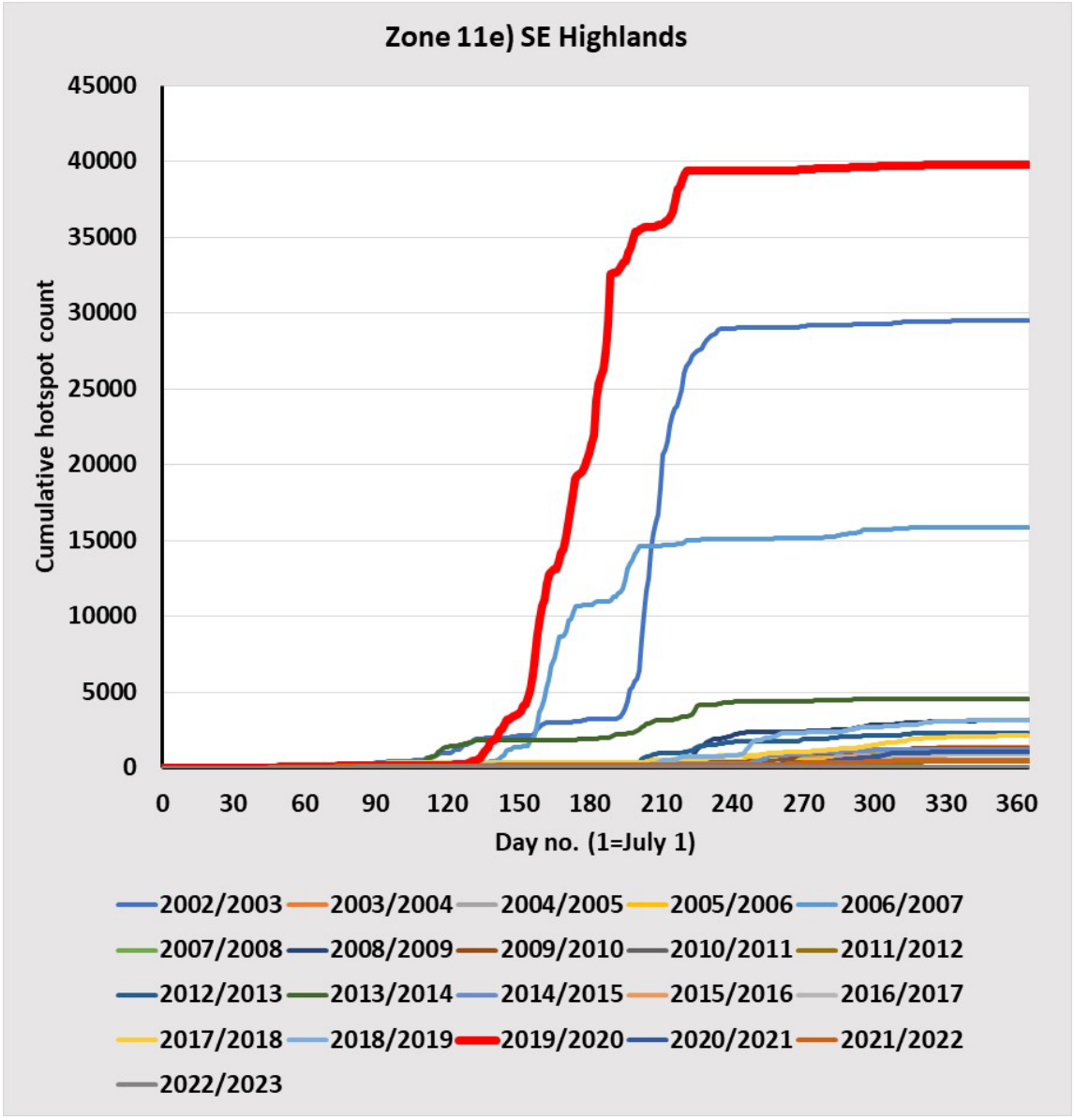


2) The distribution of total annual hotspot counts is plotted as a time series, showing "normal" fluctuations around the climatological mean, as a percentage of that mean, and unusual spikes of activity, such as is seen in BS here. The mean here and below is for all MODIS data years, to allow the extreme effects of BS to be included. Also shown is the same data expressed as a percentage of the continental hotspot count. This aim to separate zonal fluctuations that are intrinsic or extrinsic.

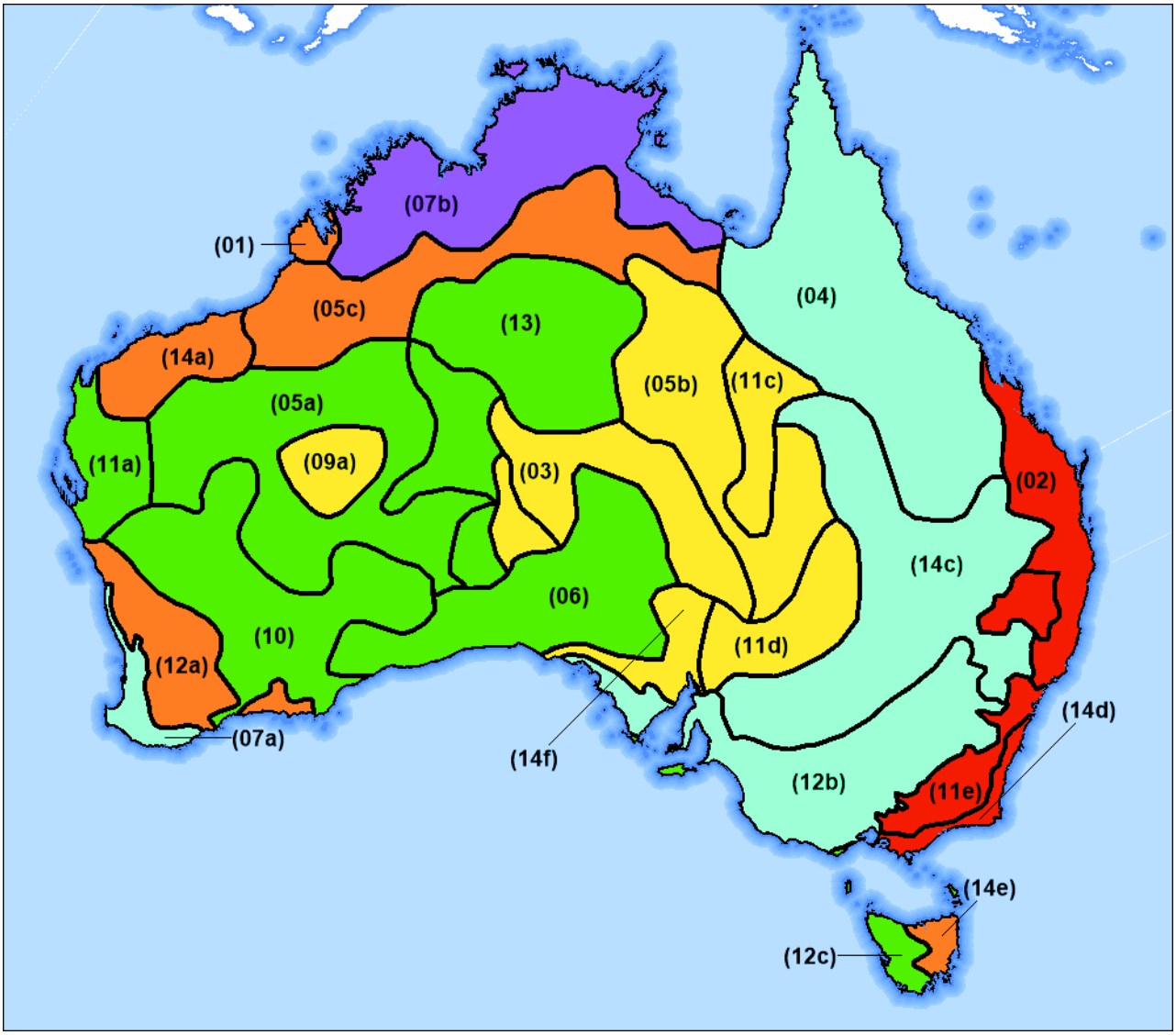


Dominated by Black Summer
Dominated by various active years
Longer-term activity swings
Major zig-zag swings
Dominated by end of Millenium Drought
Uniform

3) The build-up curves for each zone. These show how the annual accumulations progressed and highlights: the seasonality; the unusually active years; and unusual activity windows. For example, BS, highlighted in red, started to accumulate very early. This example also shows that (outside of active summers) autumn prescribed burning is the major activity cause in many years.



Dominated by Black Summer
Dominated by various active years
Longer-term activity swings
Major zig-zag swings
Dominated by end of Millenium Drought
Uniform



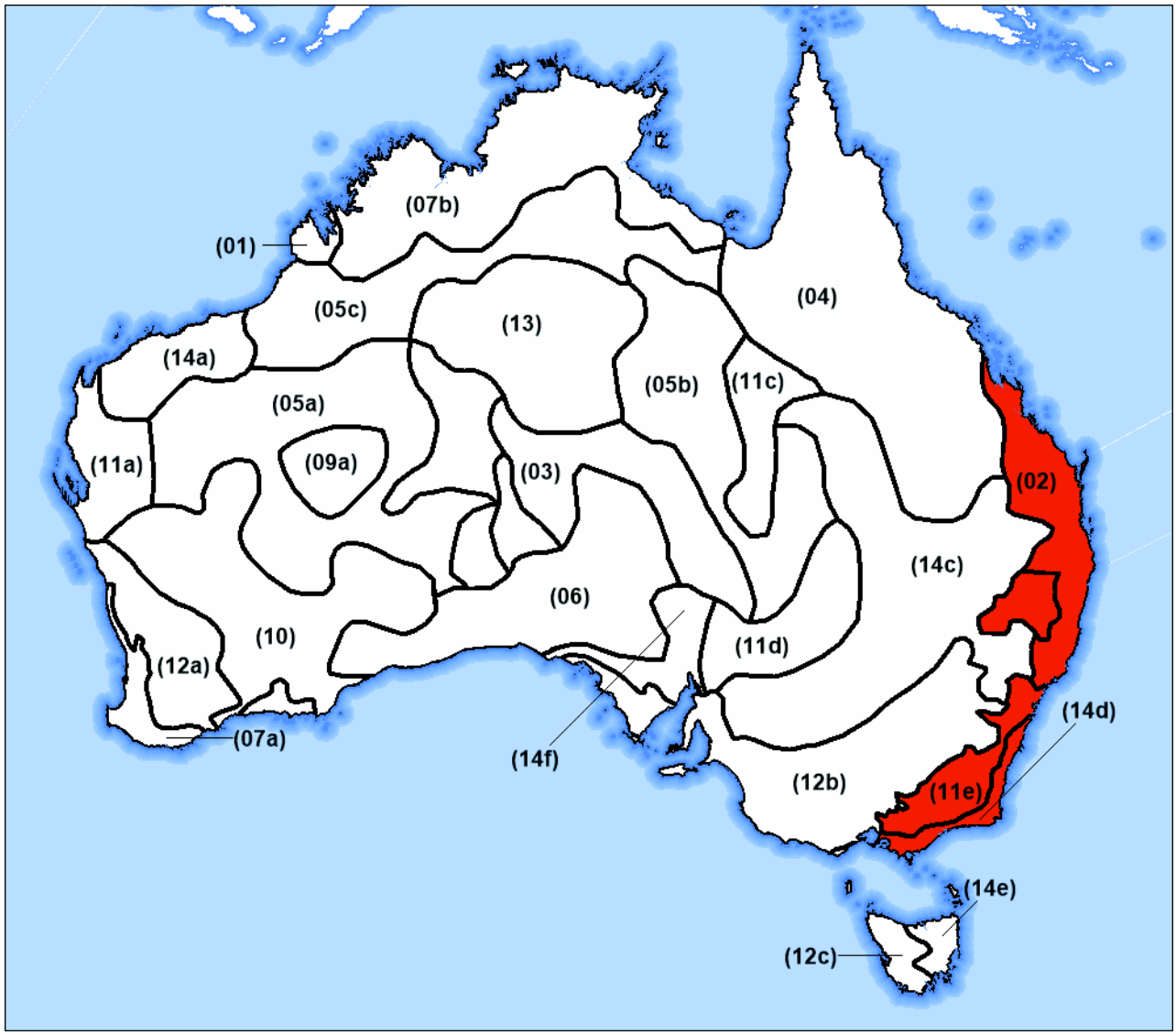
THE ZONES AND THEIR GROUPS

- Dominated by Black Summer
- Longer-term activity swings
- Dominated by end of Millenium Drought
- Dominated by various active years
- Major zig-zag swings
- Uniform

Dominated by Black Summer
Longer-term activity swings
Dominated by end of Millenium Drought
Dominated by various active years
Major zig-zag swings
Uniform

BLACK SUMMER DOMINATED

Unprecedented activity during Black Summer overwhelmed all past activity.

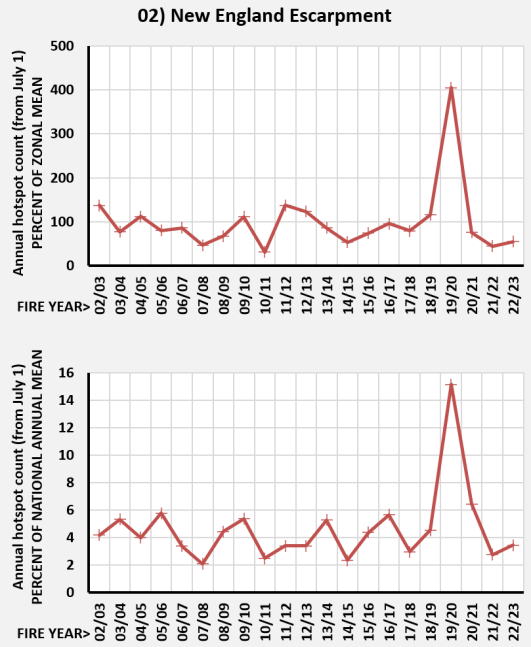


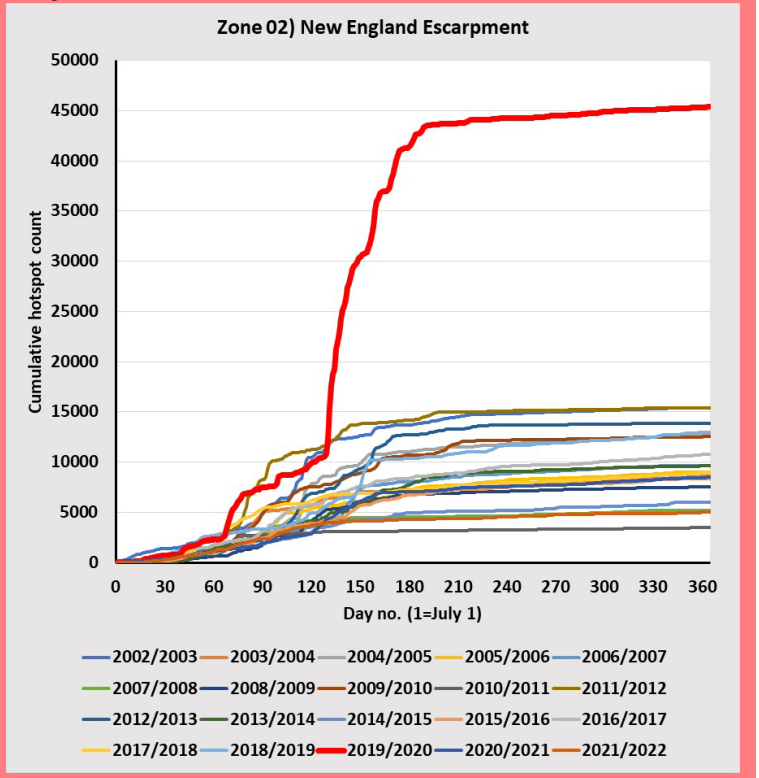
04/01/2020; -35° 149°

Dominated by Black Summer
Dominated by various active years
Longer-term activity swings
Major zig-zag swings
Dominated by end of Millenium Drought
Uniform

BLACK SUMMER DOMINATED

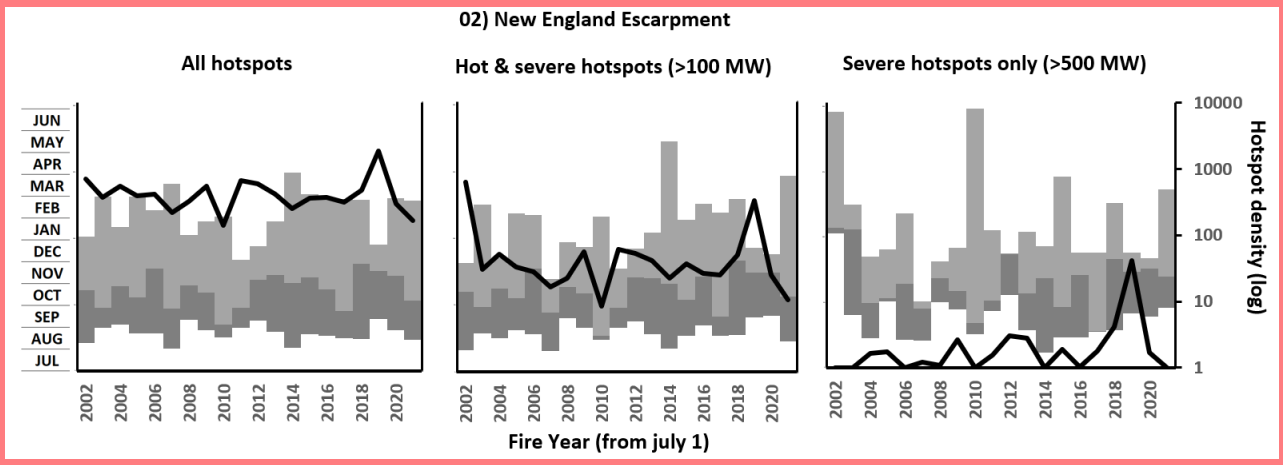
02) NEW ENGLAND ESCARPMENT





WIDTH 7

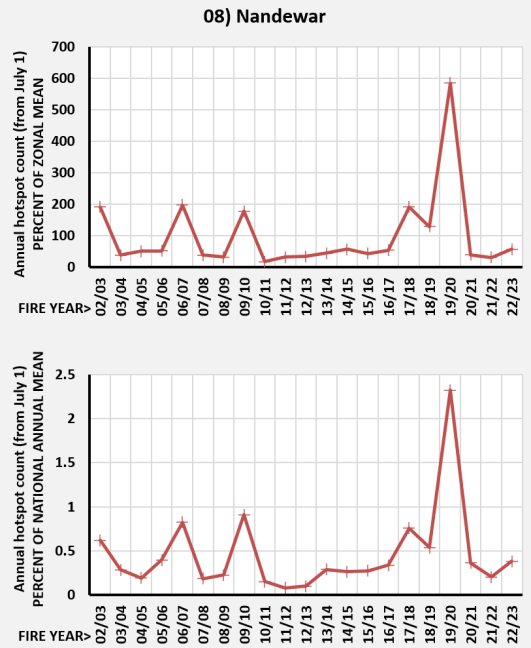
- Steady activity levels, swamped by BS – 300% above previous record..

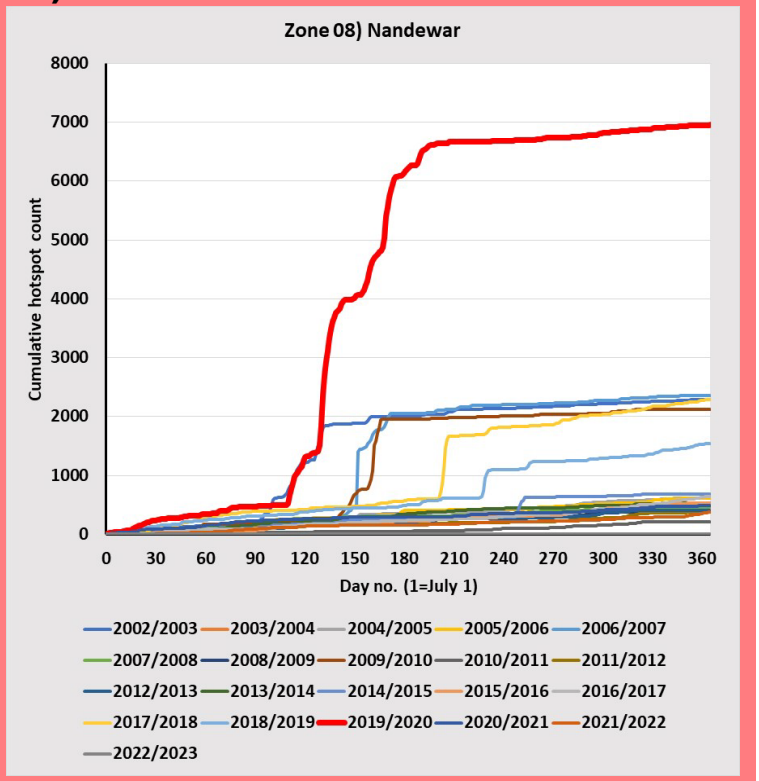


Dominated by Black Summer
Dominated by various active years
Longer-term activity swings
Major zig-zag swings
Dominated by end of Millenium Drought
Uniform

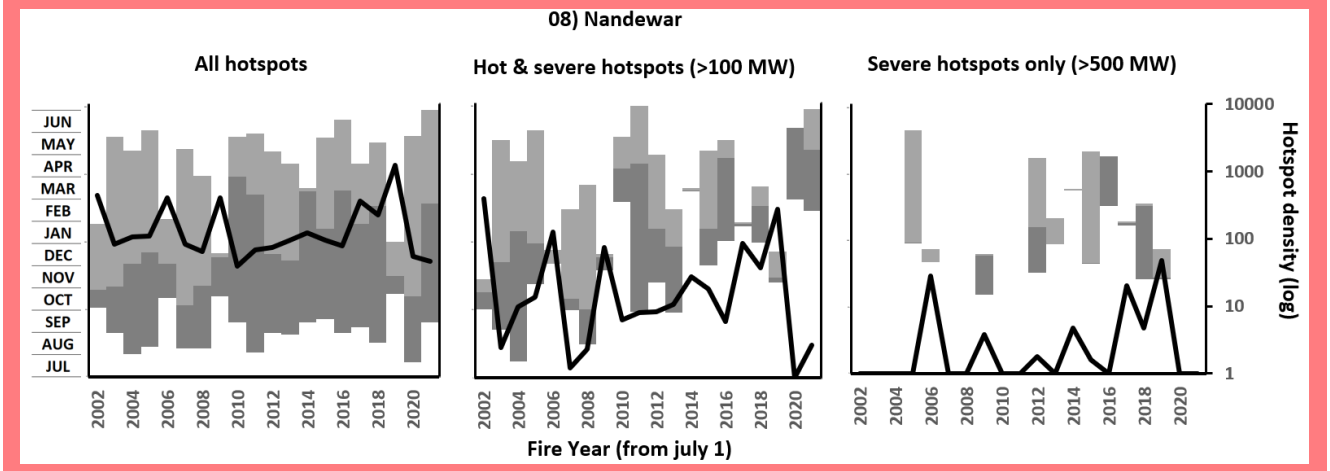
BLACK SUMMER DOMINATED

08) NANDEWAR





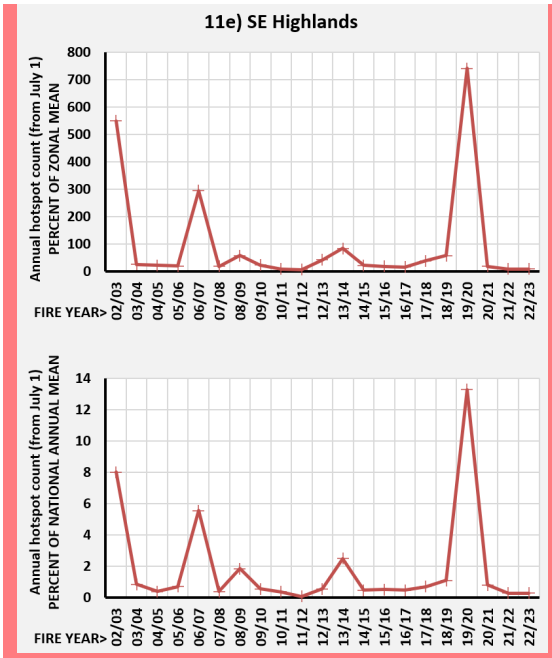
- Low activity base with occasional active years.
- BS set new record by over 200%.

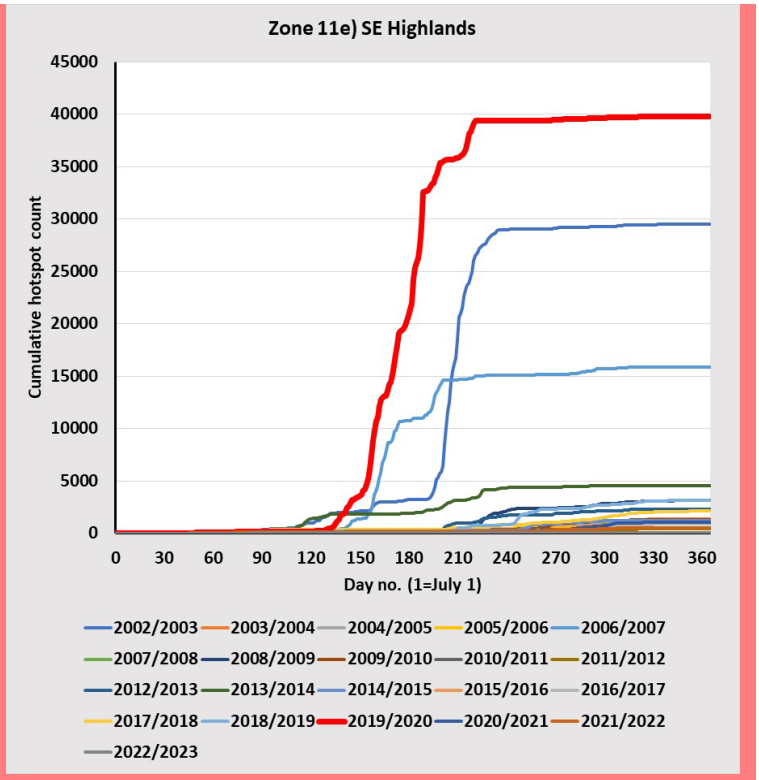


BLACK SUMMER DOMINATED

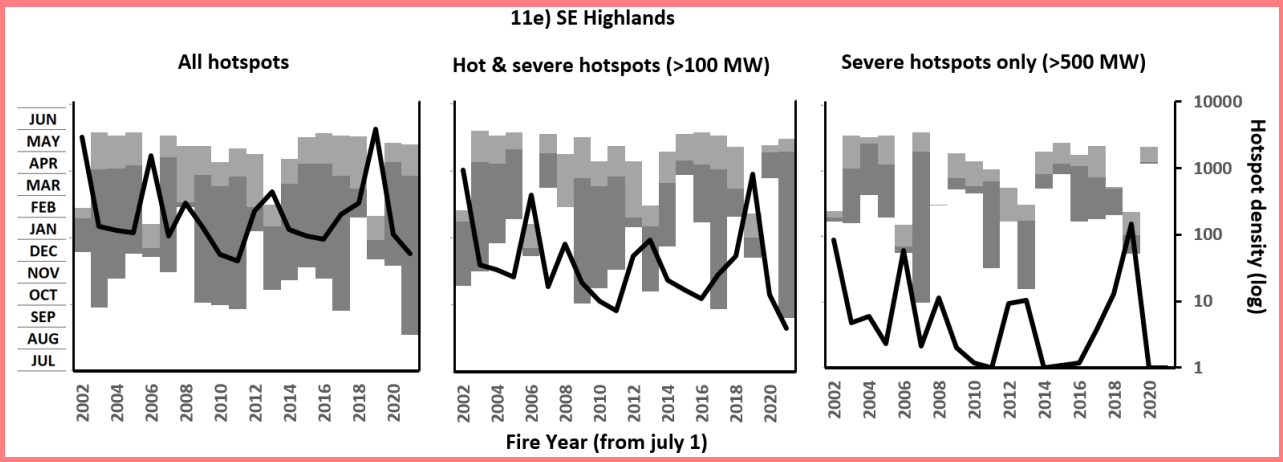
11e) SE HIGHLANDS

Dominated by Black Summer
Dominated by various active years
Longer-term activity swings
Major zig-zag swings
Dominated by end of Millenium Drought
Uniform





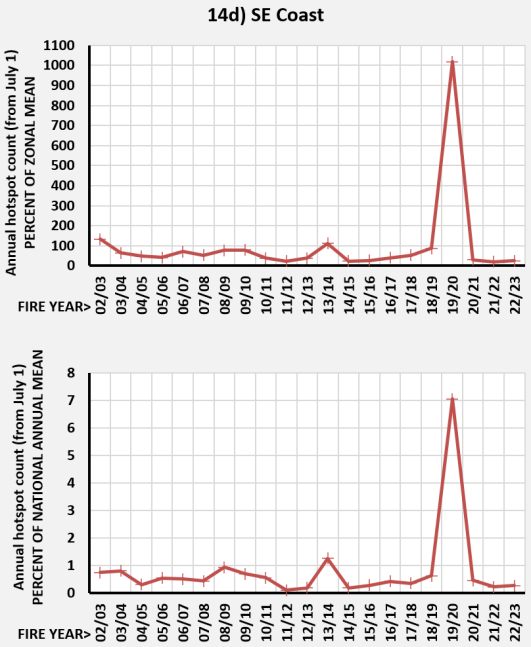
- A low activity base with a series of major spikes: 2002/2003; 2006/2007 and BS. Many dynamic fires and blow-up fire events. (The latter means that the spikes are underestimates, due to no heat remaining when the next MODIS overflight occurs.)

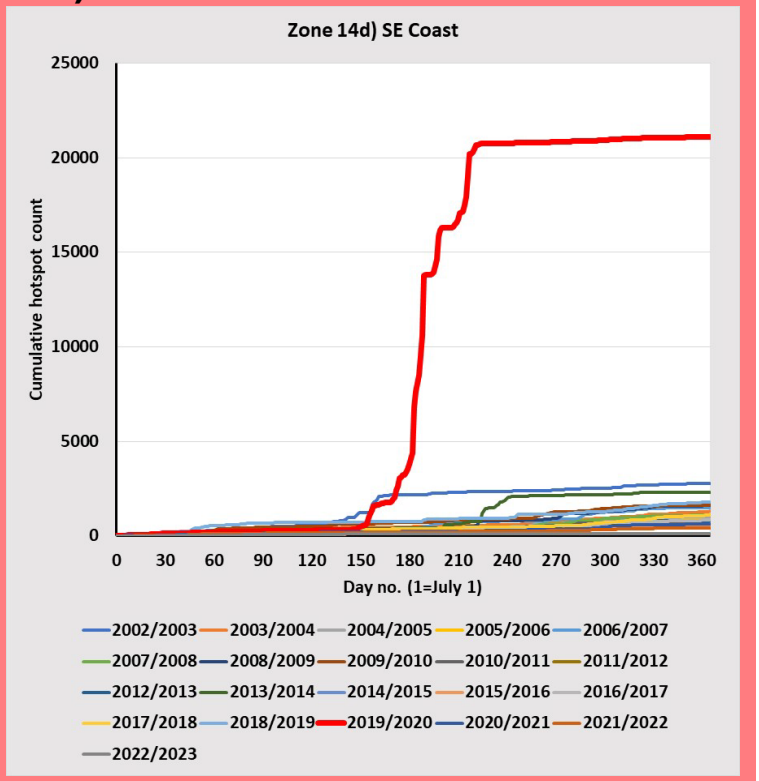


Dominated by Black Summer
Dominated by various active years
Longer-term activity swings
Major zig-zag swings
Dominated by end of Millenium Drought
Uniform

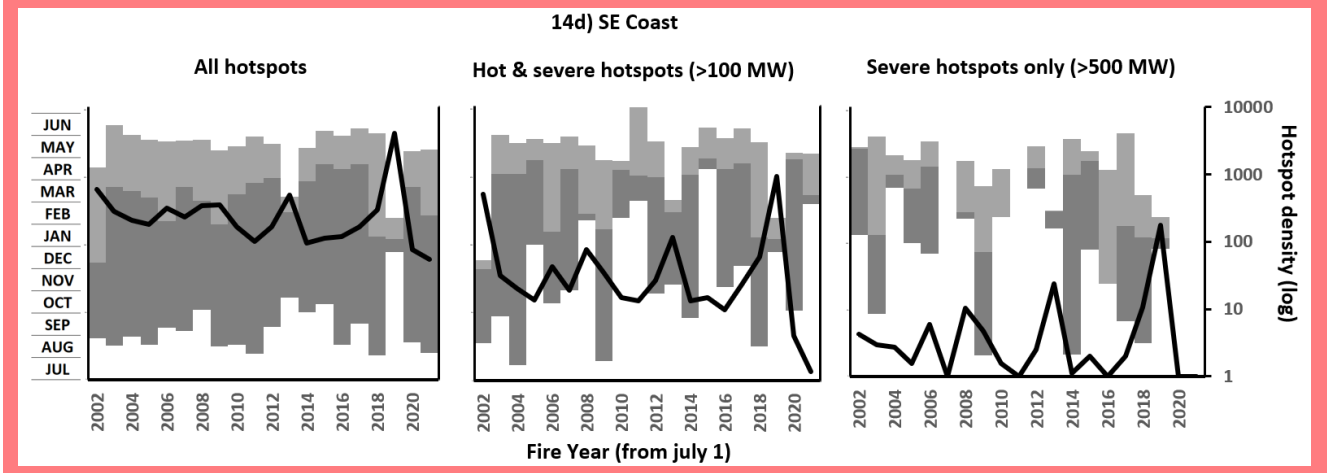
BLACK SUMMER DOMINATED

14d) SE COAST





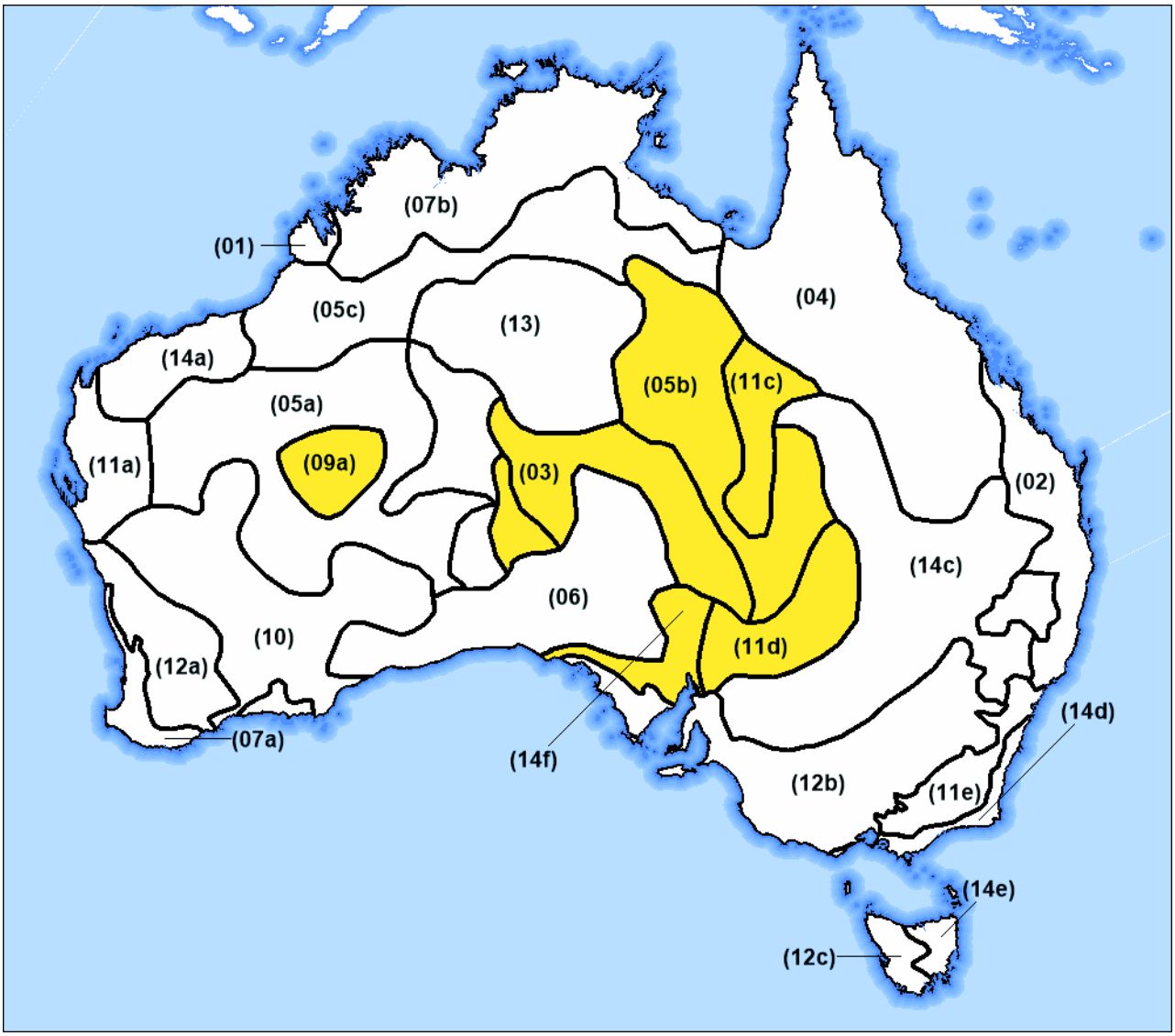
- BS exceeded the previous annual activity level by over 700%. Previous bas season in the adjacent zone 11e did not reach this zone.

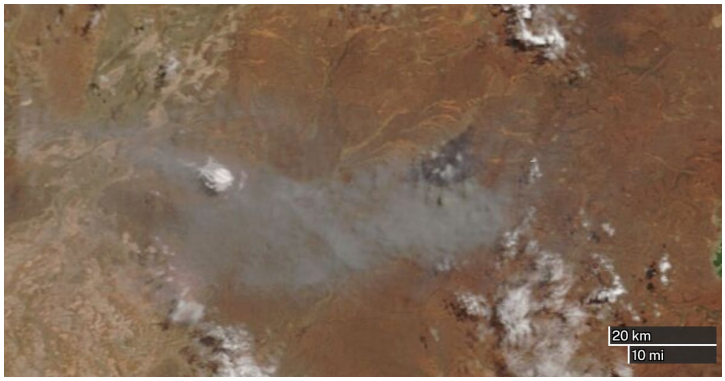


Dominated by Black Summer
Dominated by various active years
Longer-term activity swings
Major zig-zag swings
Dominated by end of Millenium Drought
Uniform

DOMINATED BY END OF MILLENIUM DROUGHT

Baseline activity near zero, but very active after Millenium Drought.



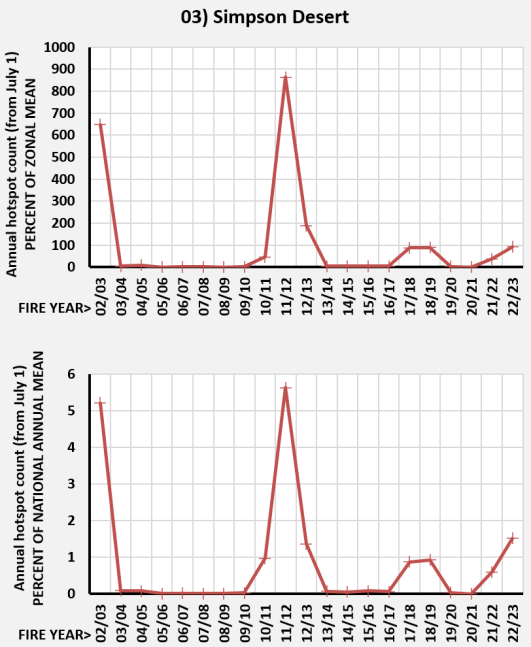


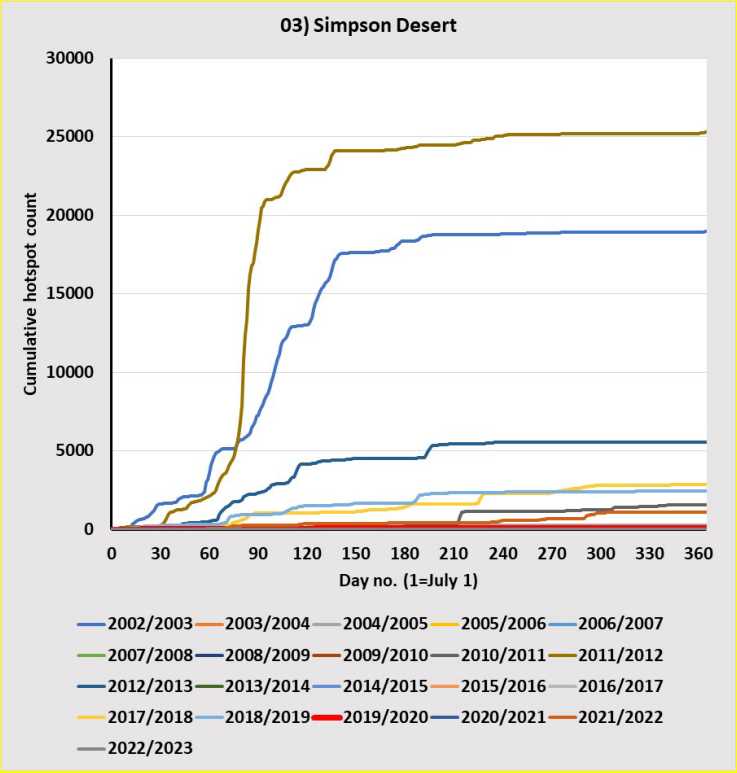
19/10/2012 -28.7° 143.6°

Dominated by Black Summer
Dominated by various active years
Longer-term activity swings
Major zig-zag swings
Dominated by end of Millenium Drought
Uniform

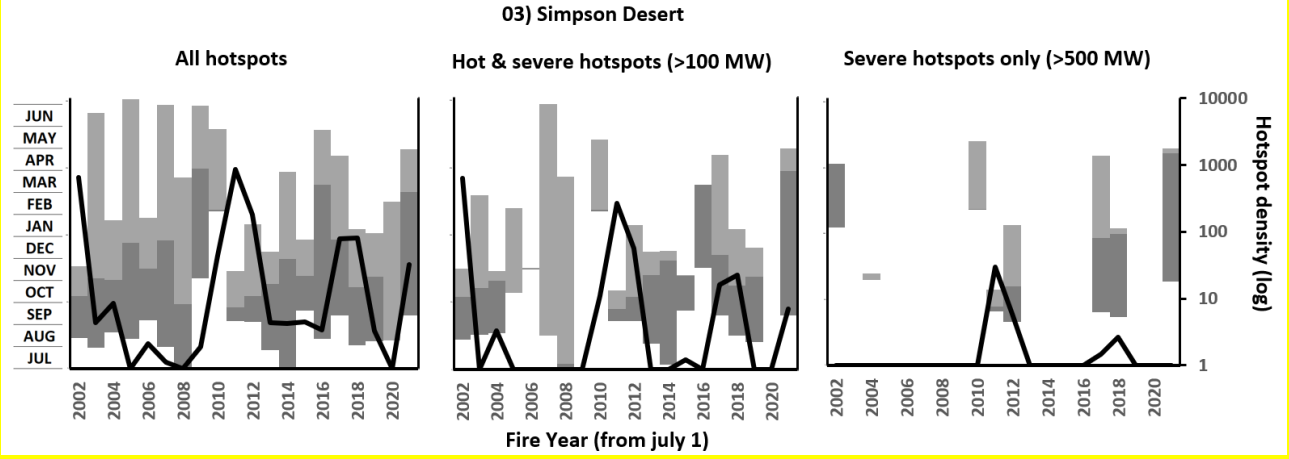
DOMINATED BY END OF MILLENIUM DROUGHT

03) SIMPSON DESERT





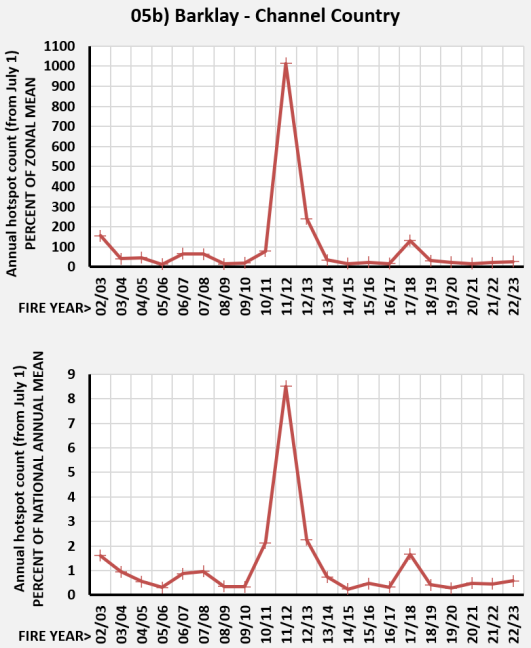
- Many years have “zero” fire activity.
- Large fire activity on a semi-decadal scale, mostly from long-time scale fires. The exception is in late 2011.

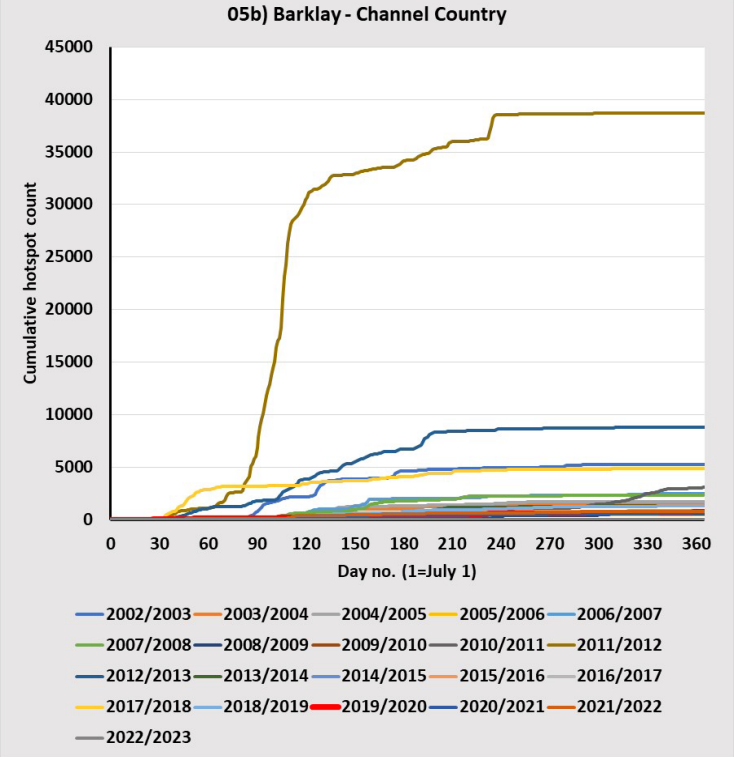


Dominated by Black Summer
Dominated by various active years
Longer-term activity swings
Major zig-zag swings
Dominated by end of Millenium Drought
Uniform

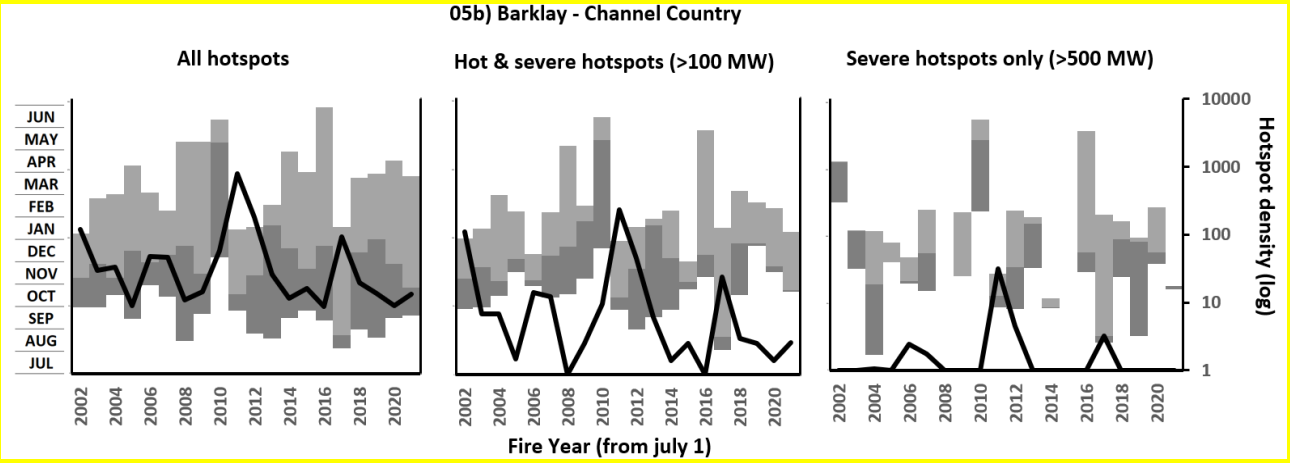
DOMINATED BY END OF MILLENIUM DROUGHT

05b) BARKLAY- CHANNEL COUNTRY





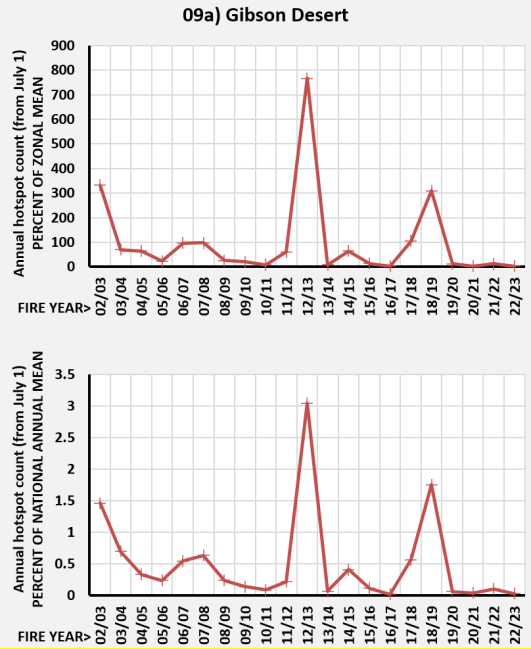
- Many years have “zero” fire activity.
- Large fire activity on a semi-decadal scale, mostly from long-time scale fires. The exception is in late 2011.

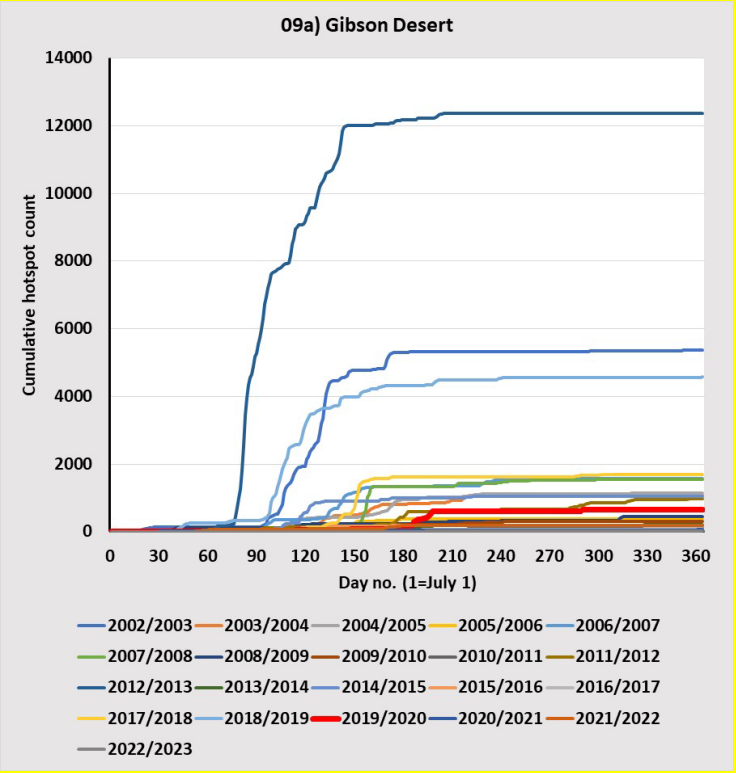


Dominated by Black Summer
Dominated by various active years
Longer-term activity swings
Major zig-zag swings
Dominated by end of Millenium Drought
Uniform

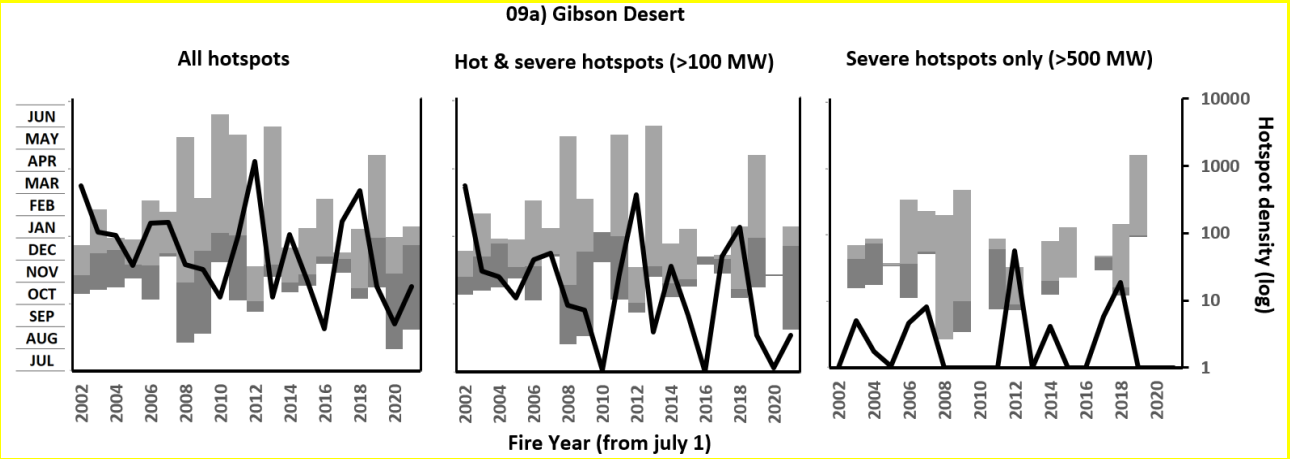
DOMINATED BY END OF MILLENIUM DROUGHT

09a) GIBSON DESERT





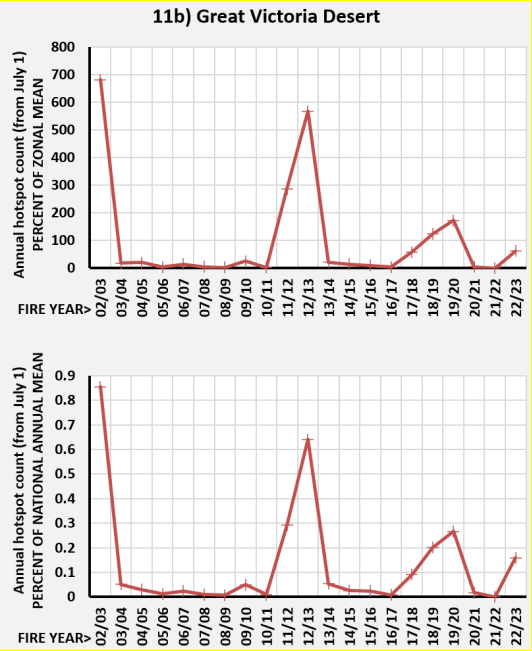
- Many years have “zero” fire activity.
- Large fire activity on a semi-decadal scale, mostly from long-time scale fires. The exceptions are in late 2002 and in late 2012 (a year out of phase with zones 03 & 05b).

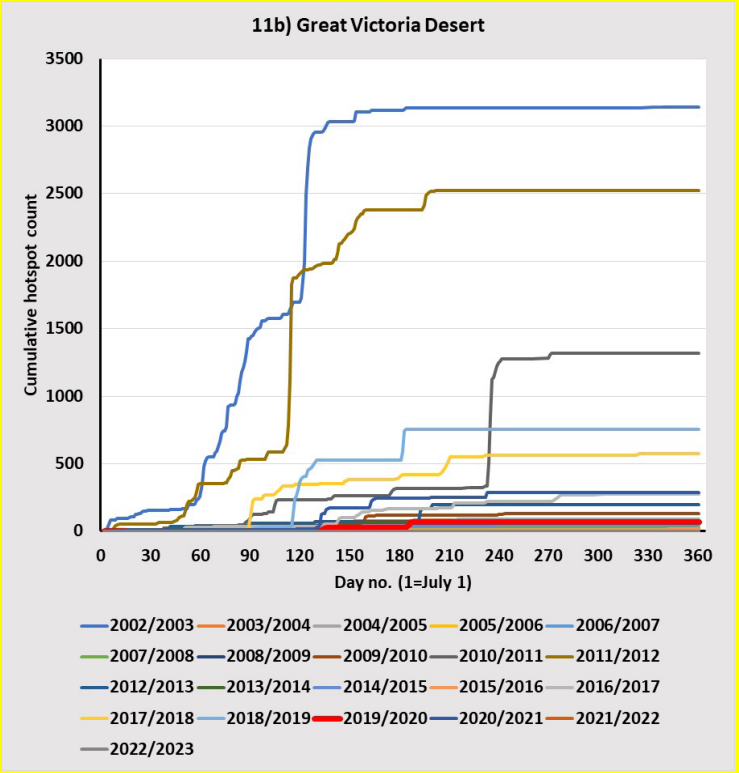


Dominated by Black Summer
Dominated by various active years
Longer-term activity swings
Major zig-zag swings
Dominated by end of Millenium Drought
Uniform

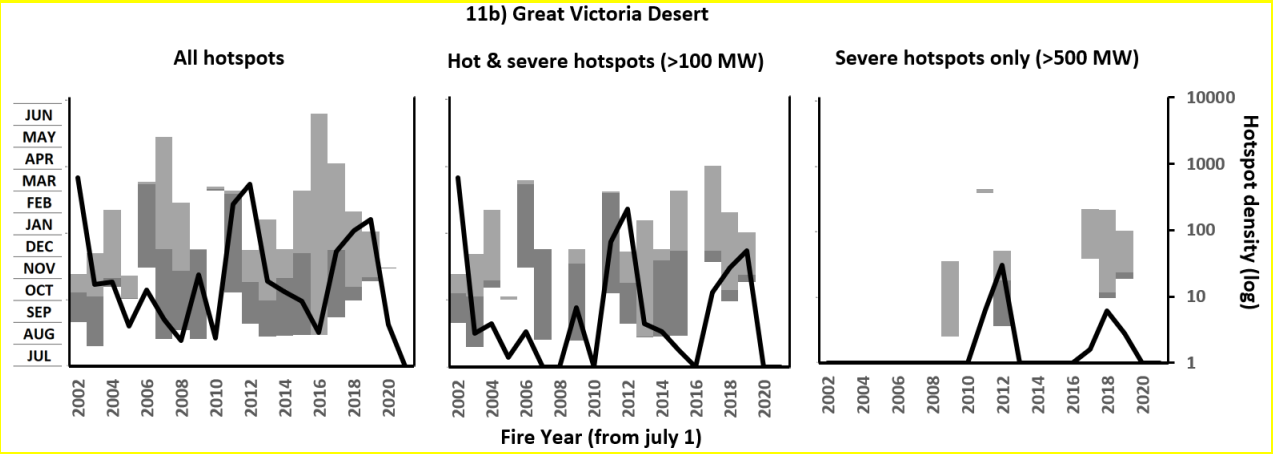
DOMINATED BY END OF MILLENIUM DROUGHT

11b) GREAT VICTORIA DESERT





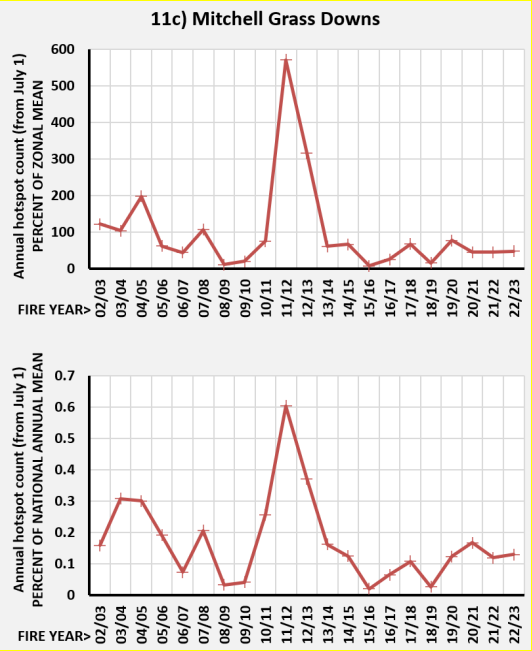
- Many years have “zero” fire activity.
- Large fire activity on a semi-decadal scale, mostly from long-time scale fires, often with major expansion phases half way through.

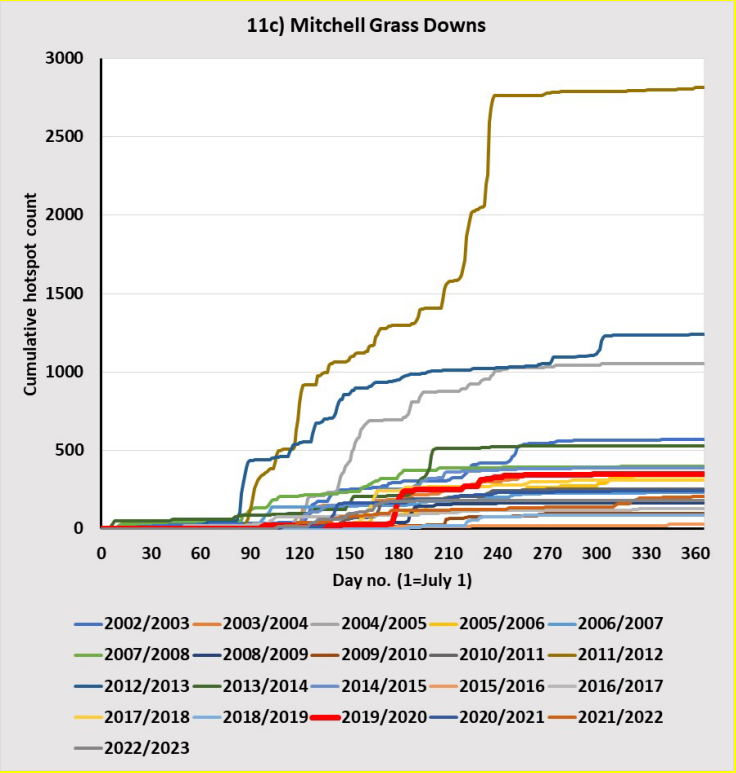


Dominated by Black Summer
Dominated by various active years
Longer-term activity swings
Major zig-zag swings
Dominated by end of Millenium Drought
Uniform

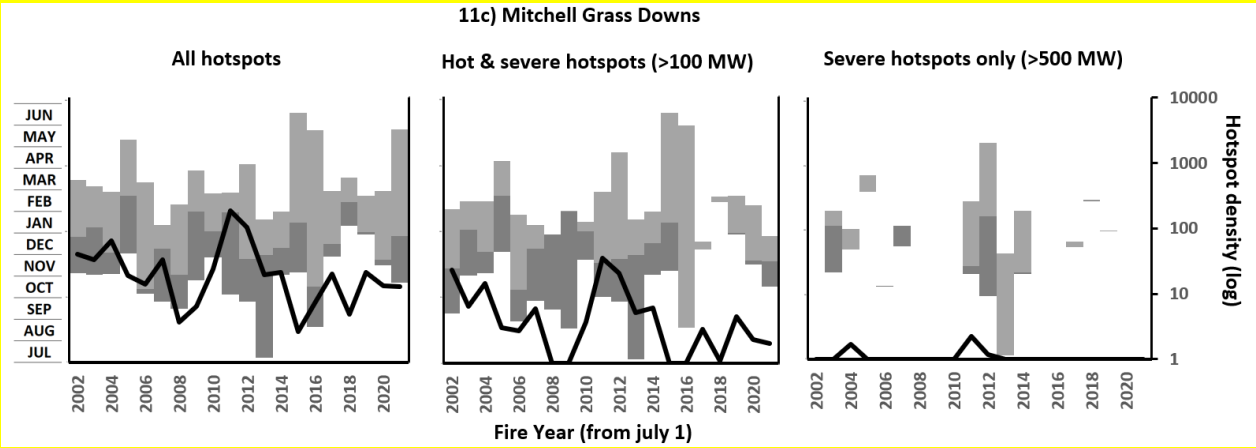
DOMINATED BY END OF MILLENIUM DROUGHT

11c) MITCHELL GRASS DOWNS





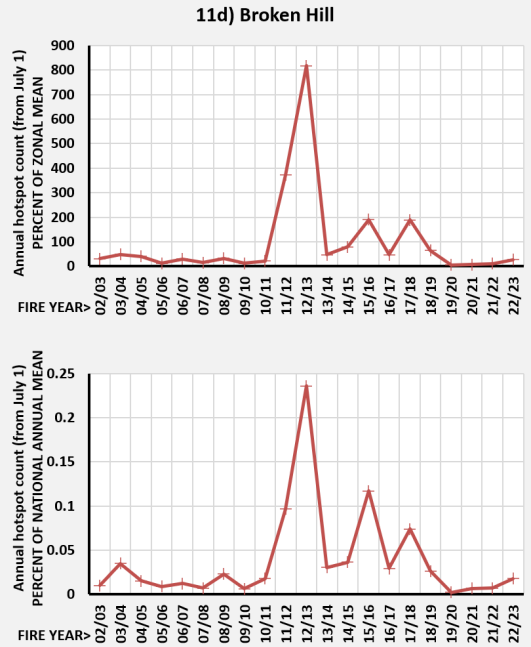
- Many years have low fire activity, with few near "zero".
- Large fire activity on a semi-decadal scale, mostly from long-time scale fires. The exception is in 2011 - 2012.

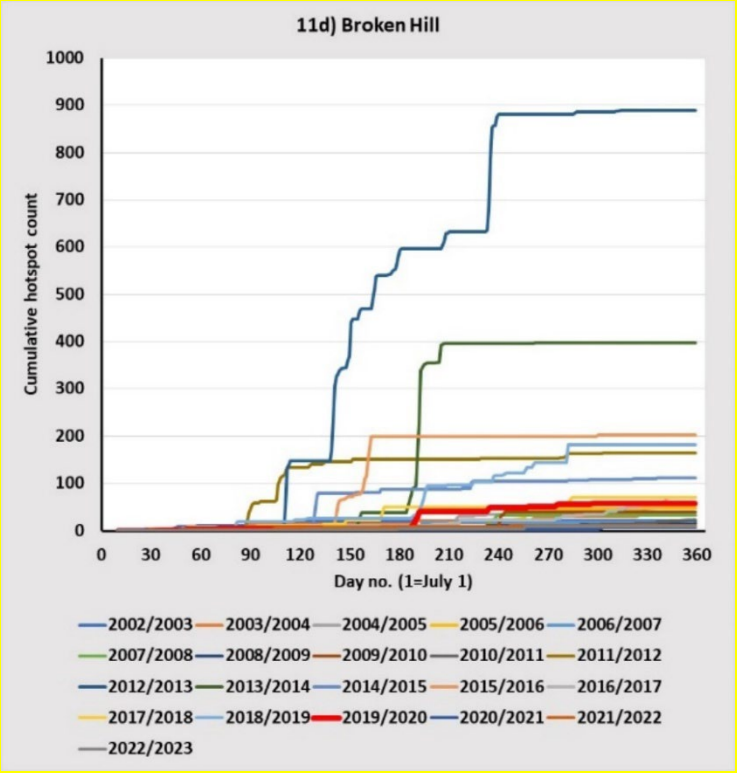


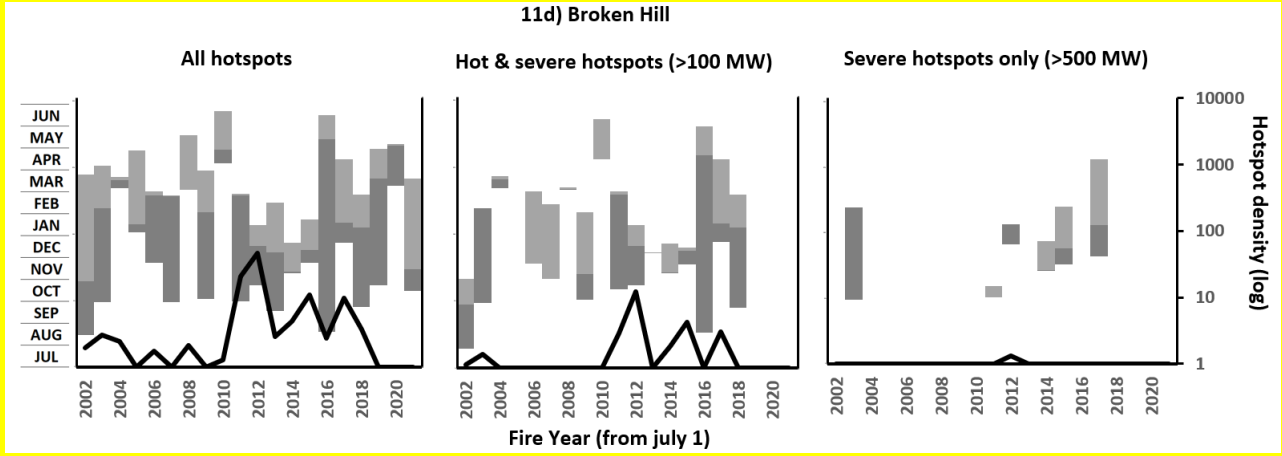
Dominated by Black Summer
Dominated by various active years
Longer-term activity swings
Major zig-zag swings
Dominated by end of Millenium Drought
Uniform

DOMINATED BY END OF MILLENIUM DROUGHT

11d) BROKEN HILL



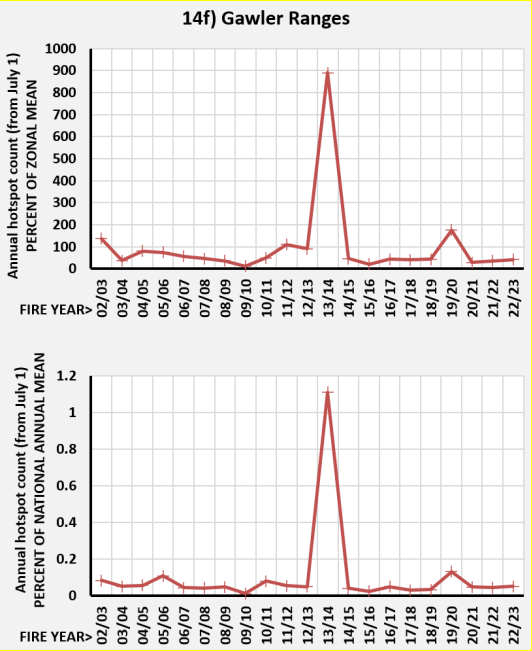


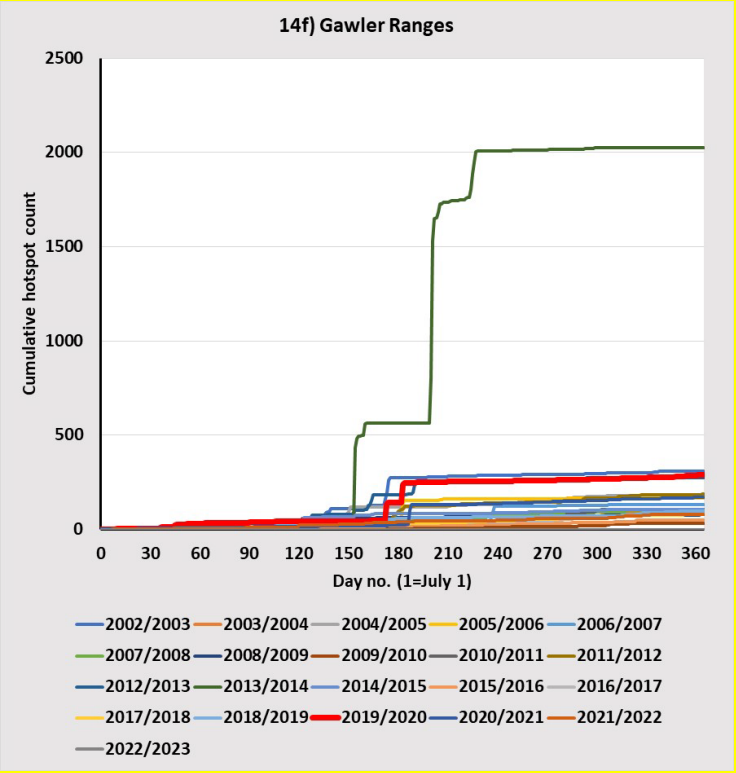


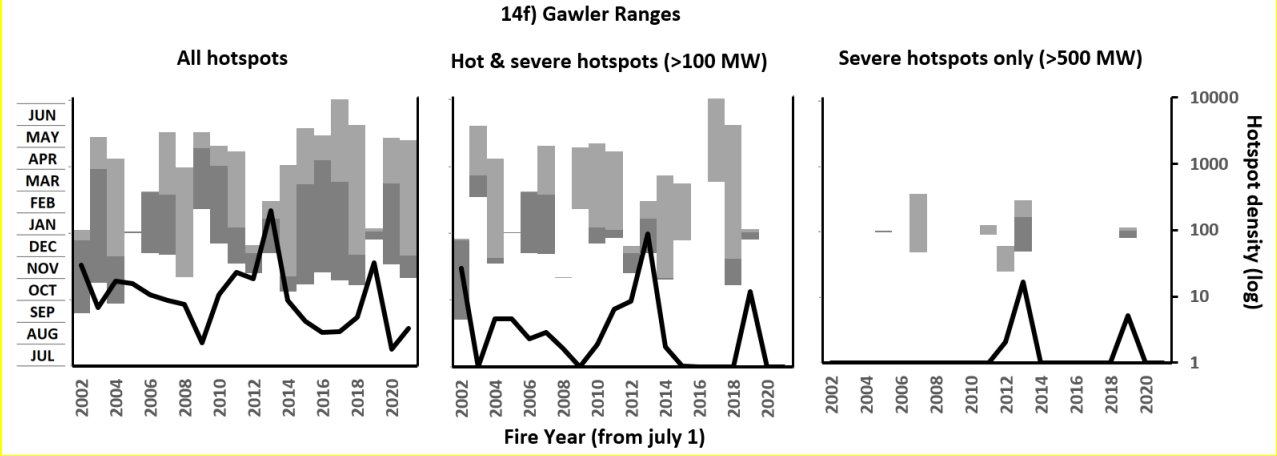
Dominated by Black Summer
Dominated by various active years
Longer-term activity swings
Major zig-zag swings
Dominated by end of Millenium Drought
Uniform

DOMINATED BY END OF MILLENIUM DROUGHT

14f) GAWLER RANGES



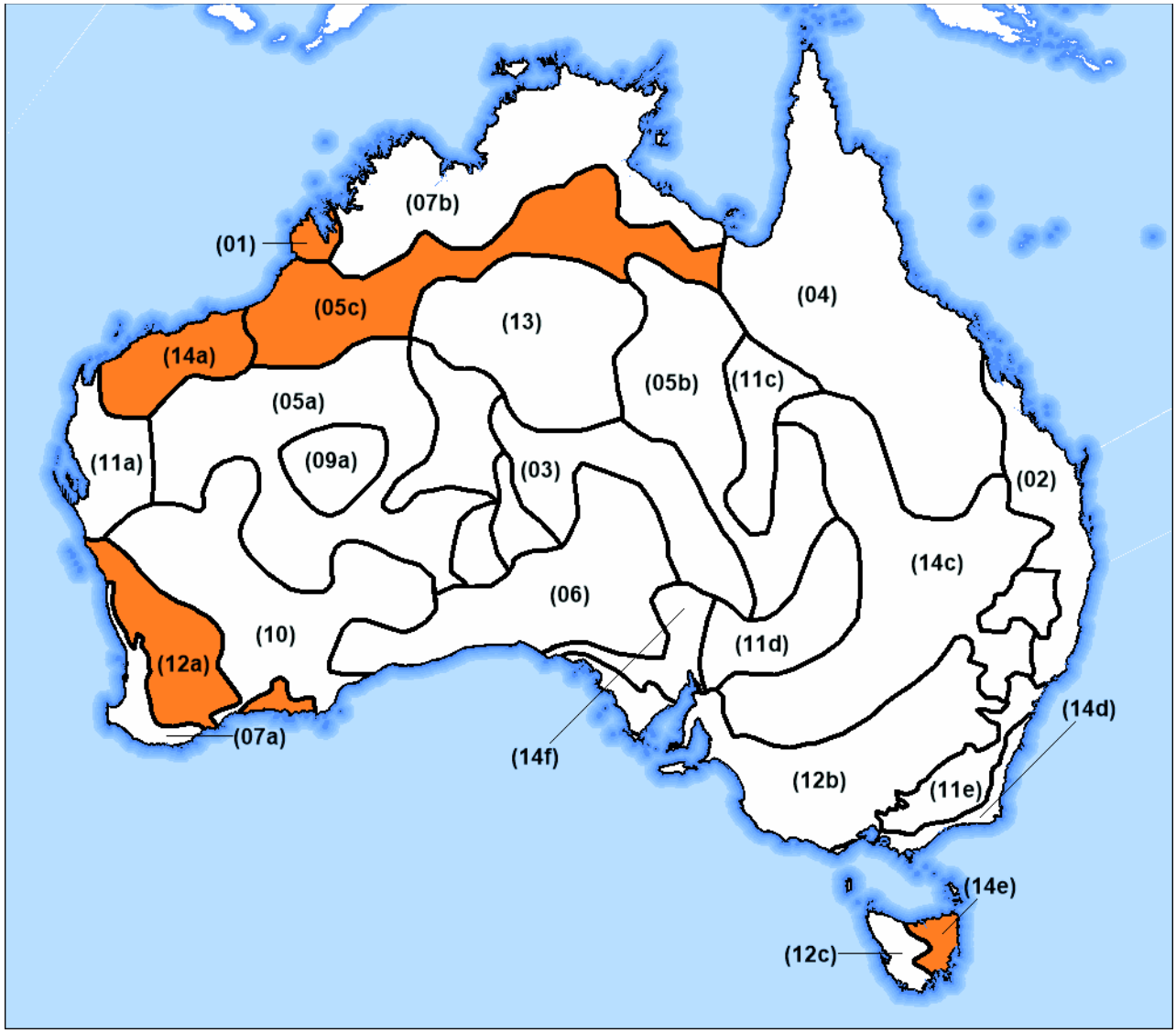


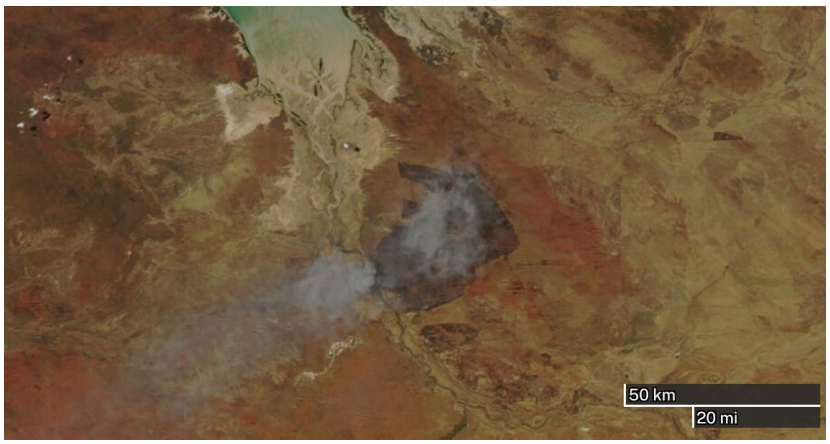


Dominated by Black Summer
Dominated by various active years
Longer-term activity swings
Major zig-zag swings
Dominated by end of Millenium Drought
Uniform

MAJOR ZIG-ZAG SWINGS

Oscillating between ***medium*** and high activity levels.



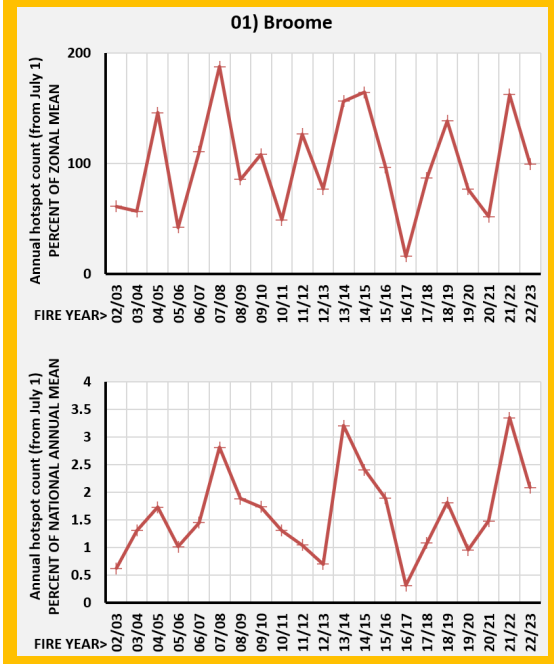


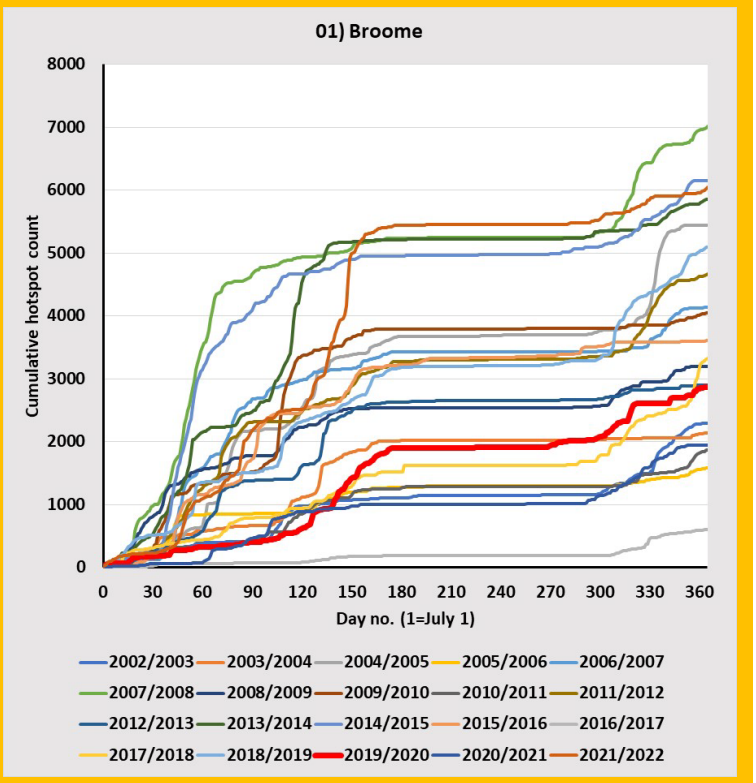
22/09/2015 -17.6° 123.8°

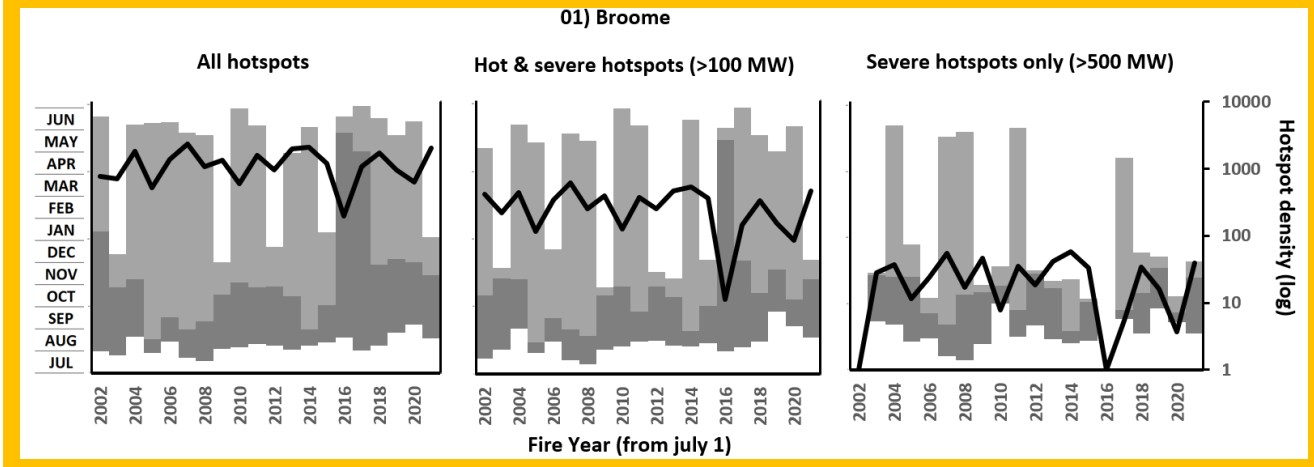
Dominated by Black Summer
Dominated by various active years
Longer-term activity swings
Major zig-zag swings
Dominated by end of Millenium Drought
Uniform

MAJOR ZIG-ZAG SWINGS

01) BROOME





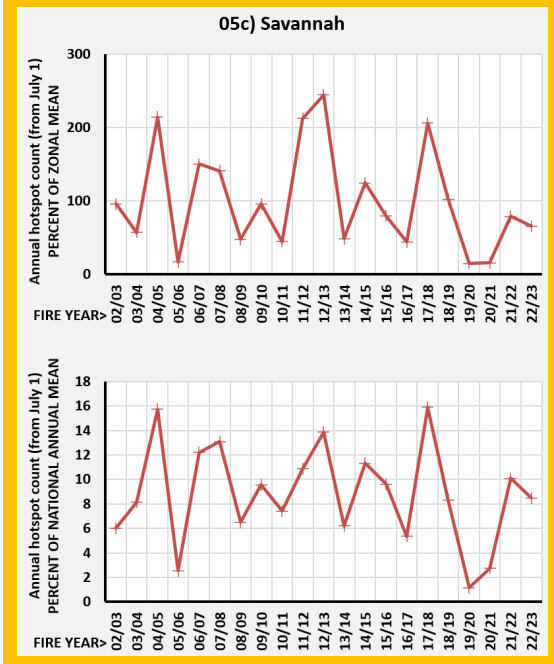


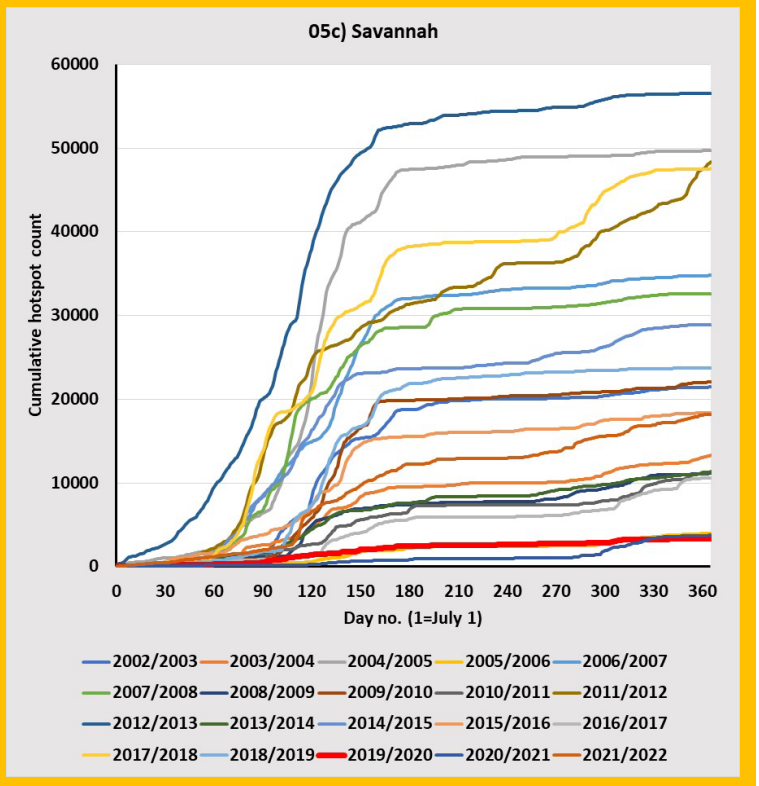
Winter fire season!!!!

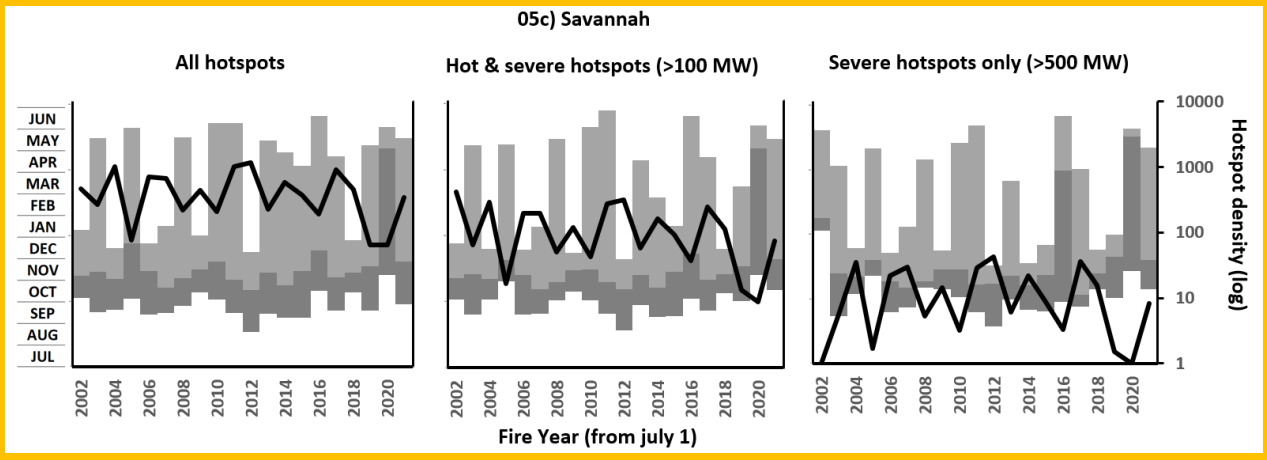
Dominated by Black Summer
Dominated by various active years
Longer-term activity swings
Major zig-zag swings
Dominated by end of Millenium Drought
Uniform

MAJOR ZIG-ZAG SWINGS

05c) SAVANNAH



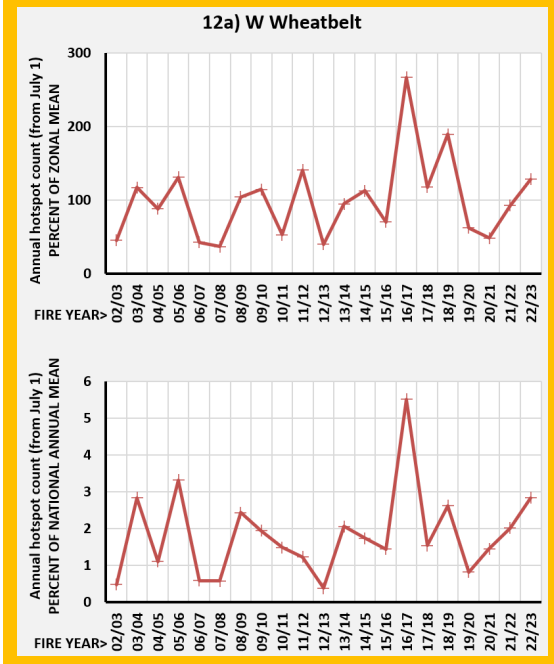


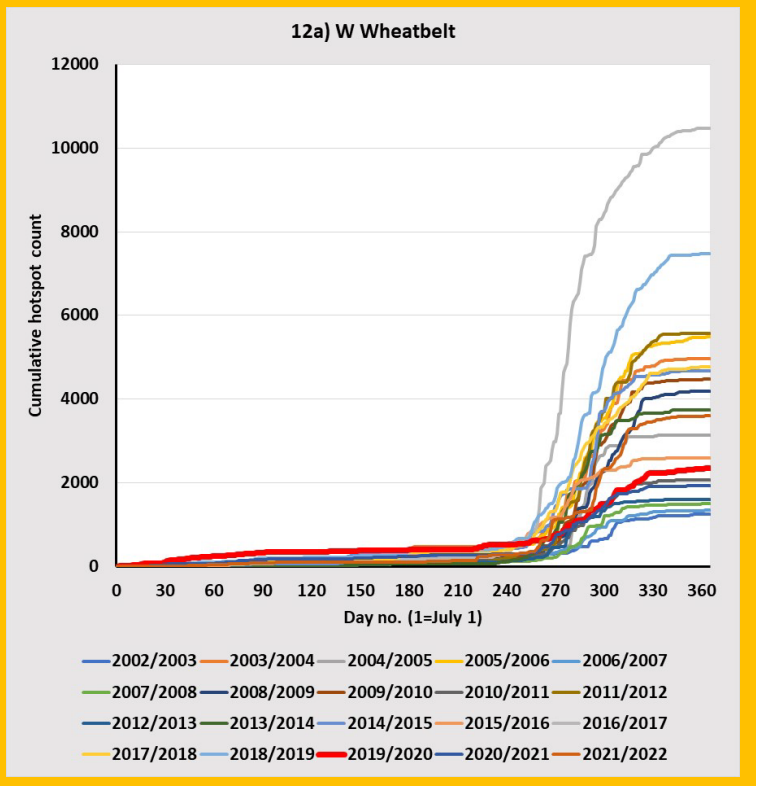


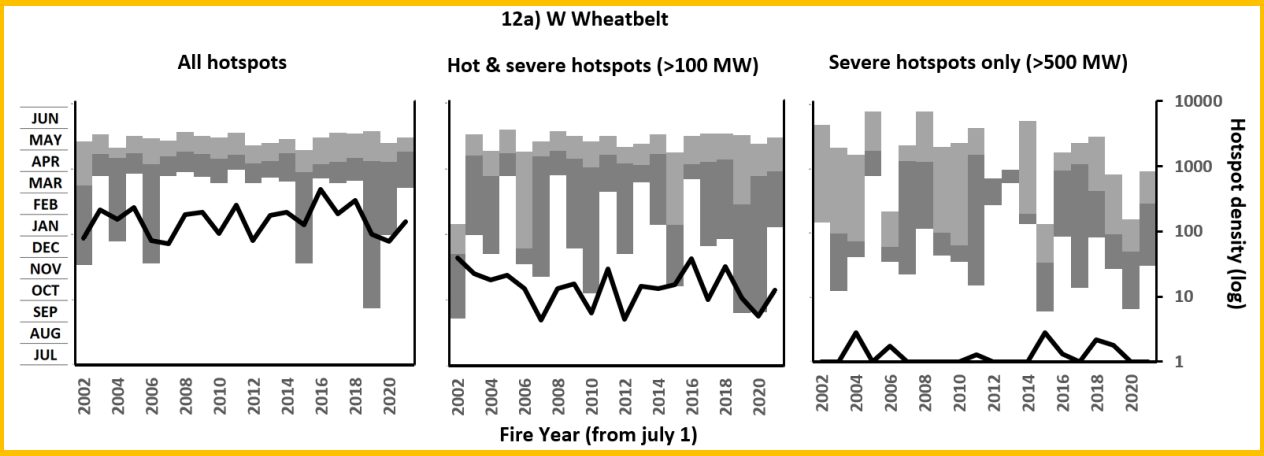
Dominated by Black Summer
Dominated by various active years
Longer-term activity swings
Major zig-zag swings
Dominated by end of Millenium Drought
Uniform

MAJOR ZIG-ZAG SWINGS

12a) W WHEATBELT



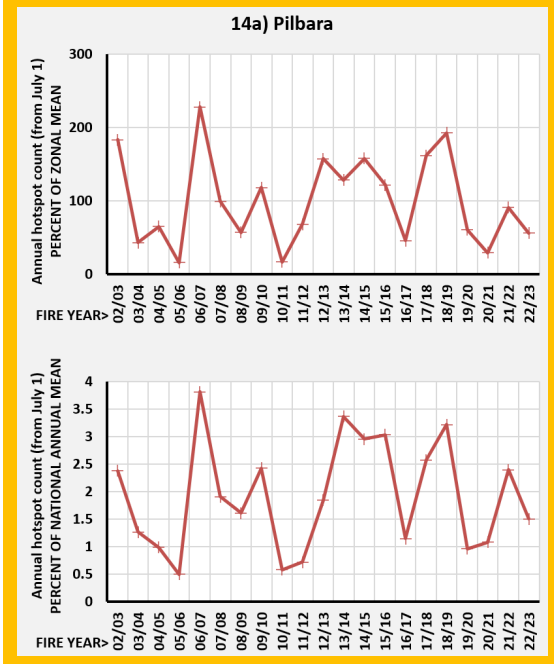


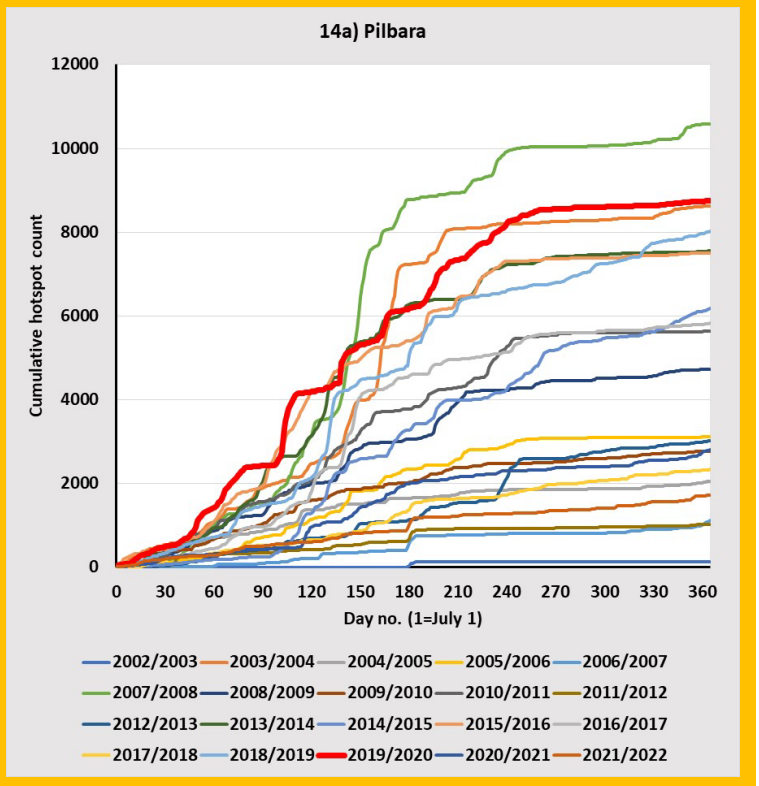


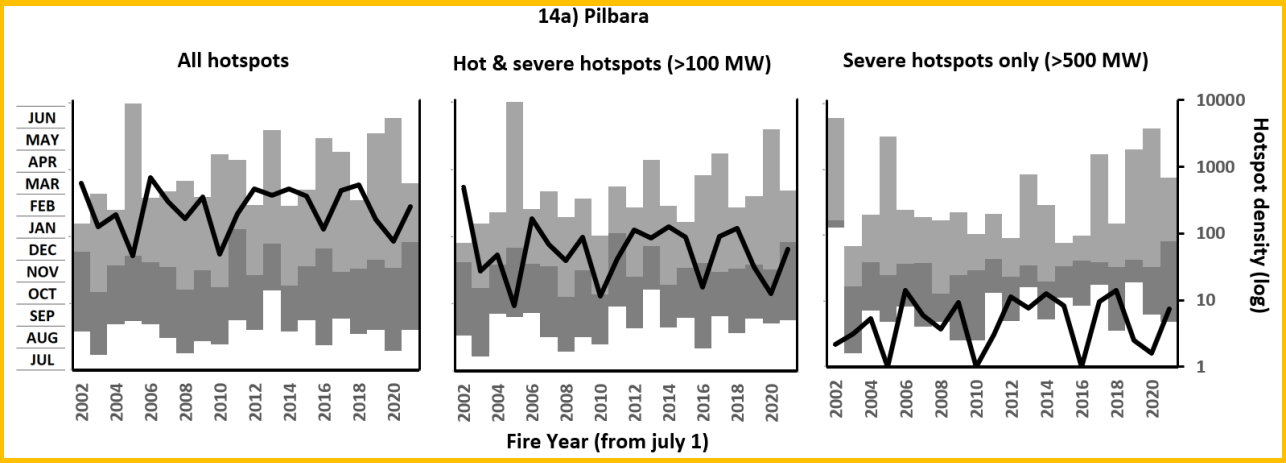
Dominated by Black Summer
Dominated by various active years
Longer-term activity swings
Major zig-zag swings
Dominated by end of Millenium Drought
Uniform

MAJOR ZIG-ZAG SWINGS

14a) PILBARA



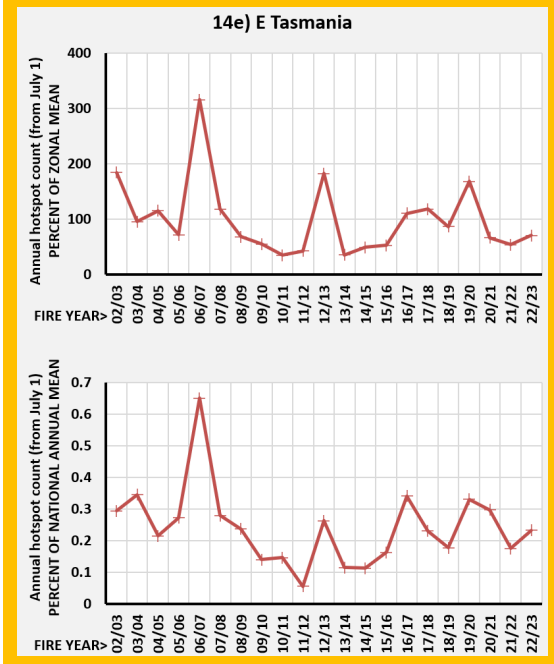


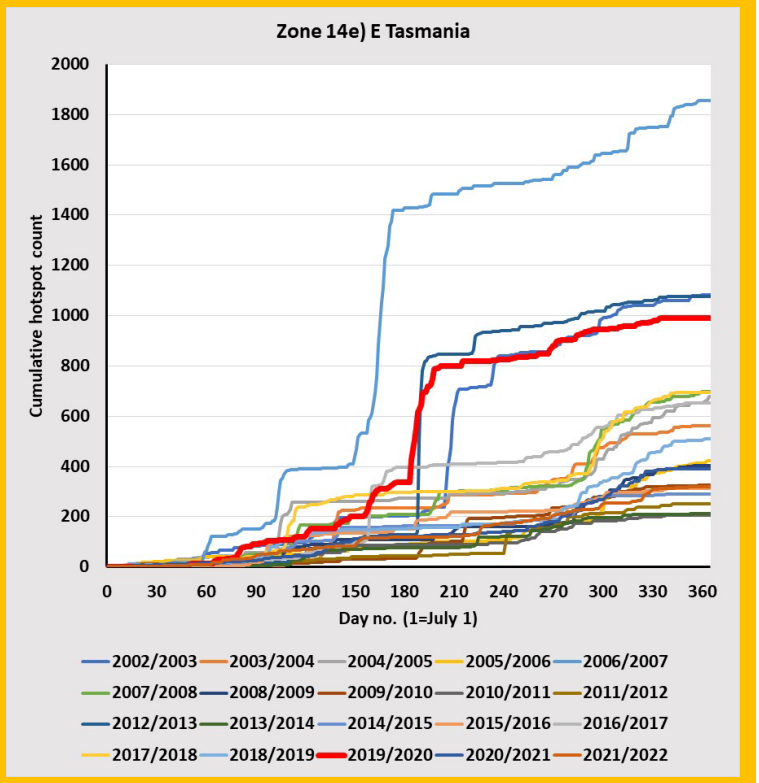


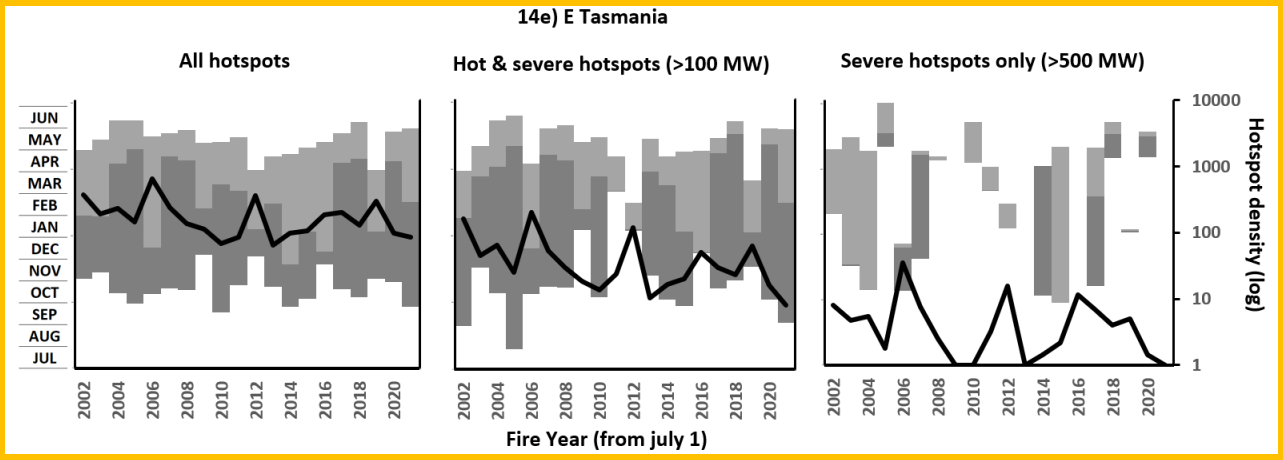
Dominated by Black Summer
Dominated by various active years
Longer-term activity swings
Major zig-zag swings
Dominated by end of Millenium Drought
Uniform

MAJOR ZIG-ZAG SWINGS

14e) E TASMANIA



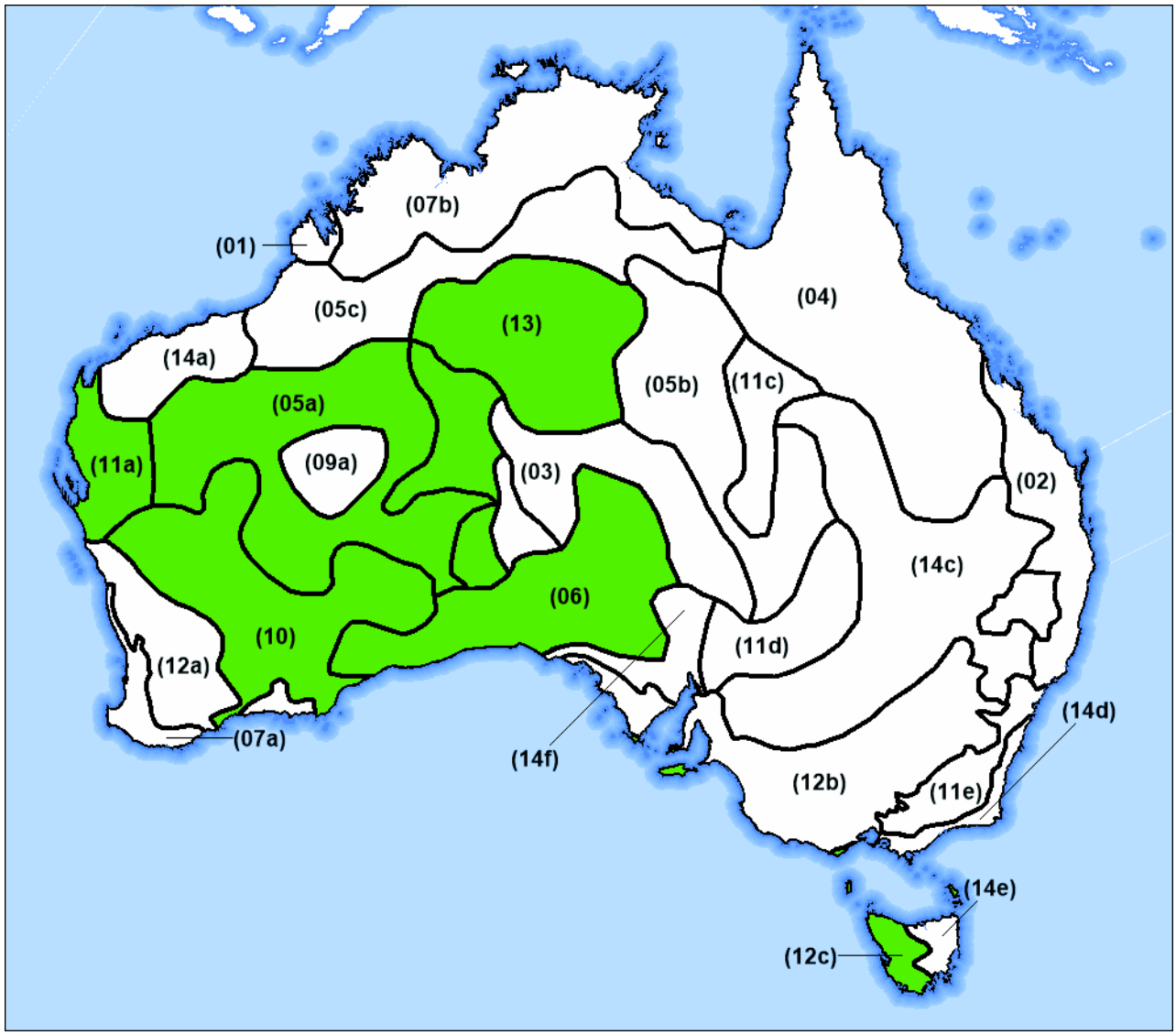


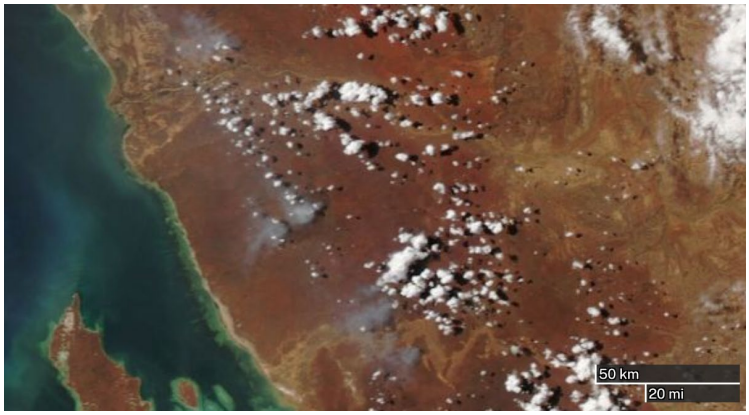


Dominated by Black Summer
Dominated by various active years
Longer-term activity swings
Major zig-zag swings
Dominated by end of Millenium Drought
Uniform

DOMINATED BY VARIOUS ACTIVE YEARS

Some inactive years (near zero), various active ones.



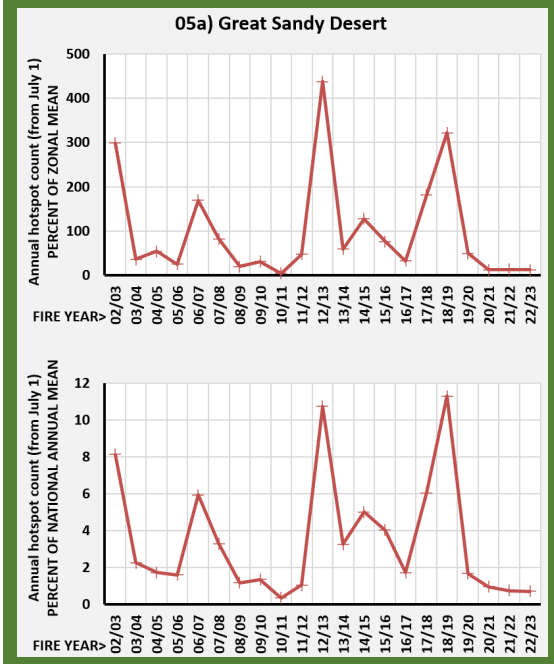


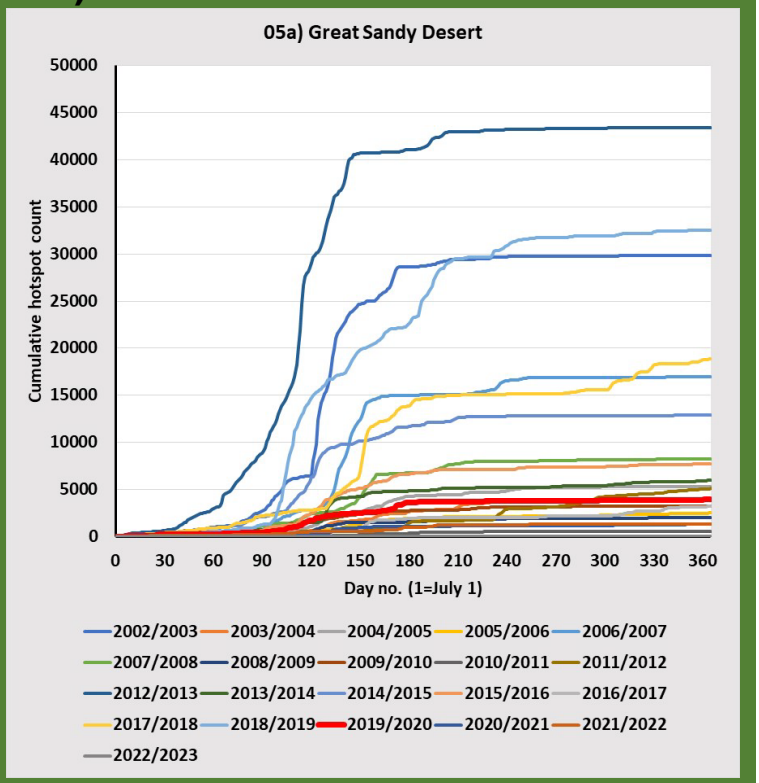
21/02/2012 -25.5° 114.6°

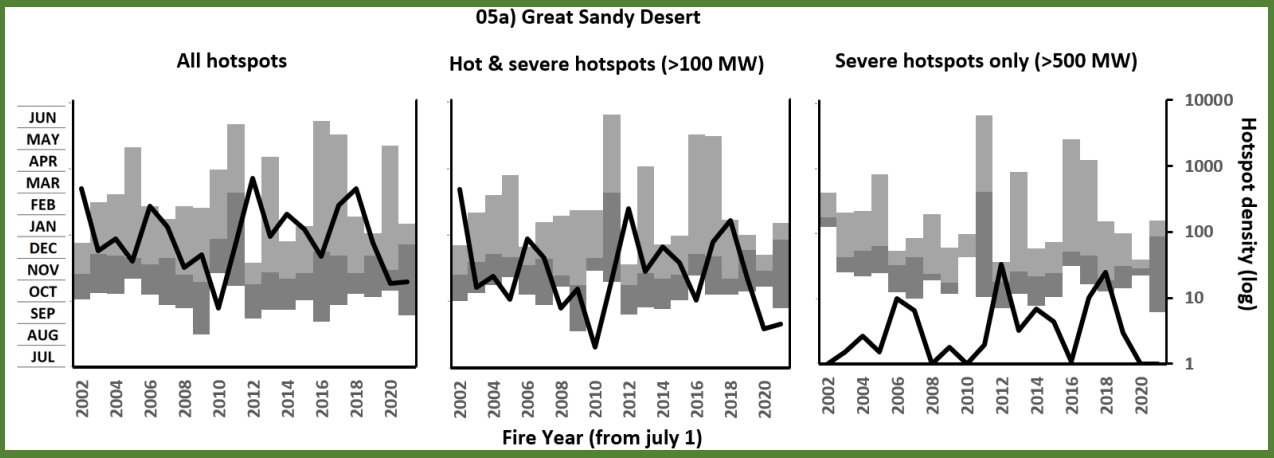
Dominated by Black Summer
Dominated by various active years
Longer-term activity swings
Major zig-zag swings
Dominated by end of Millenium Drought
Uniform

DOMINATED BY VARIOUS ACTIVE YEARS

05a) GREAT SANDY DESERT



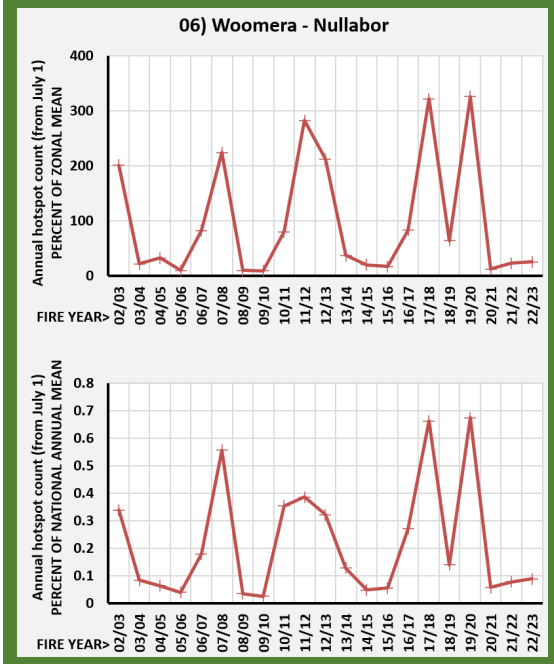


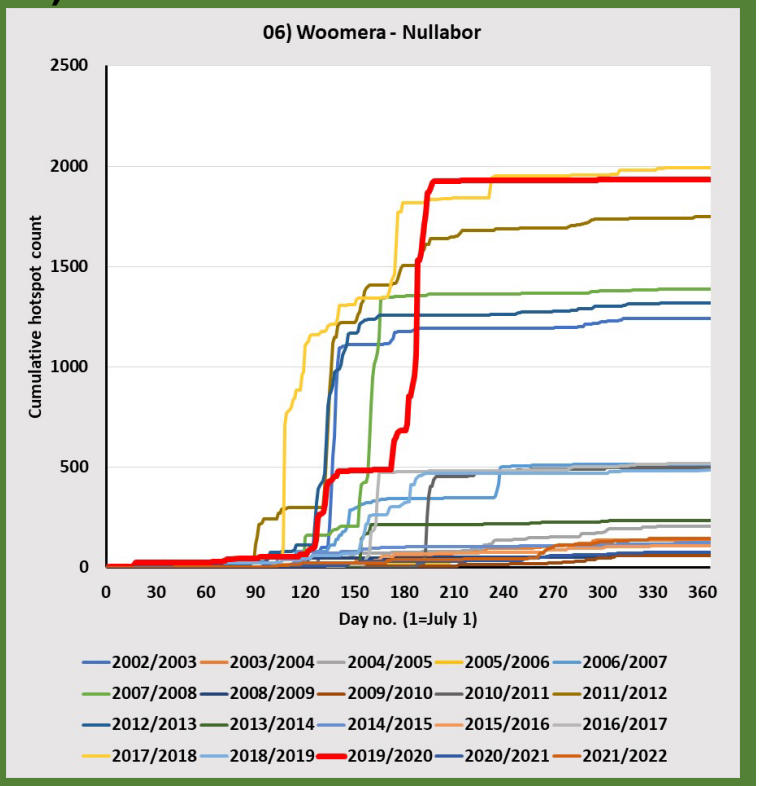


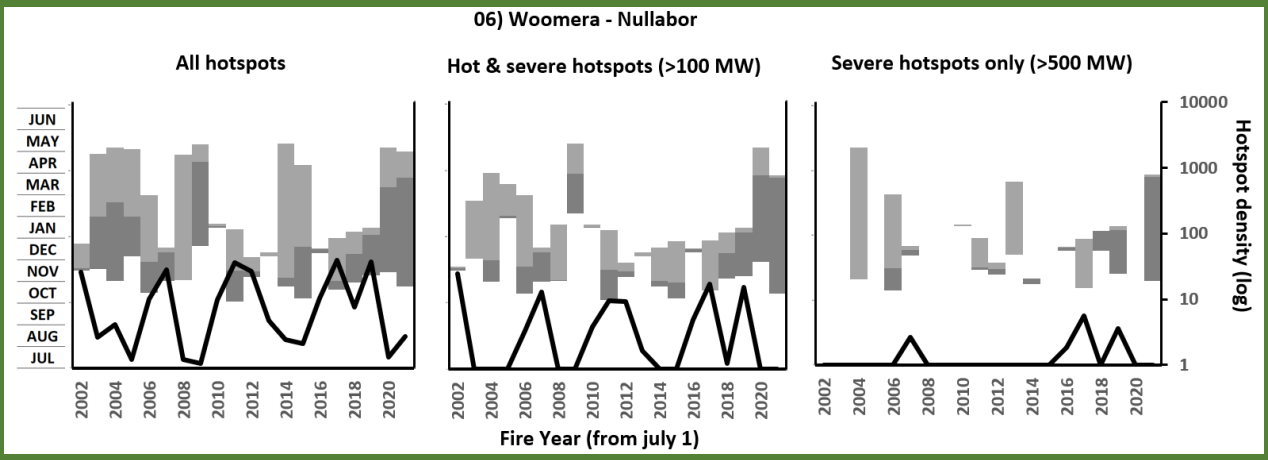
Dominated by Black Summer
Dominated by various active years
Longer-term activity swings
Major zig-zag swings
Dominated by end of Millenium Drought
Uniform

DOMINATED BY VARIOUS ACTIVE YEARS

06) WOOMERA-NULLABOR



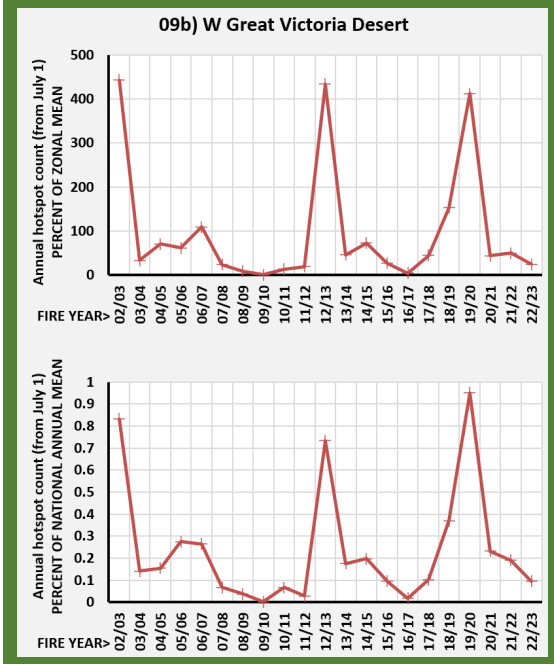


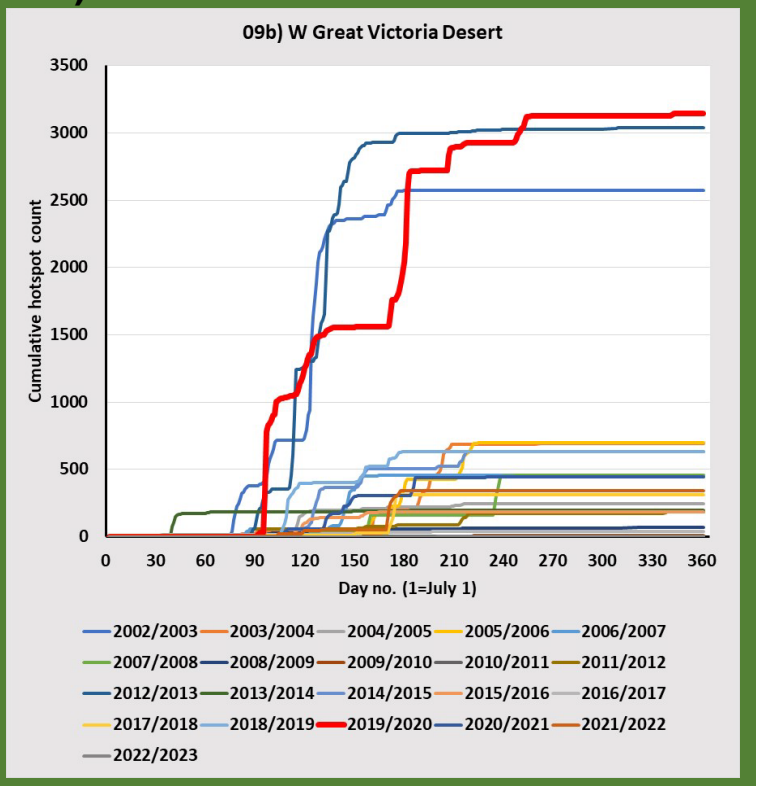


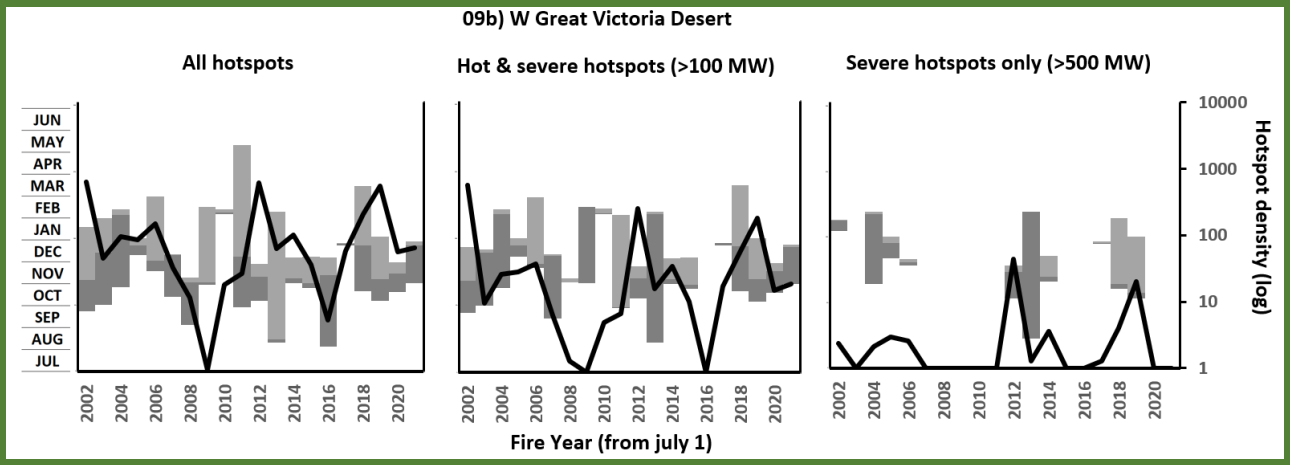
Dominated by Black Summer
Dominated by various active years
Longer-term activity swings
Major zig-zag swings
Dominated by end of Millenium Drought
Uniform

DOMINATED BY VARIOUS ACTIVE YEARS

09b) GREAT VICTORIA DESERT



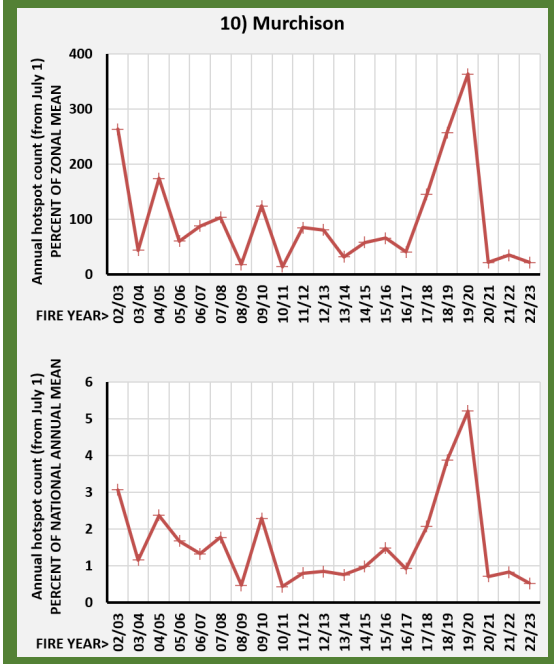


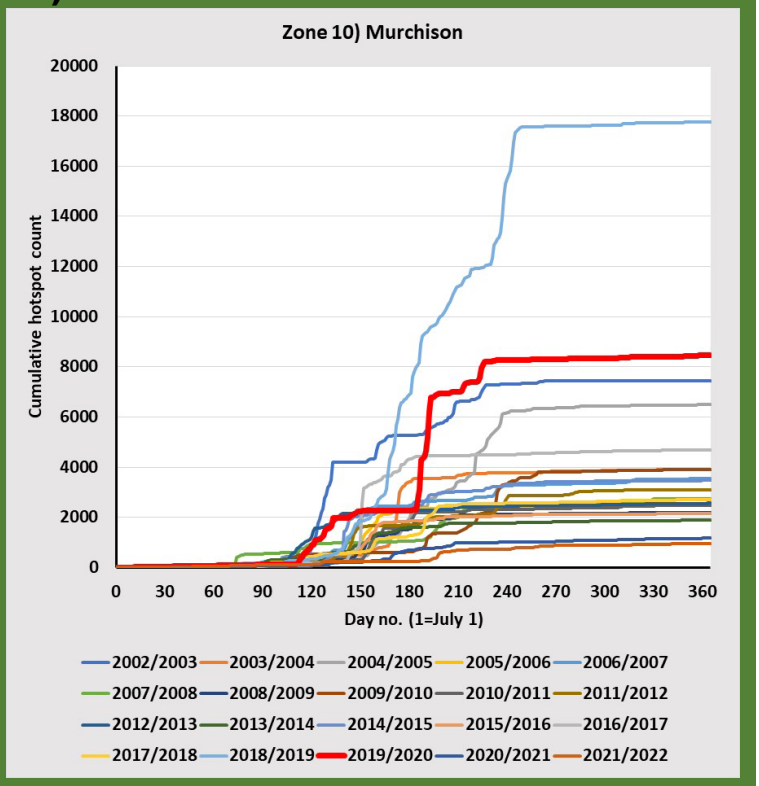


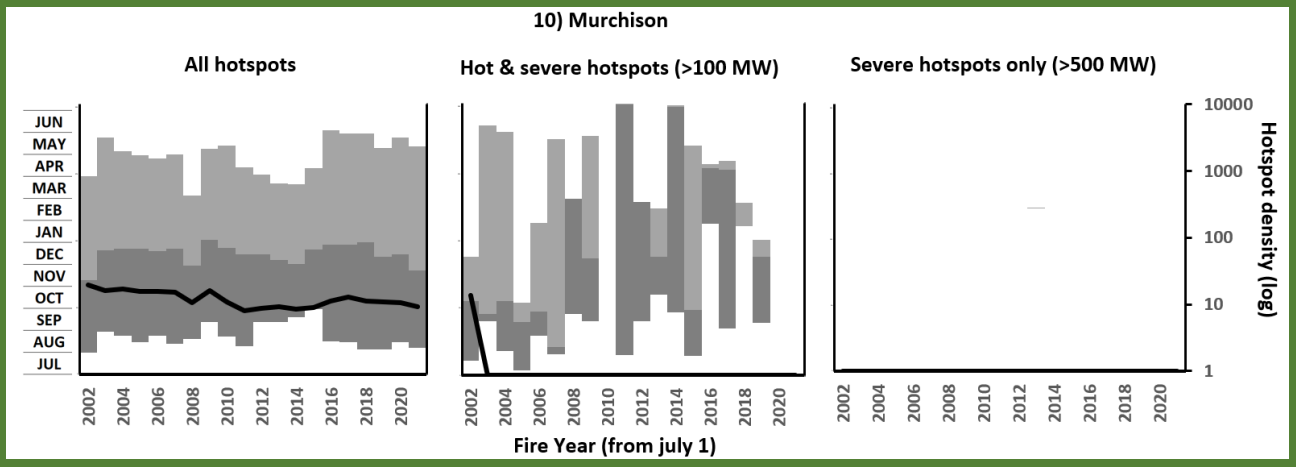
Dominated by Black Summer
Dominated by various active years
Longer-term activity swings
Major zig-zag swings
Dominated by end of Millenium Drought
Uniform

DOMINATED BY VARIOUS ACTIVE YEARS

10) MURCHISON



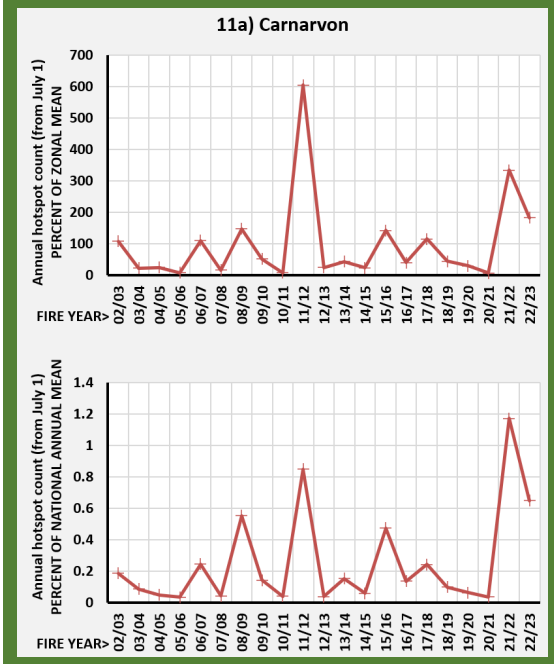




Dominated by Black Summer
Dominated by various active years
Longer-term activity swings
Major zig-zag swings
Dominated by end of Millenium Drought
Uniform

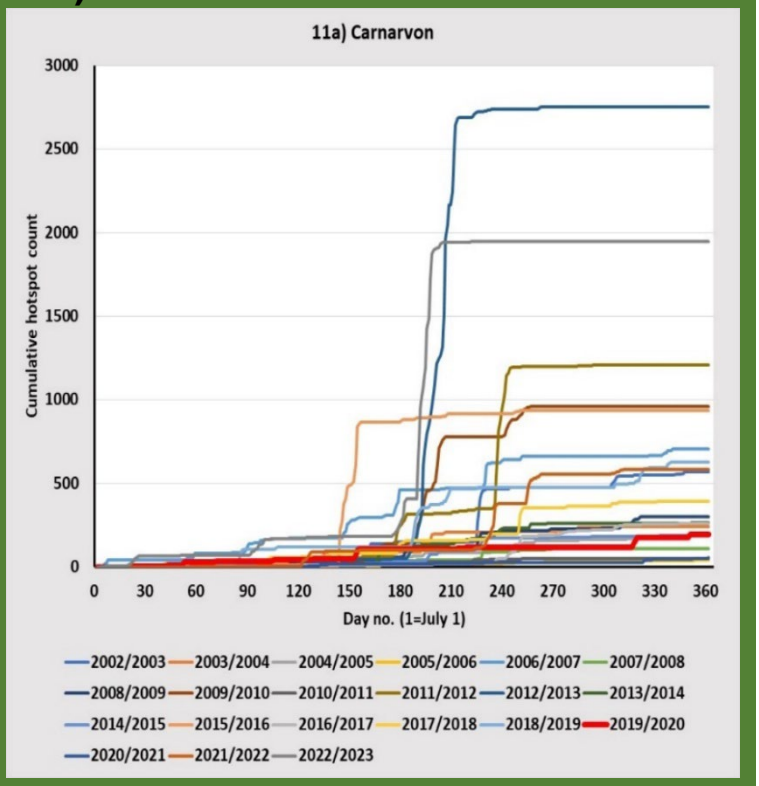
DOMINATED BY VARIOUS ACTIVE YEARS

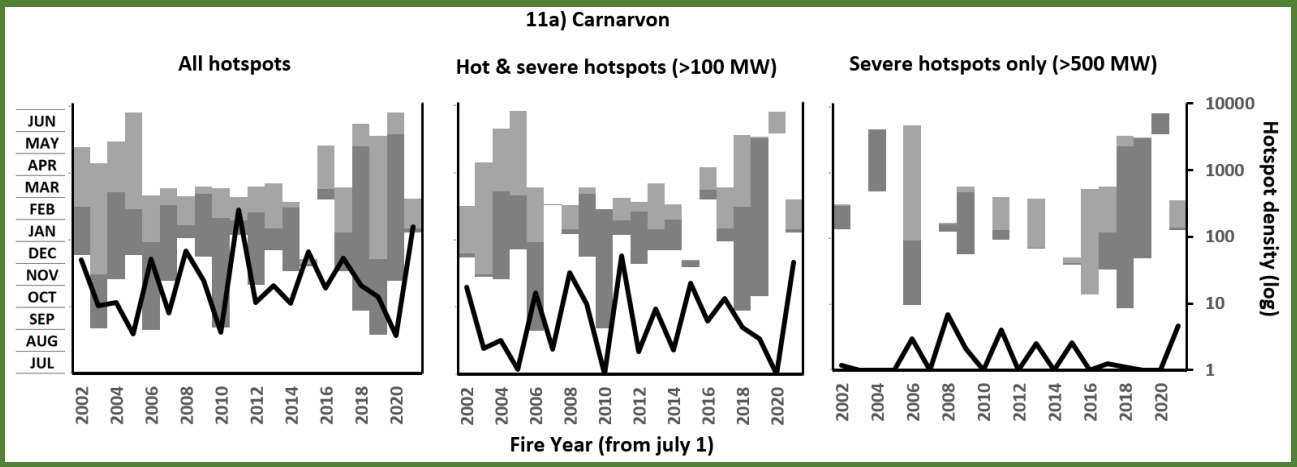
11a) CARNARVON



^^^CHECK^^^

6536





Dominated by Black Summer

Dominated by various active years

Longer-term activity swings

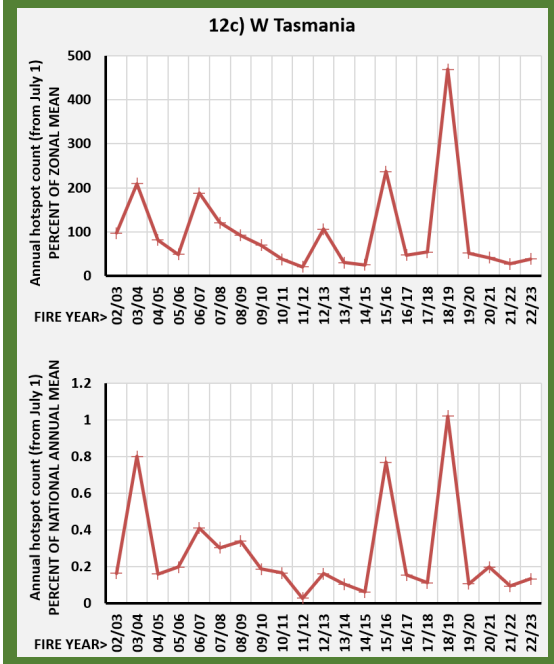
Major zig-zag swings

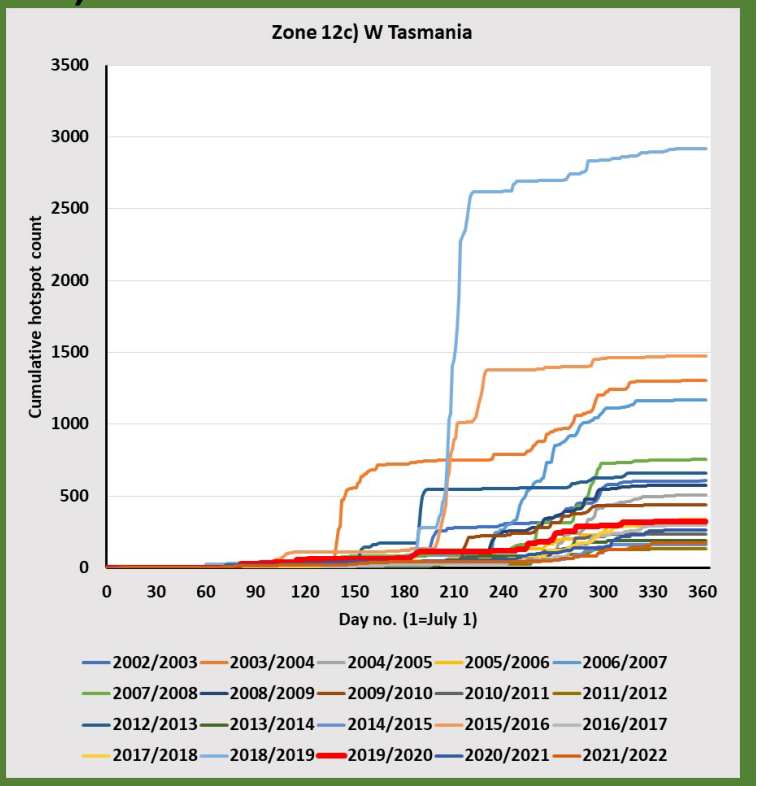
Dominated by end of Millenium Drought

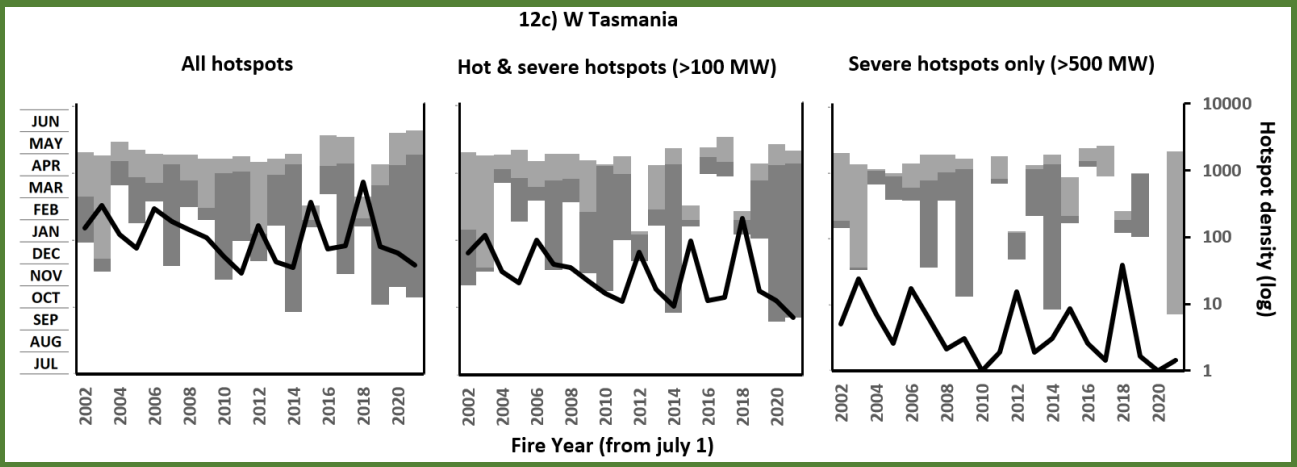
Uniform

DOMINATED BY VARIOUS ACTIVE YEARS

12c) W TASMANIA



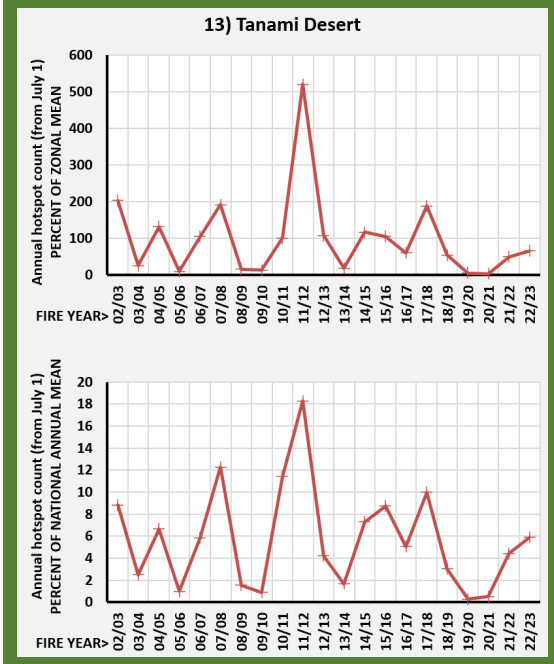


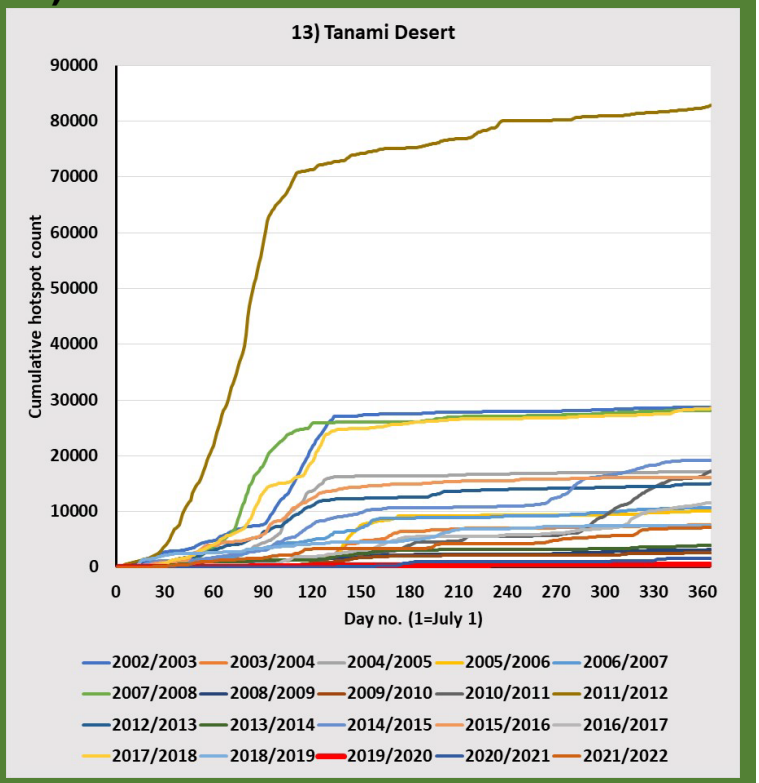


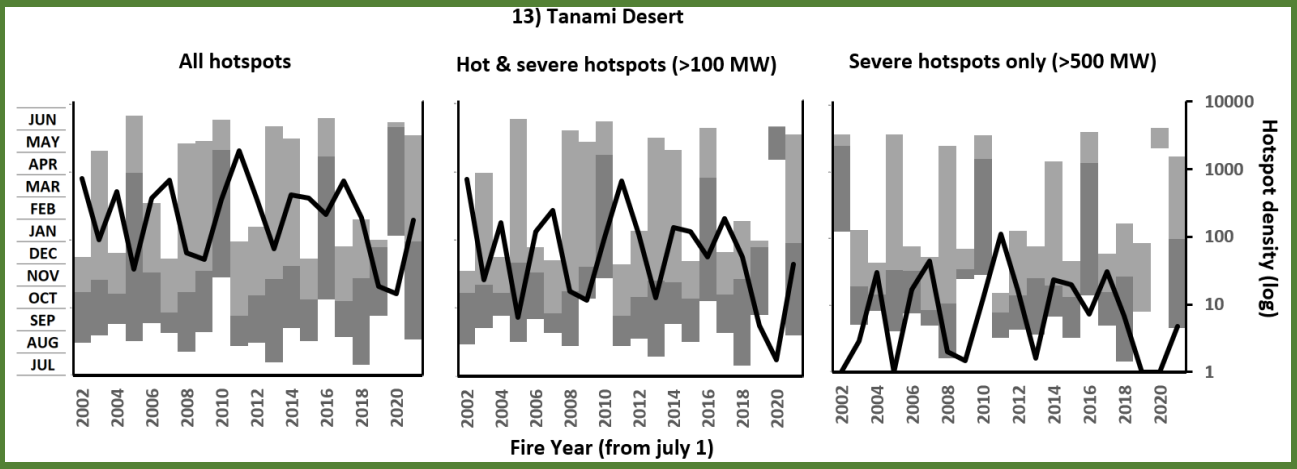
Dominated by Black Summer
Dominated by various active years
Longer-term activity swings
Major zig-zag swings
Dominated by end of Millenium Drought
Uniform

DOMINATED BY VARIOUS ACTIVE YEARS

13) TANAMI DESERT



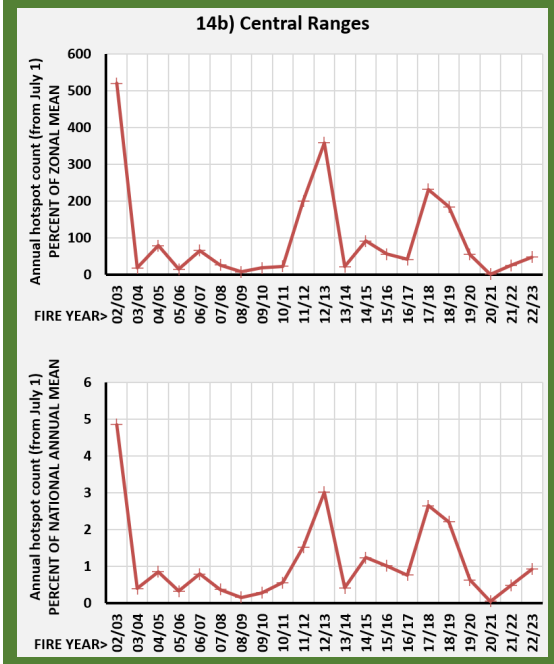


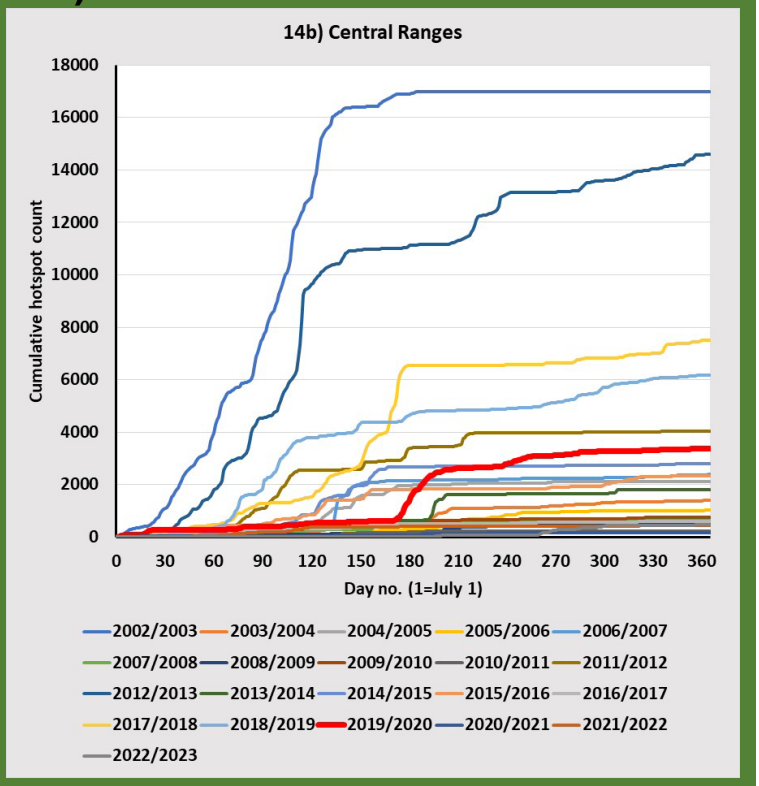


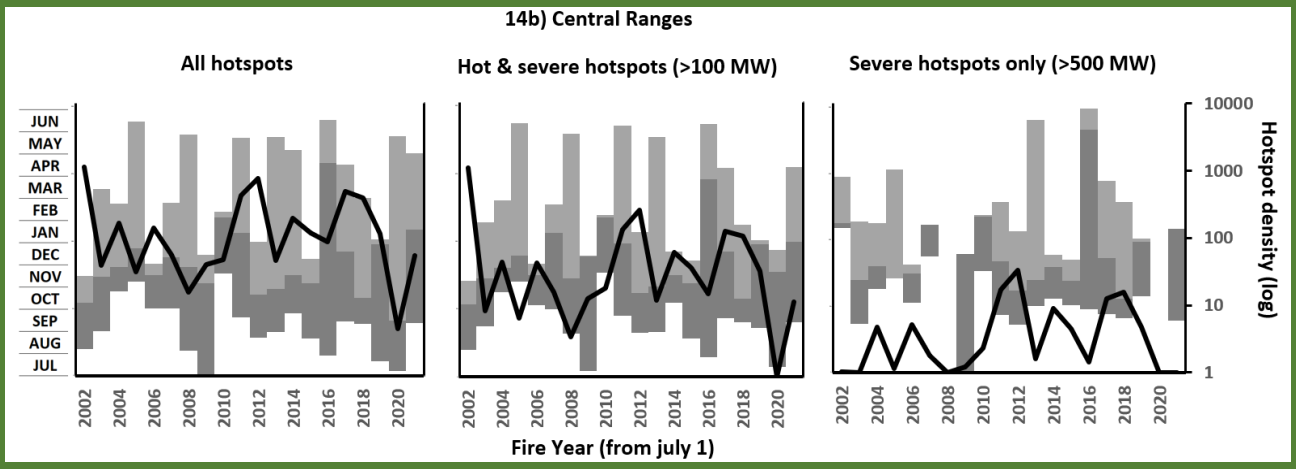
Dominated by Black Summer
Dominated by various active years
Longer-term activity swings
Major zig-zag swings
Dominated by end of Millenium Drought
Uniform

DOMINATED BY VARIOUS ACTIVE YEARS

14b) CENTRAL RANGES



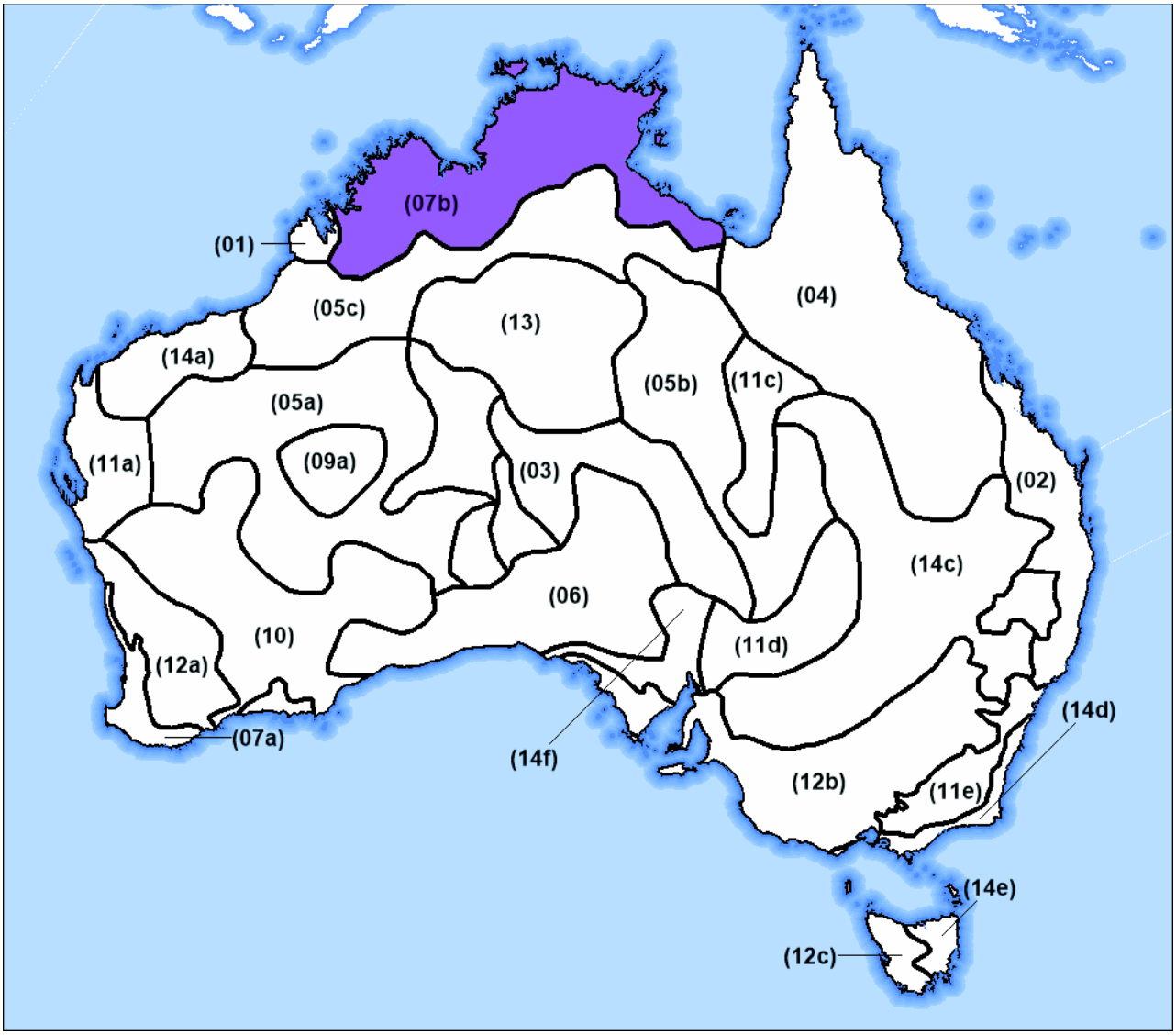




Dominated by Black Summer
Dominated by various active years
Longer-term activity swings
Major zig-zag swings
Dominated by end of Millenium Drought
Uniform

UNIFORM PATTERN

Little inter-annual variation.



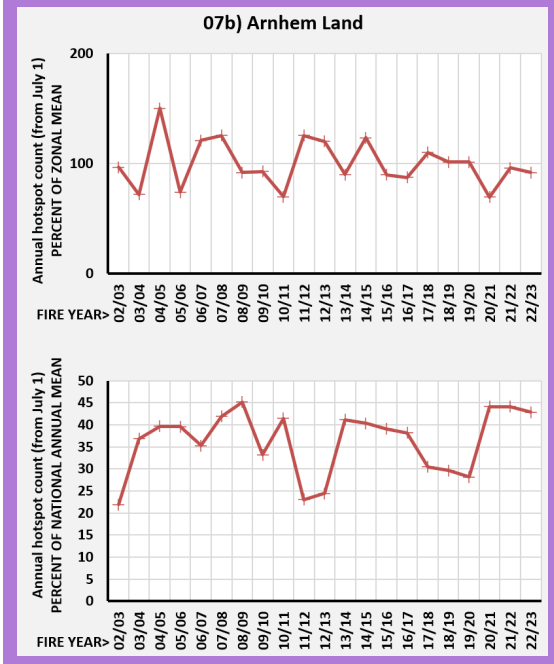
26/05/2012; -14° 132°

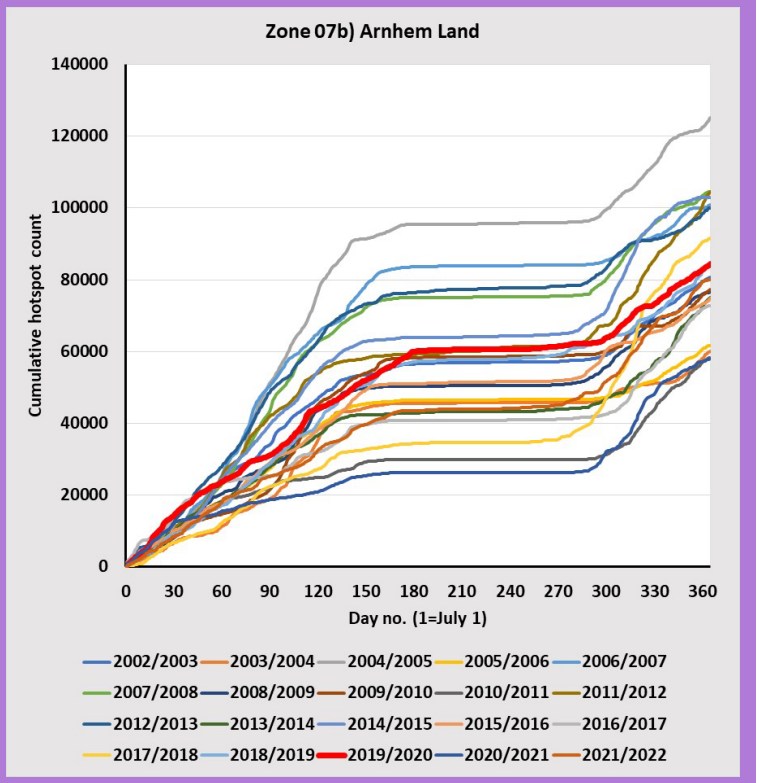
Dominated by Black Summer | Longer-term activity swings | Dominated by end of Millenium Drought

Dominated by various active years | Major zig-zag swings | Uniform

UNIFORM PATTERN

07b) ARNHAM LAND

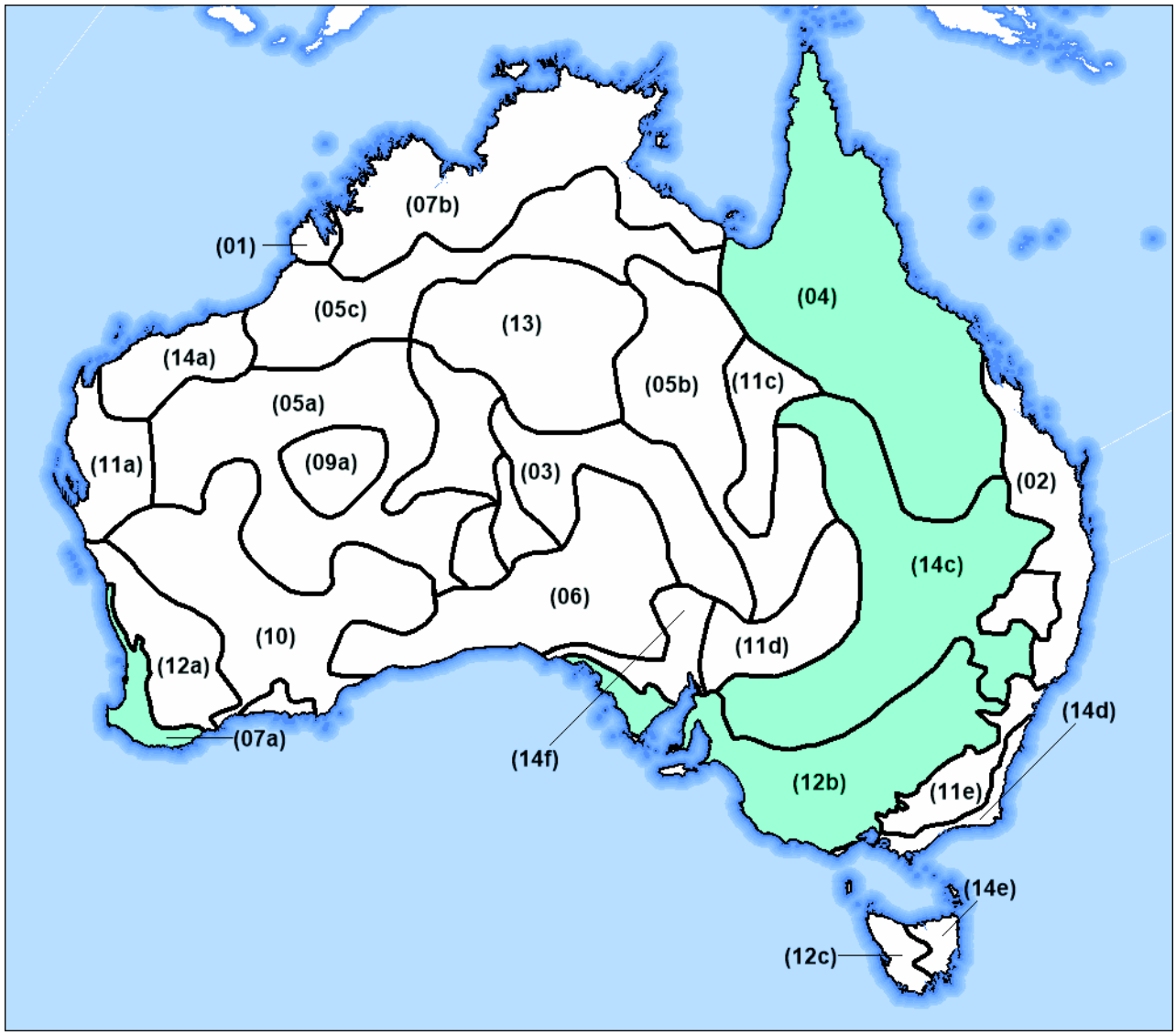




Dominated by Black Summer
Dominated by various active years
Longer-term activity swings
Major zig-zag swings
Dominated by end of Millenium Drought
Uniform

LONGER-TERM ACTIVITY SWINGS

Variations on a 5 year, or longer, scale.

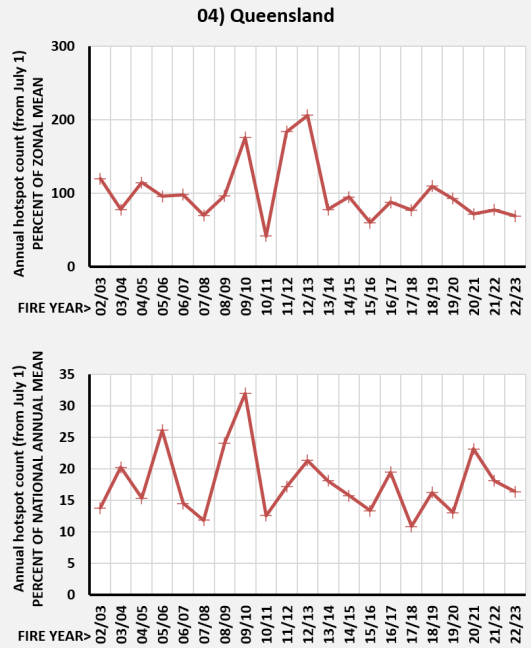


06/01/2013; -36.7° 146.3°

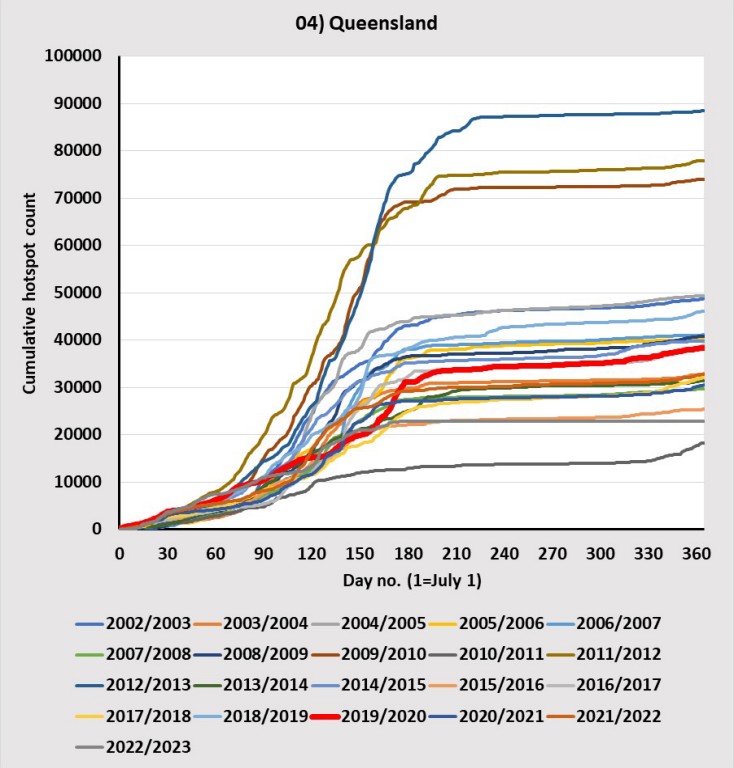
Dominated by Black Summer
Dominated by various active years
Longer-term activity swings
Major zig-zag swings
Dominated by end of Millenium Drought
Uniform

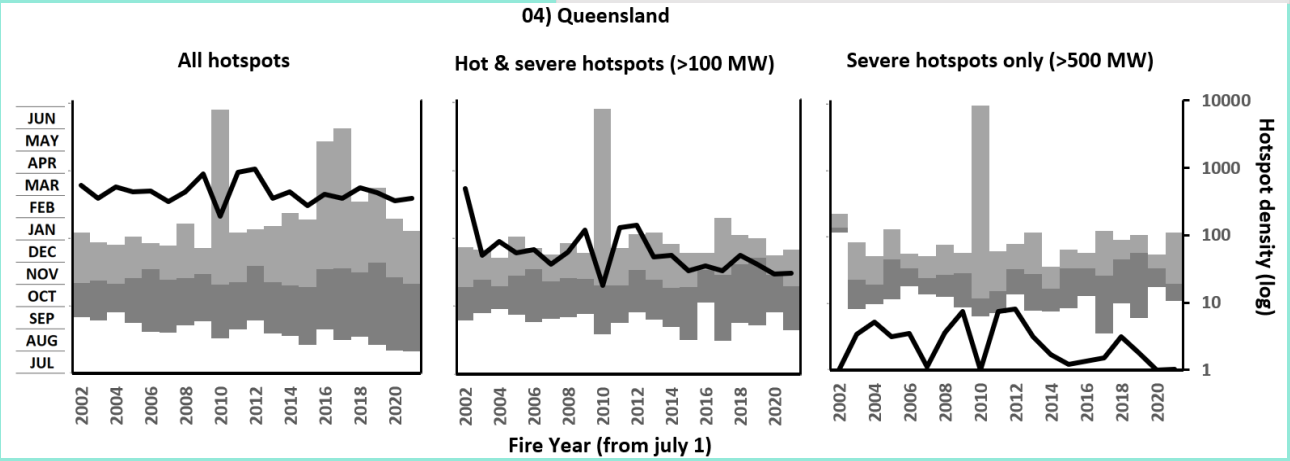
LONGER-TERM ACTIVITY SWINGS

04) QUEENSLAND



- A fairly constant baseline.
- Large swings around the Millenium Drought, but over four years.

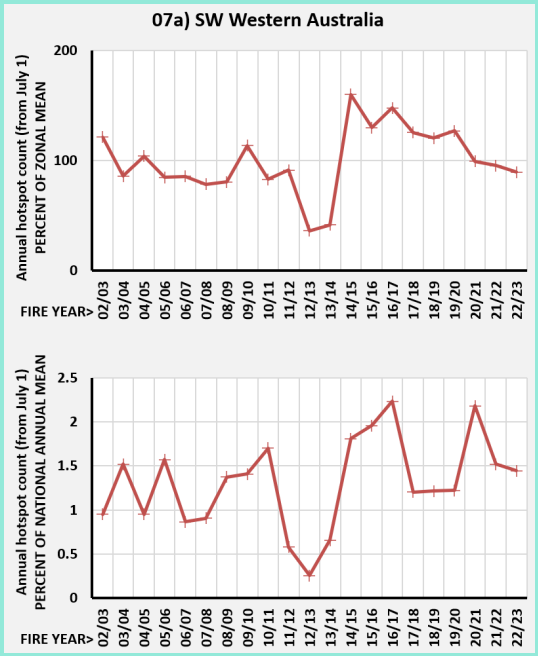


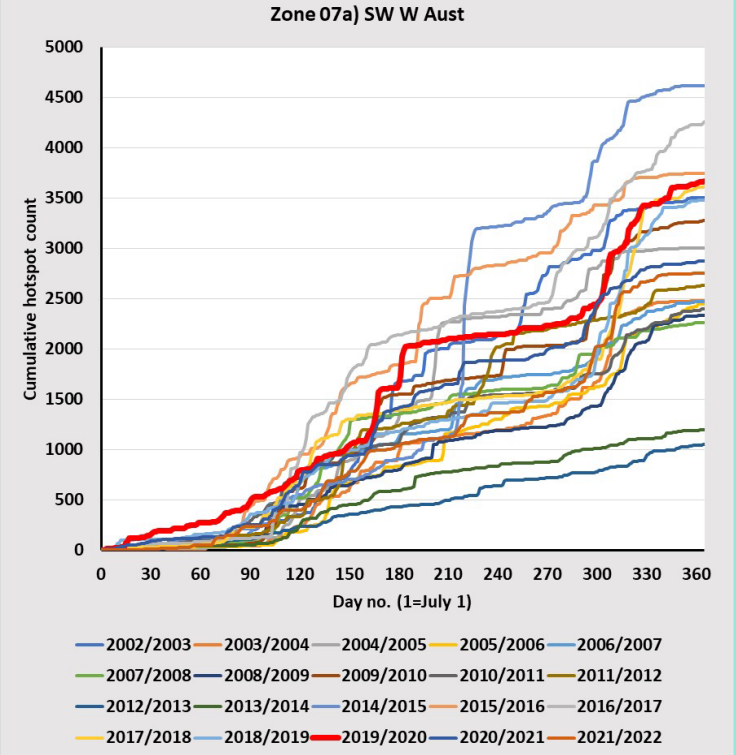


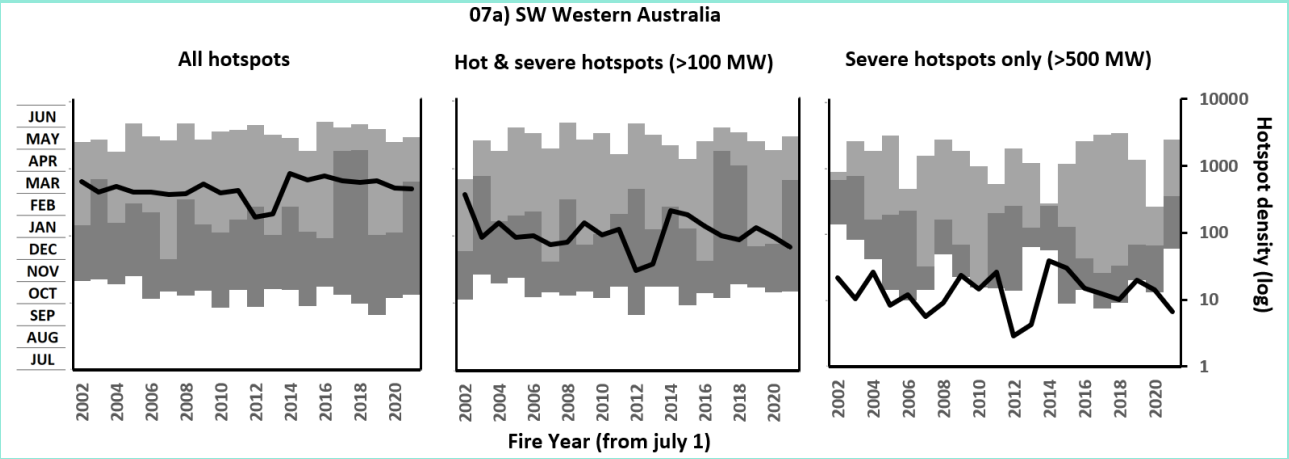
Dominated by Black Summer
Dominated by various active years
Longer-term activity swings
Major zig-zag swings
Dominated by end of Millenium Drought
Uniform

LONGER-TERM ACTIVITY SWINGS

07a) SW WESTERN AUSTRALIA



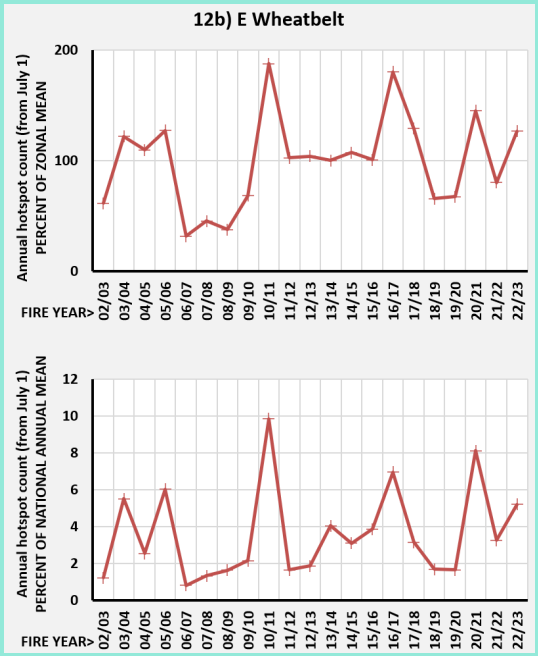


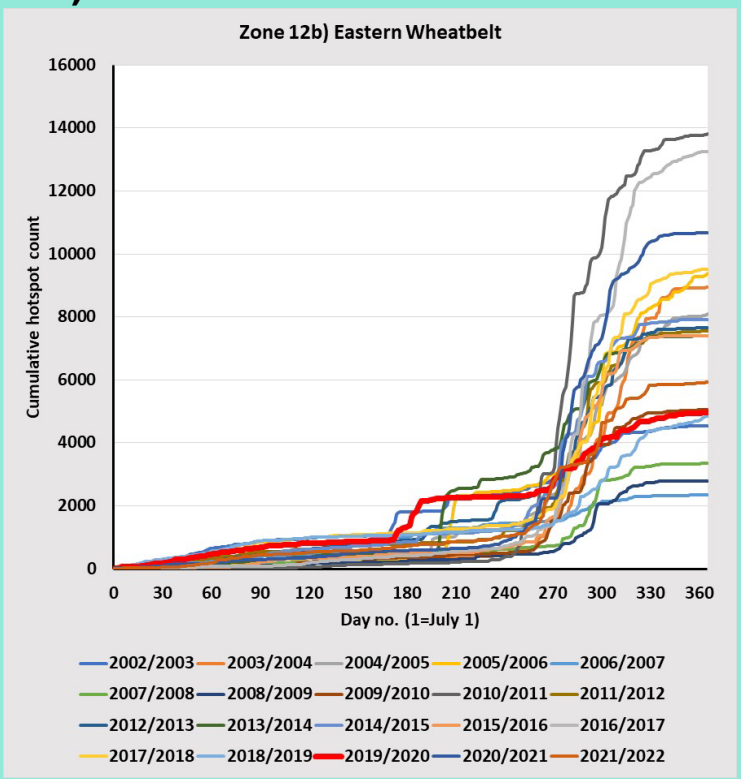


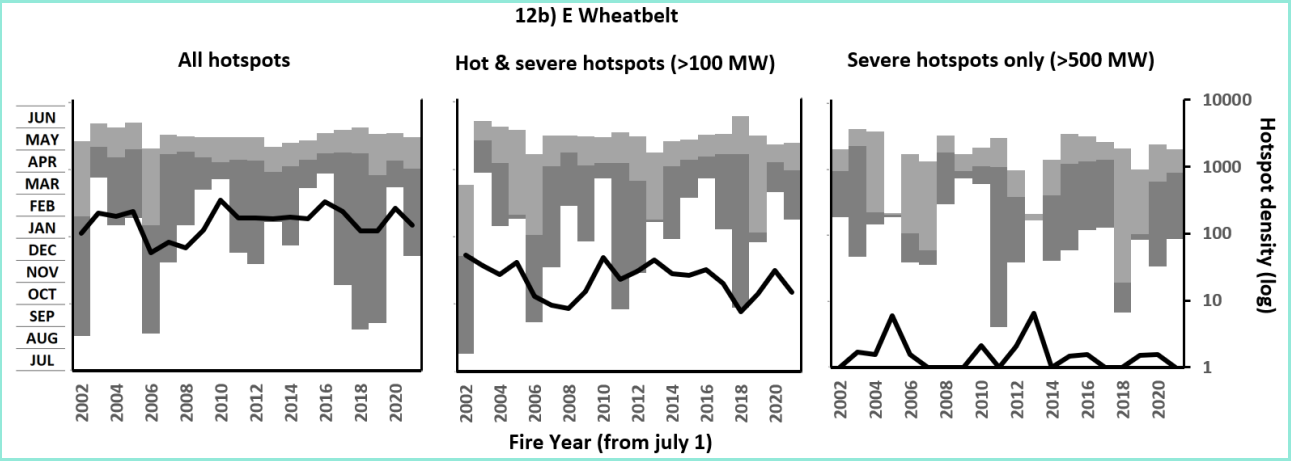
Dominated by Black Summer
Dominated by various active years
Longer-term activity swings
Major zig-zag swings
Dominated by end of Millenium Drought
Uniform

LONGER-TERM ACTIVITY SWINGS

12b) W WHEATBELT



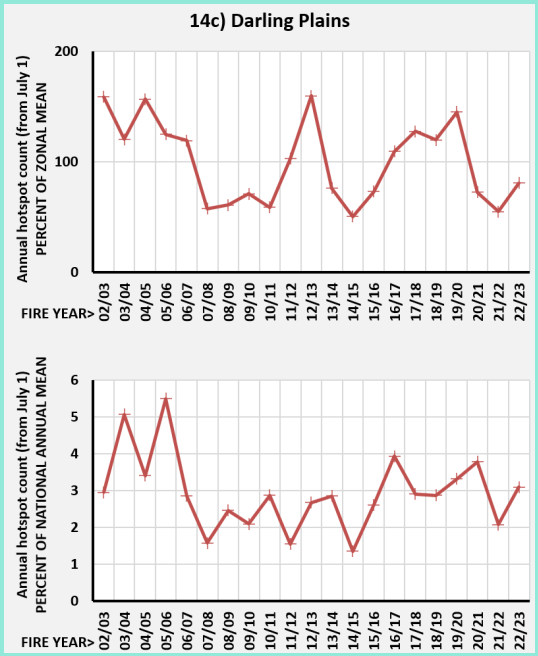


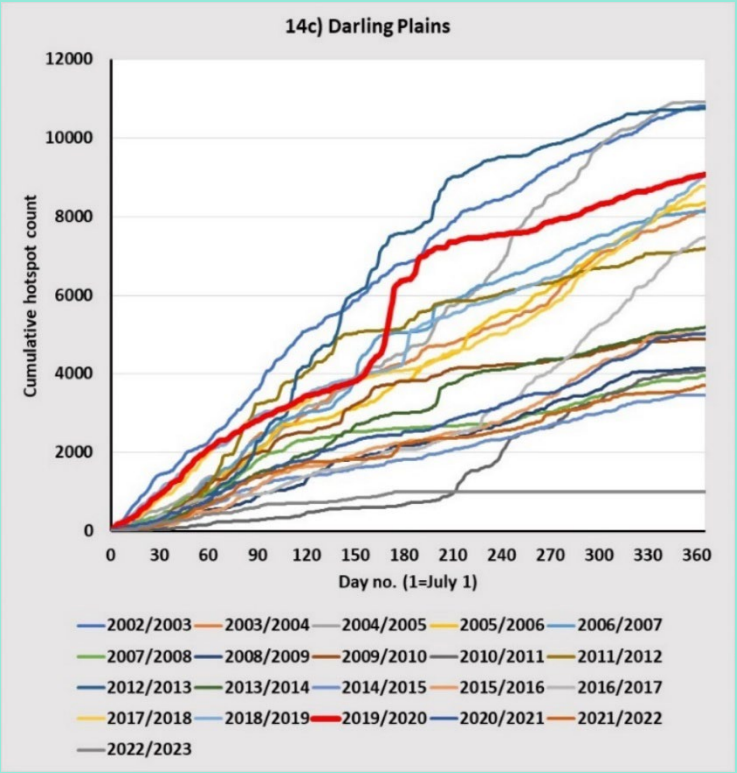


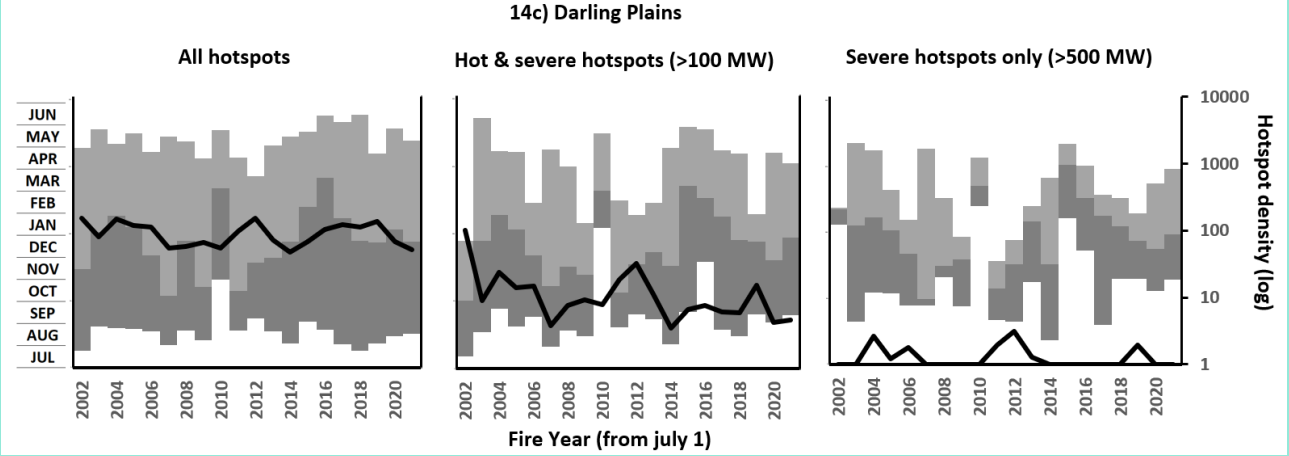
Dominated by Black Summer
Dominated by various active years
Longer-term activity swings
Major zig-zag swings
Dominated by end of Millenium Drought
Uniform

LONGER-TERM ACTIVITY SWINGS

14c) DARLING PLAINS







Dominated by Black Summer
Dominated by various active years
Longer-term activity swings
Major zig-zag swings
Dominated by end of Millenium Drought
Uniform