

Waterfowl, Environment and Climate conditions and forecast considerations to inform 2021 Duck and Quail Open Seasons setting

December 2020

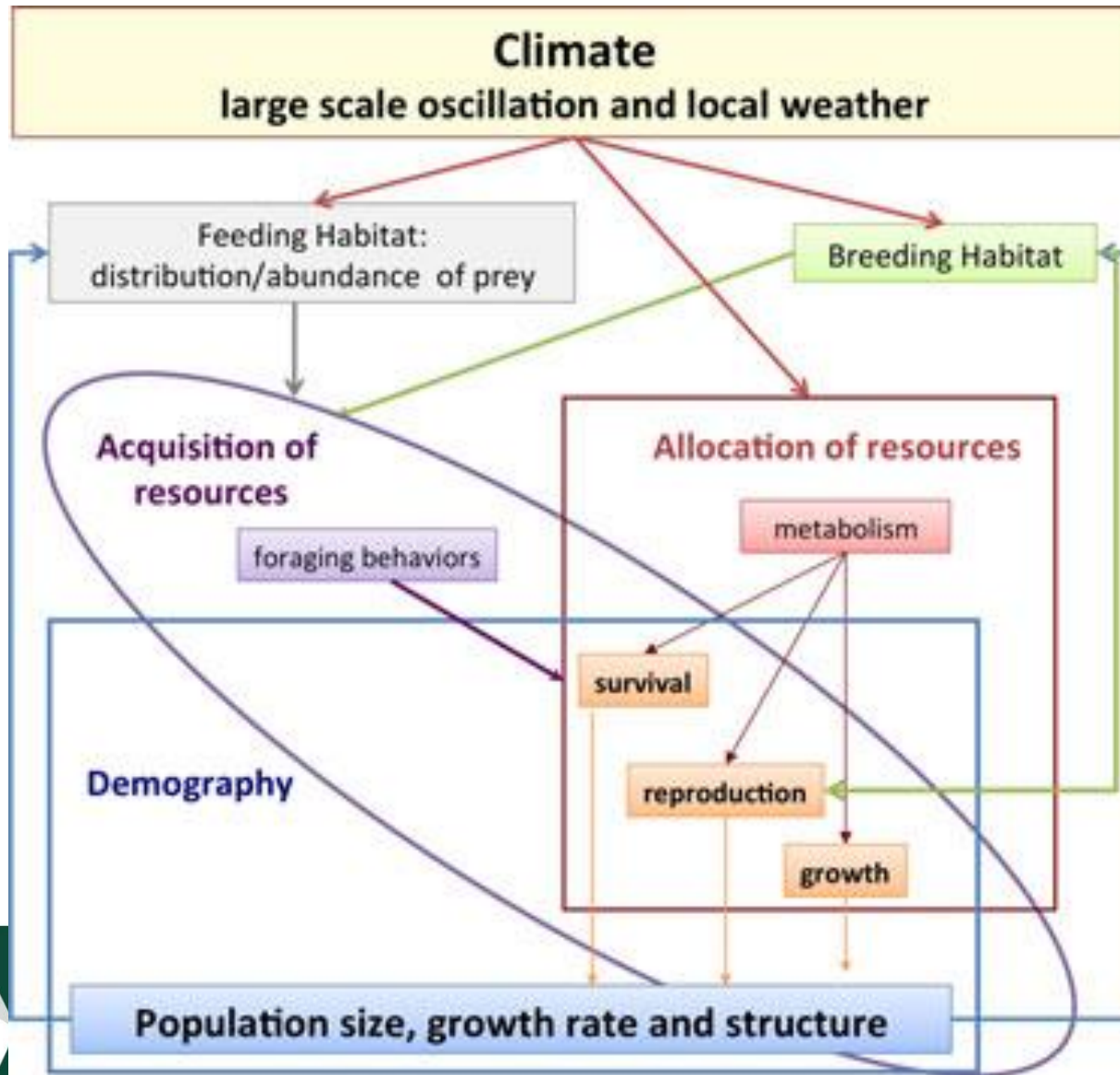


Government of South Australia
Department for Environment
and Water

Conditions – review and outlook

- Climate influence on bird abundance & distribution
- Rainfall summary
- Climate drivers
 - El Niño Southern Oscillation - La Niña
 - Indian Ocean Dipole
 - Southern Annular Mode
- Summer rainfall & temperature forecasts
- River Murray inflows, storages and flow to SA
- Lake Eyre Basin

Climatic conditions affecting bird abundance & demographics

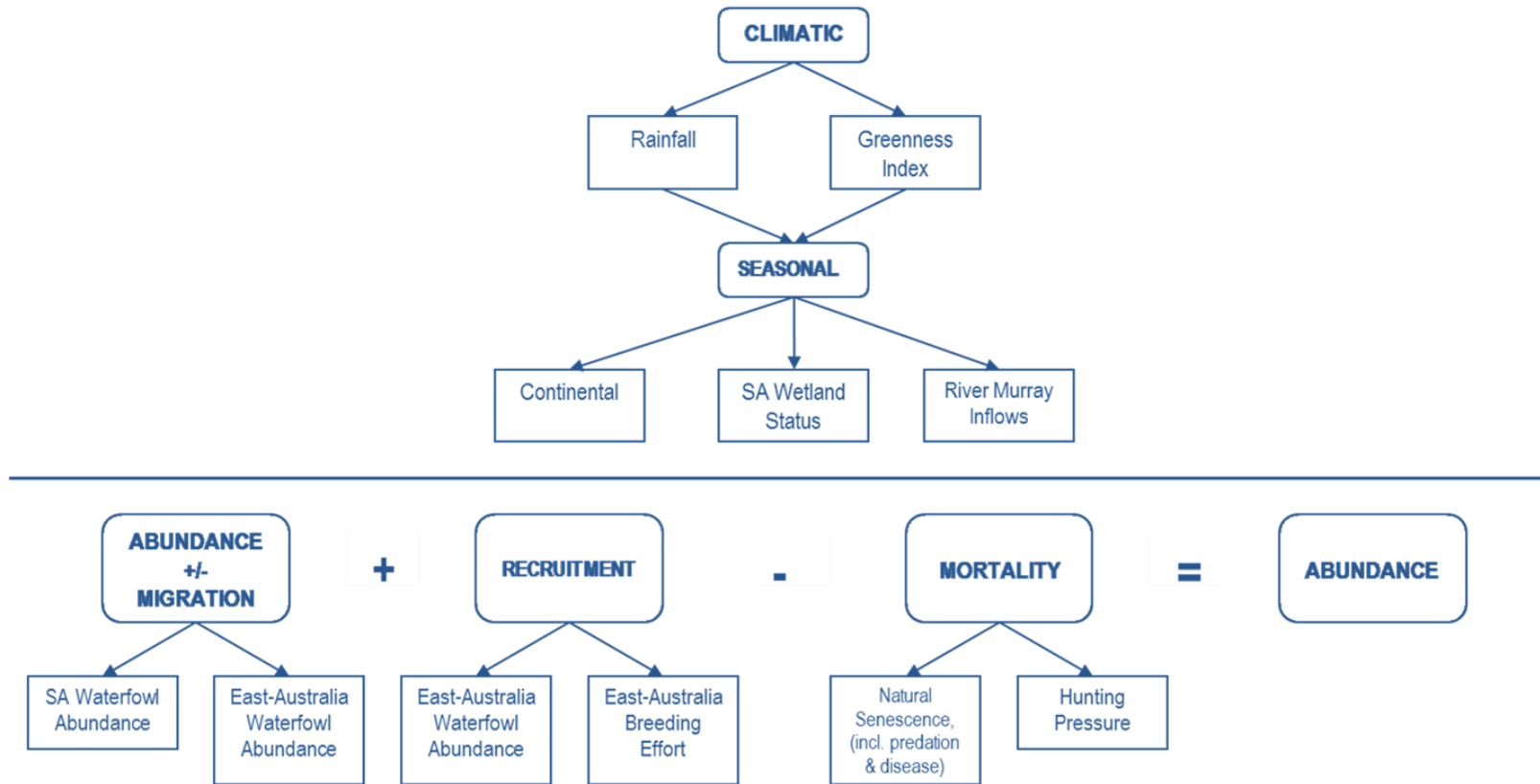


Source: Jenouvrier, S., 2013. Impacts of climate change on avian populations. *Global Change Biology*, 19(7), pp.2036-2057.

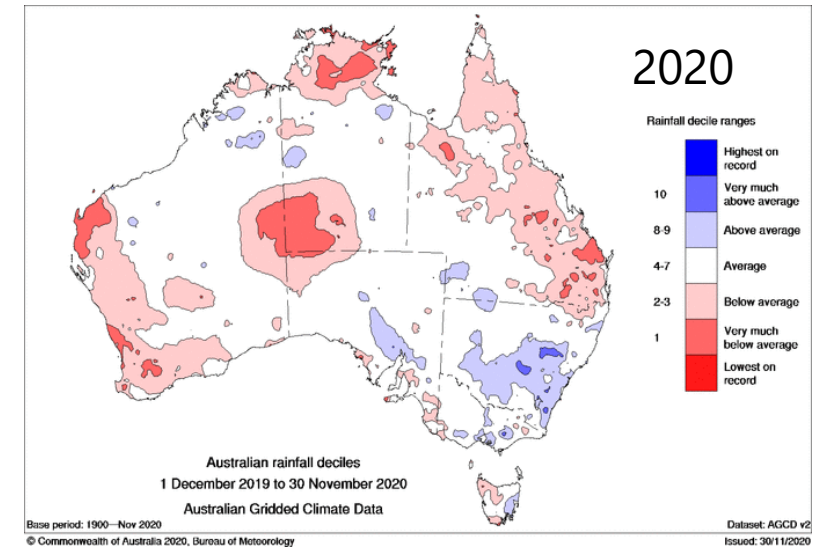
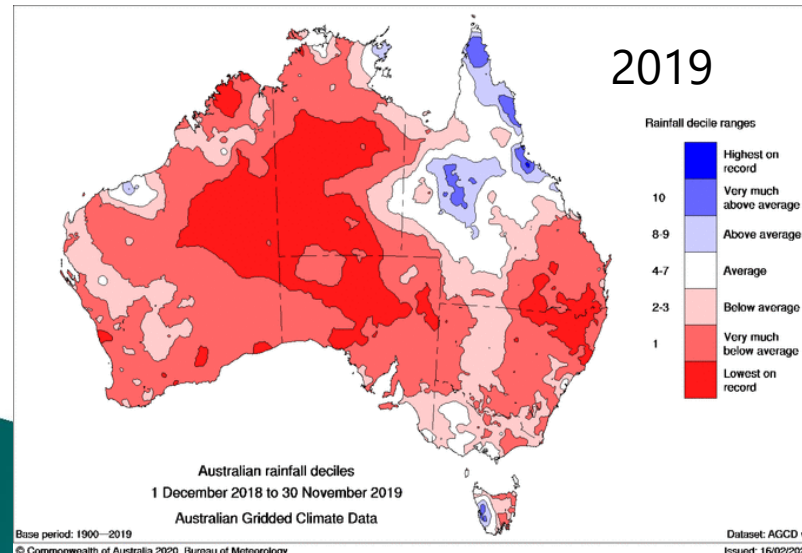
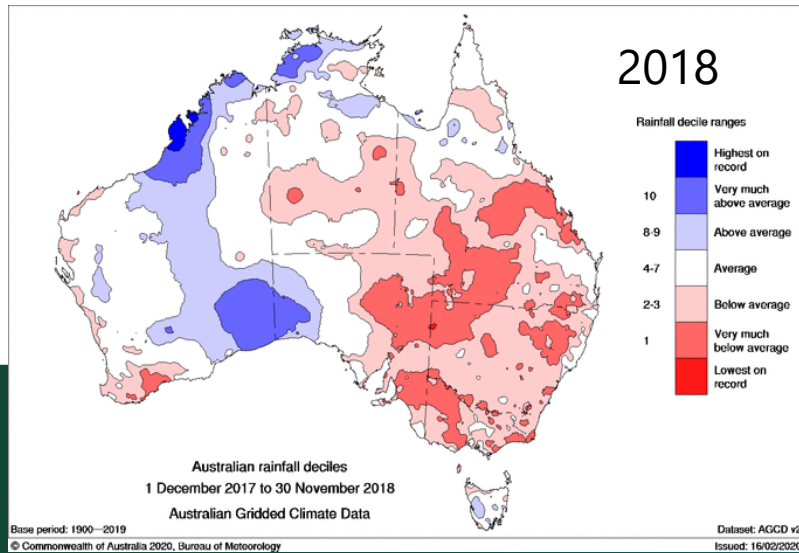
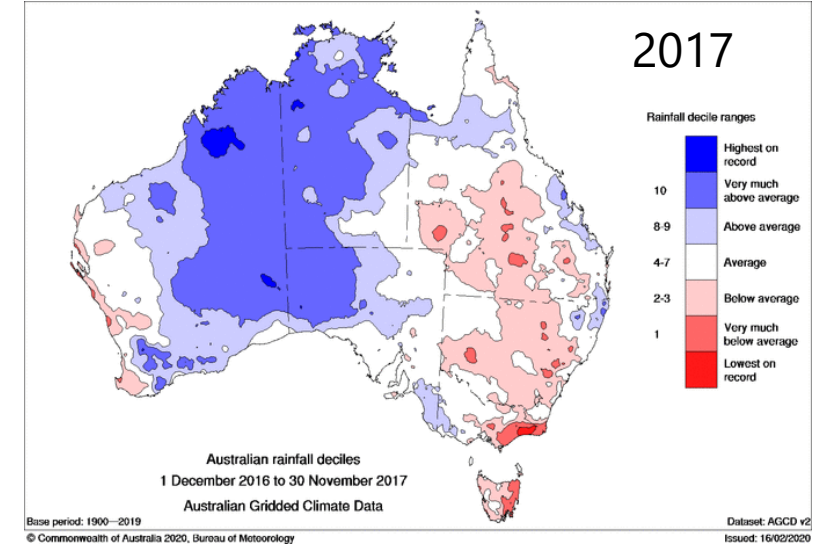
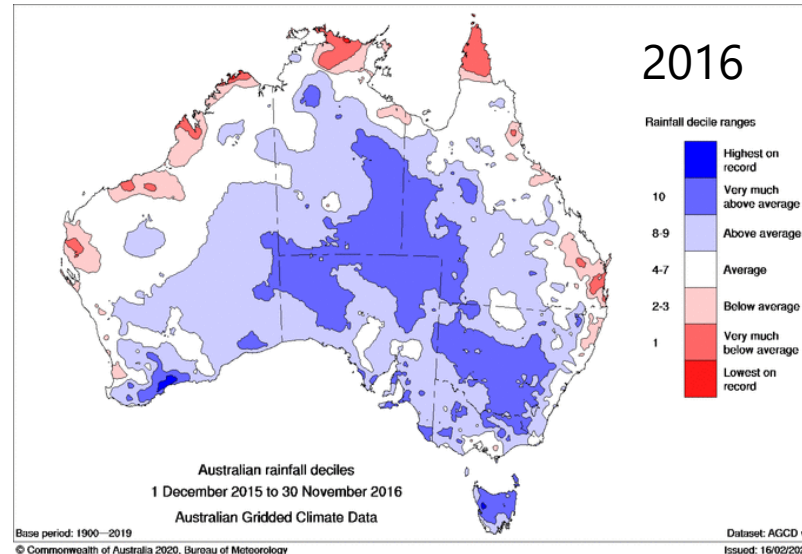
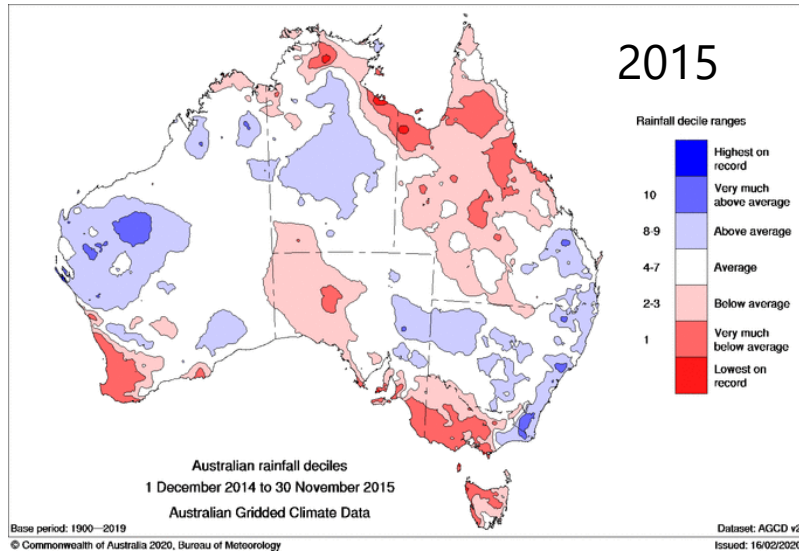


Duck and quail hunting in South Australia

Factors influencing waterfowl species and populations

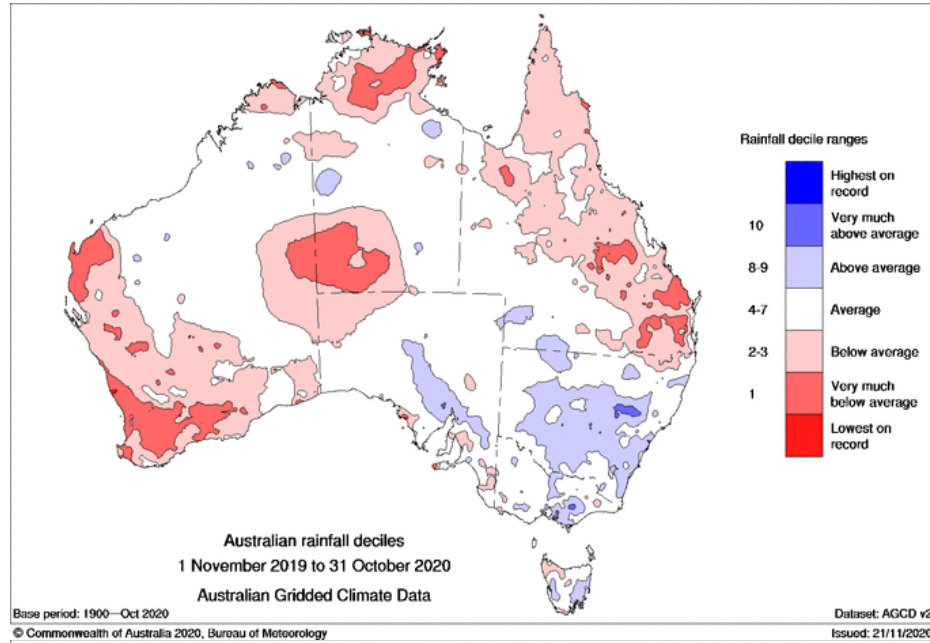


Rainfall 2015 to 2020 (1 Dec - 30 Nov)

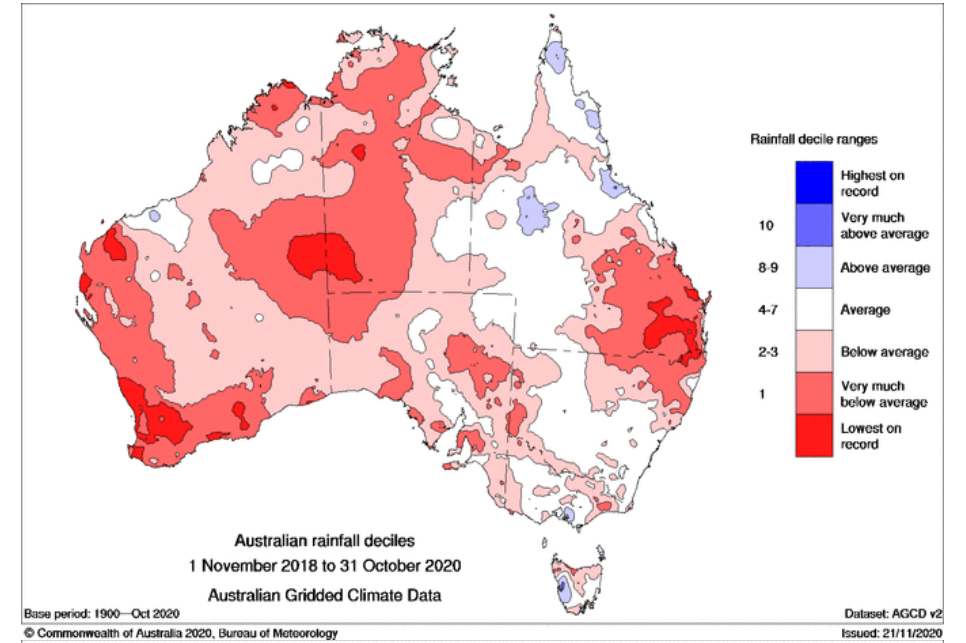


12, 24, 36 and 48 month rainfall deciles

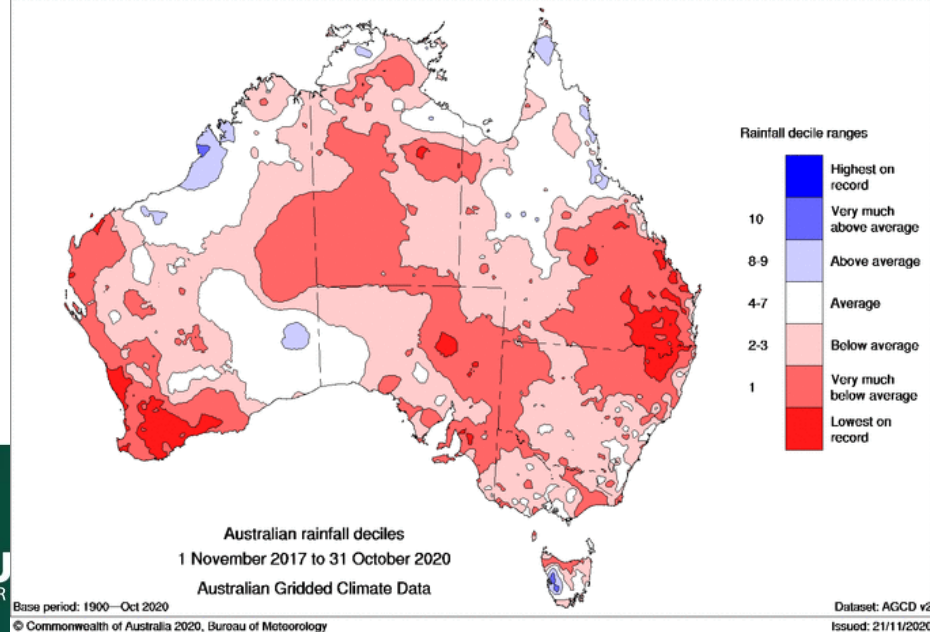
12 month



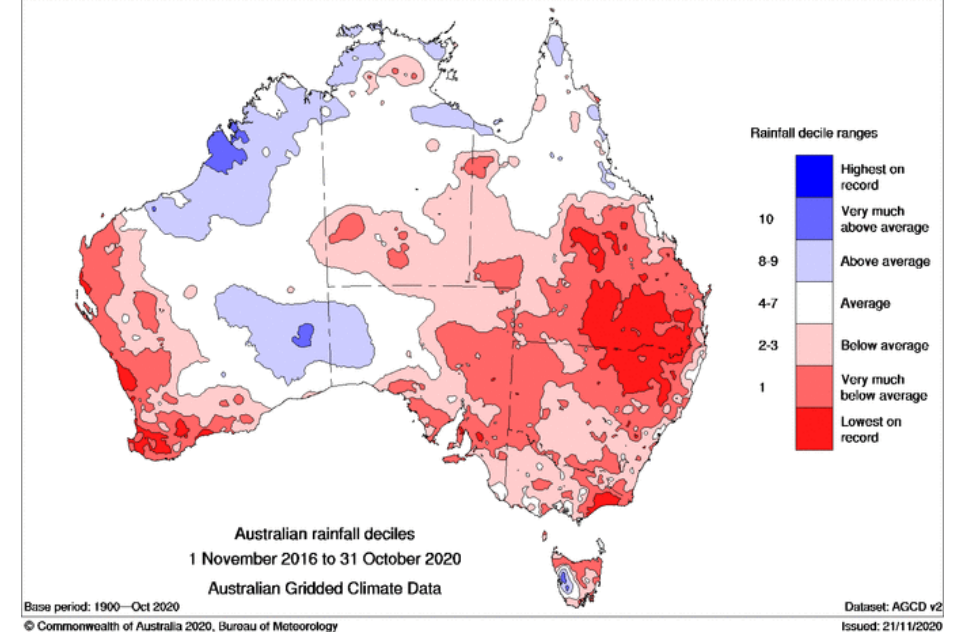
24 month



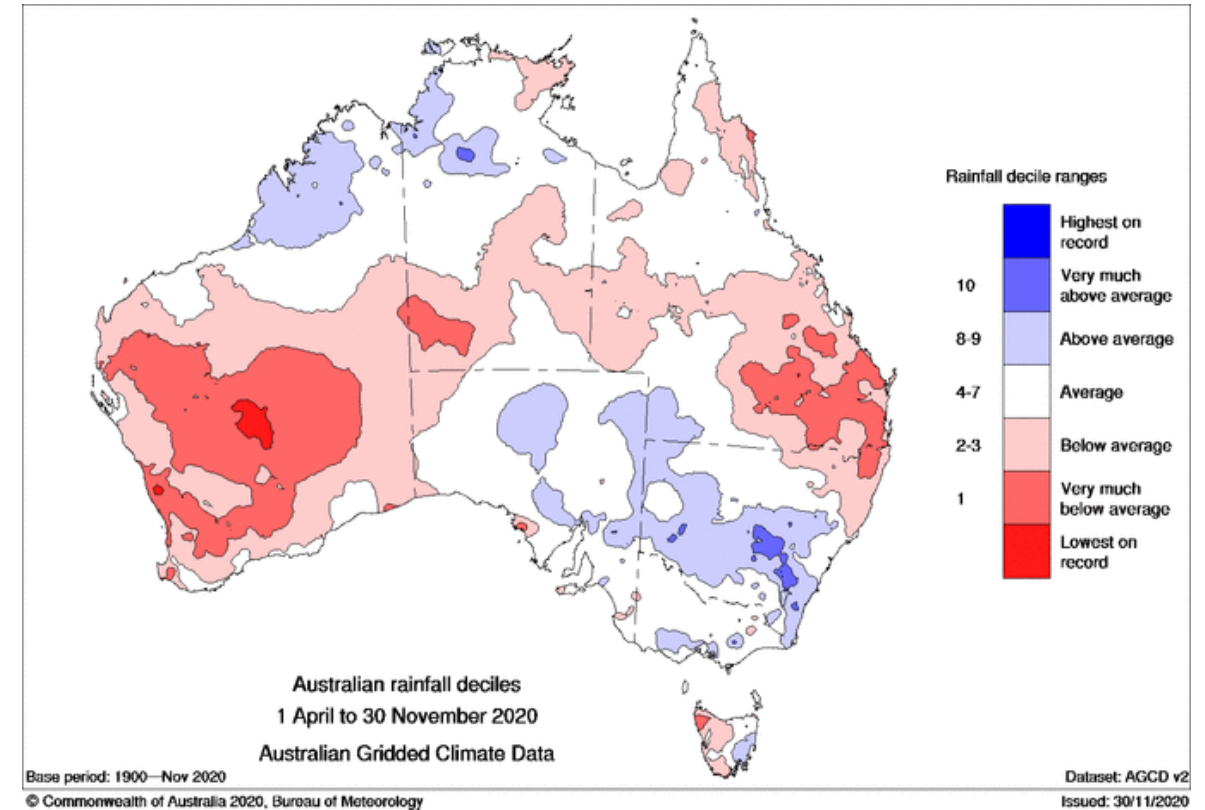
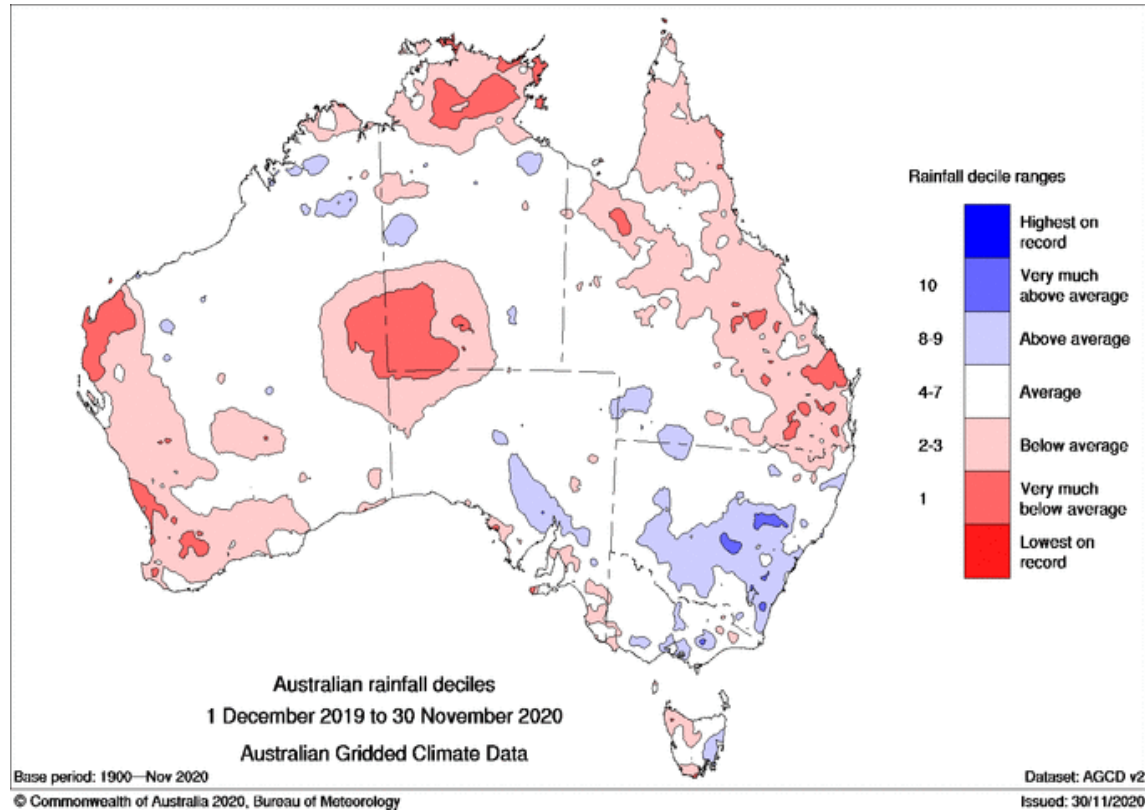
36 month



48 month

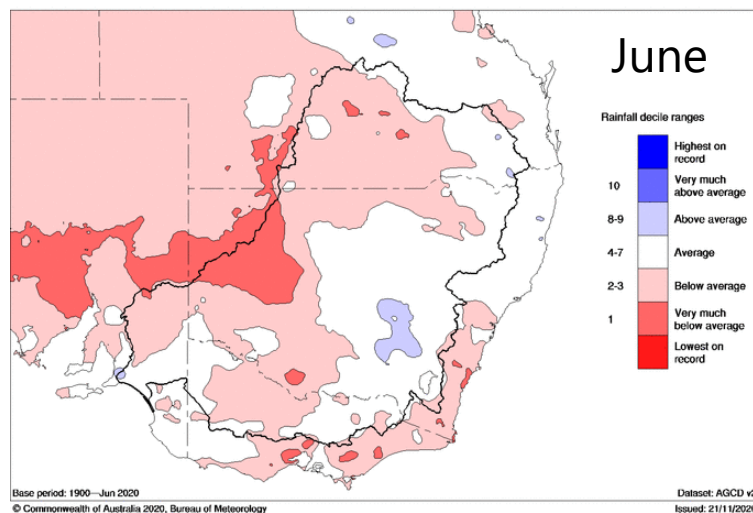


Rainfall deciles: 12 month & southern wet season

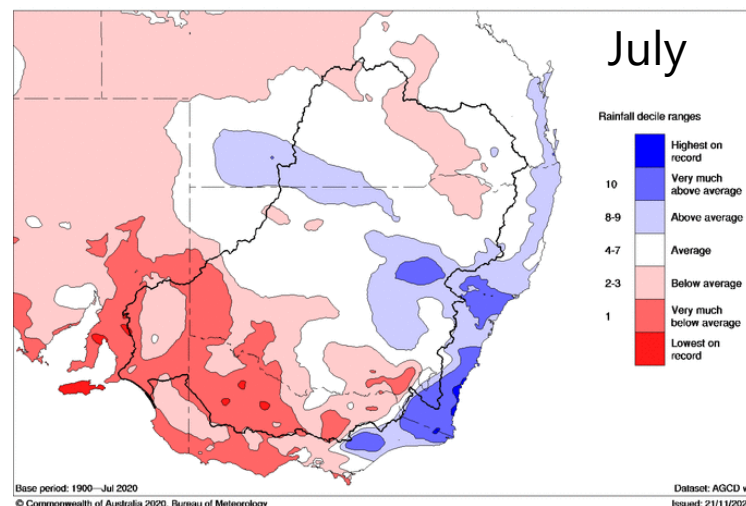


2020 Rainfall in the Murray Darling Basin

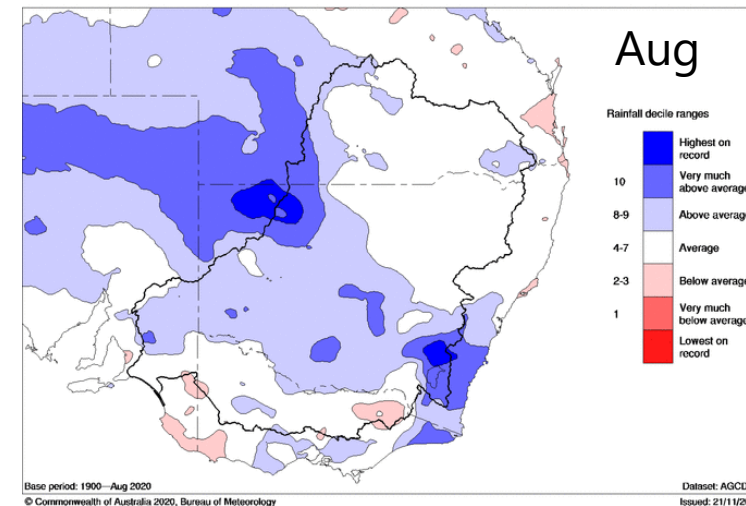
Murray-Darling rainfall deciles June 2020
Australian Gridded Climate Data



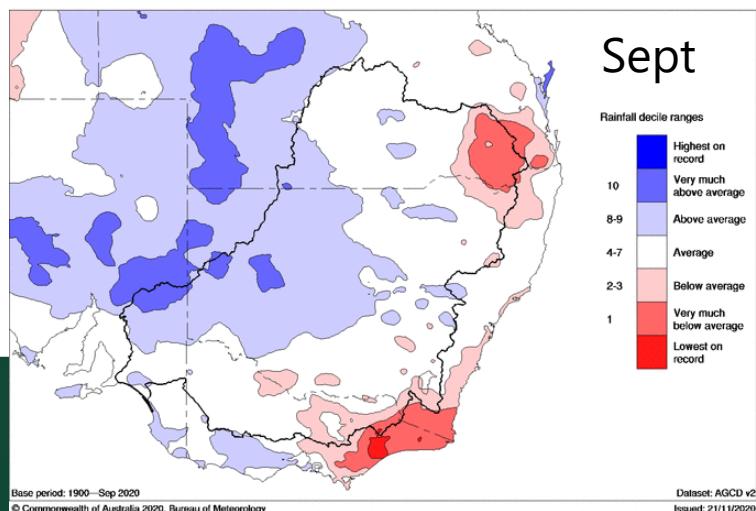
Murray-Darling rainfall deciles July 2020
Australian Gridded Climate Data



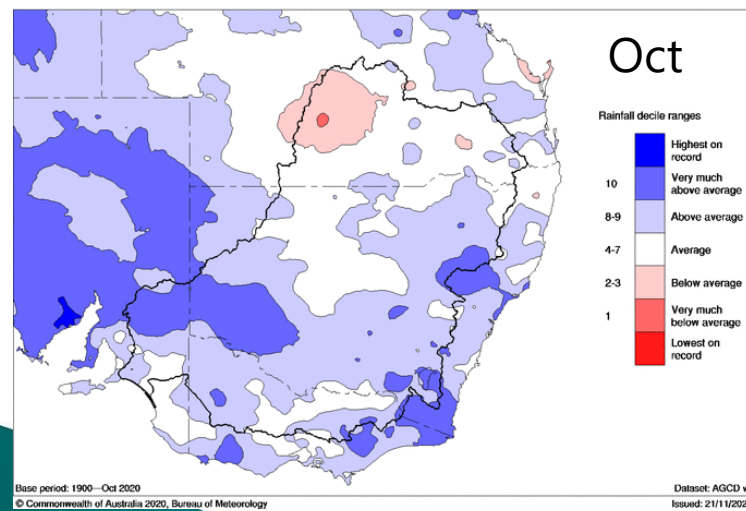
Murray-Darling rainfall deciles August 2020
Australian Gridded Climate Data



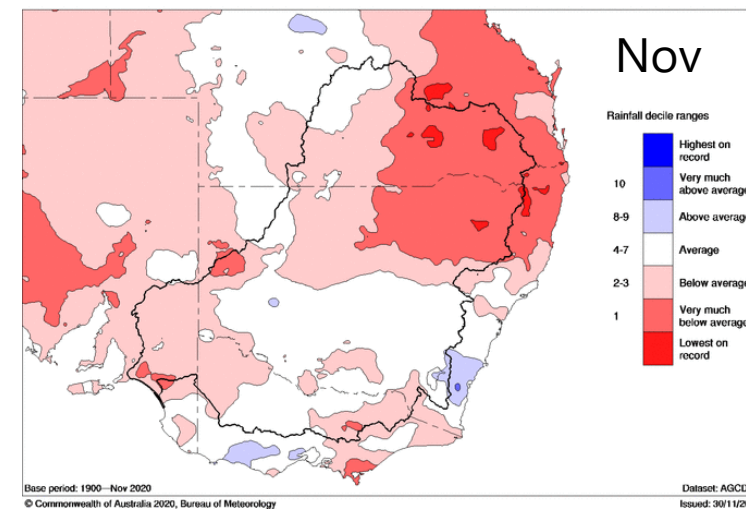
Murray-Darling rainfall deciles September 2020
Australian Gridded Climate Data

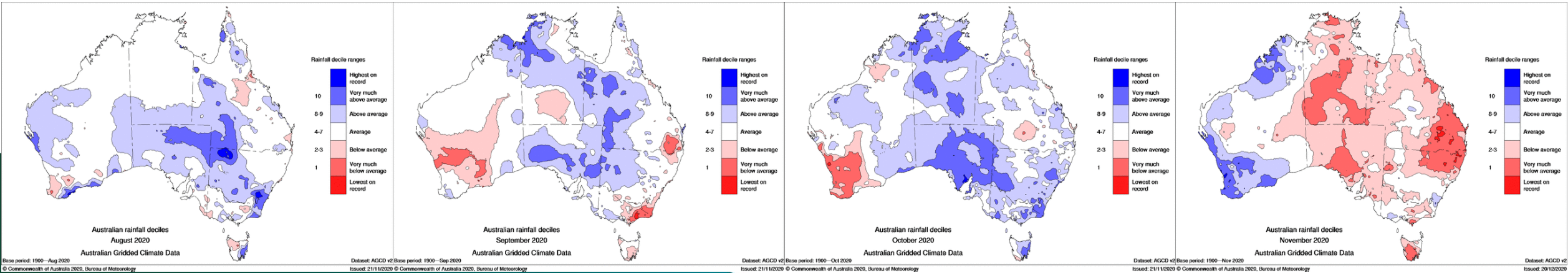
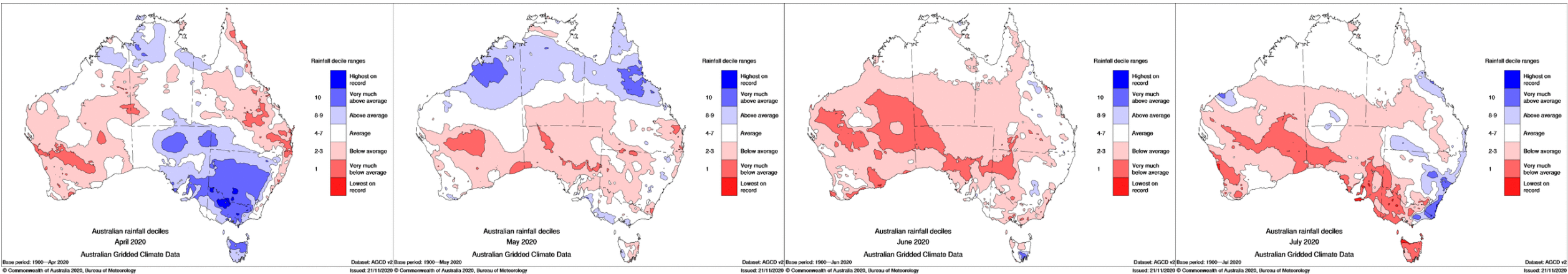
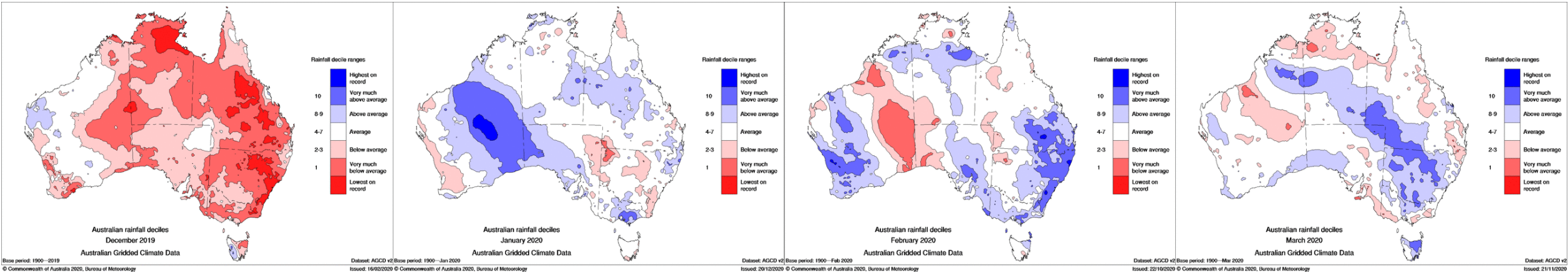


Murray-Darling rainfall deciles October 2020
Australian Gridded Climate Data

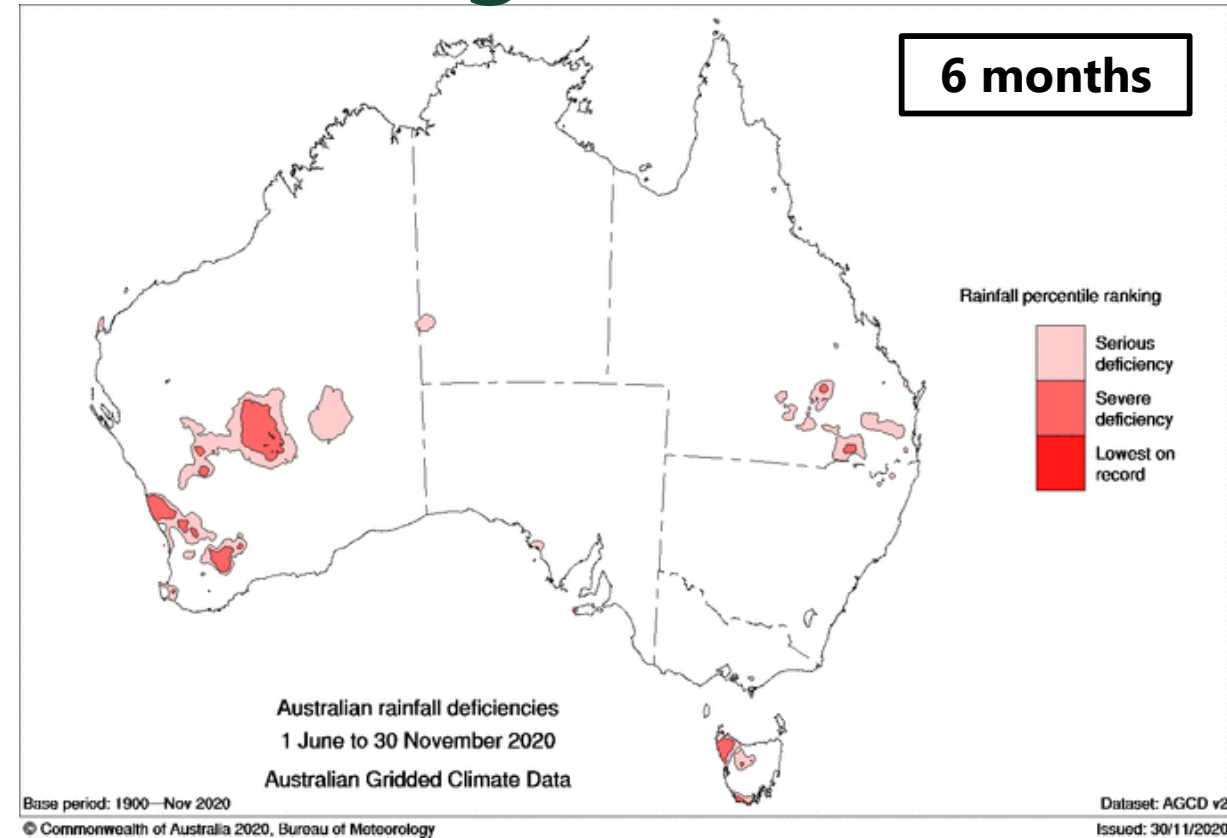
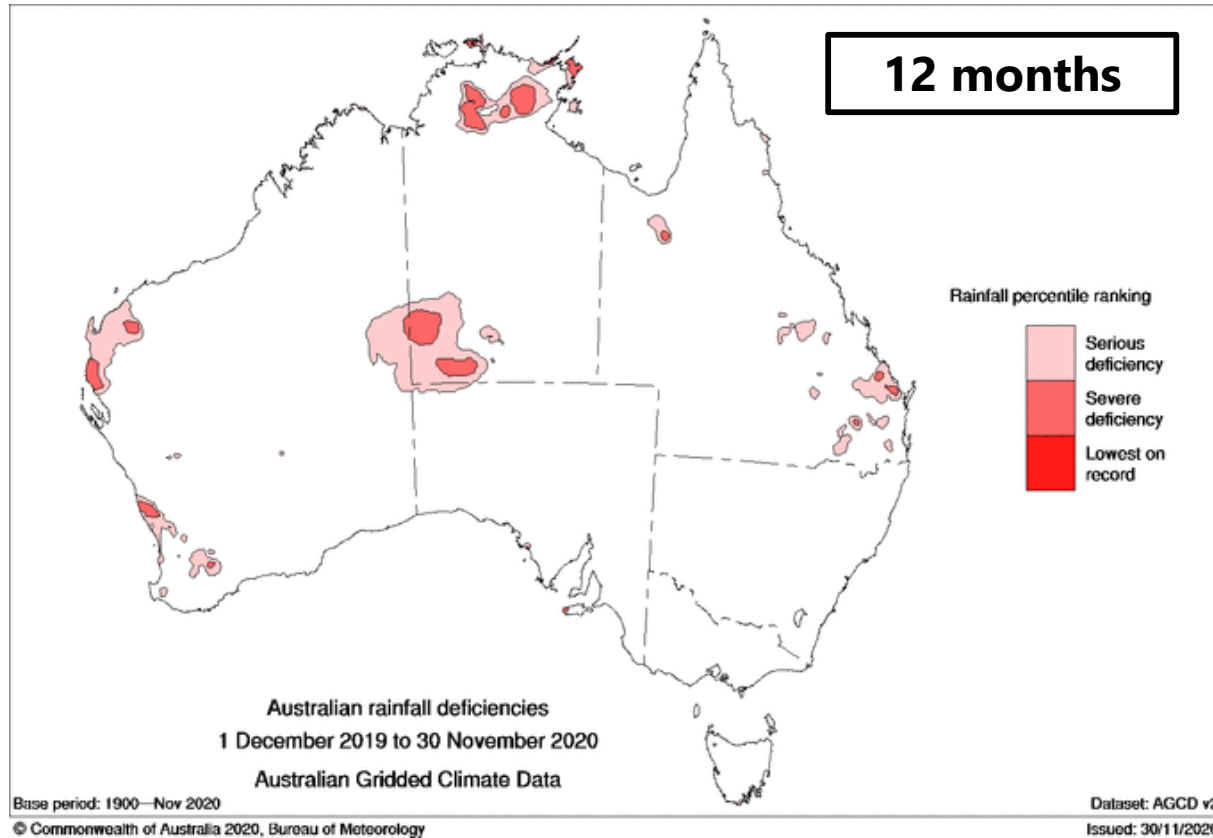


Murray-Darling rainfall deciles November 2020
Australian Gridded Climate Data

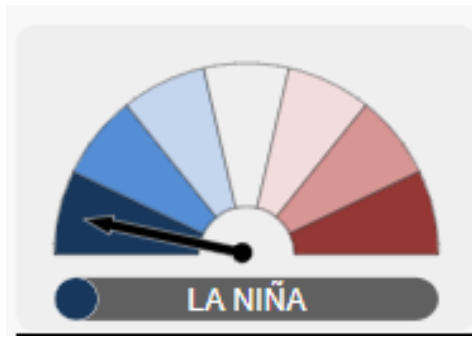




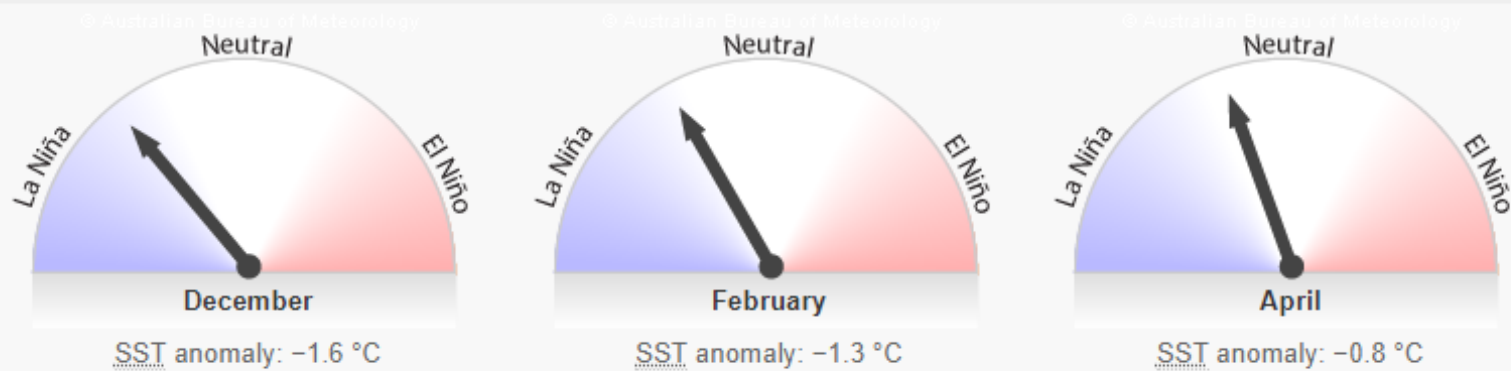
2020 Rainfall deficiencies (drought)



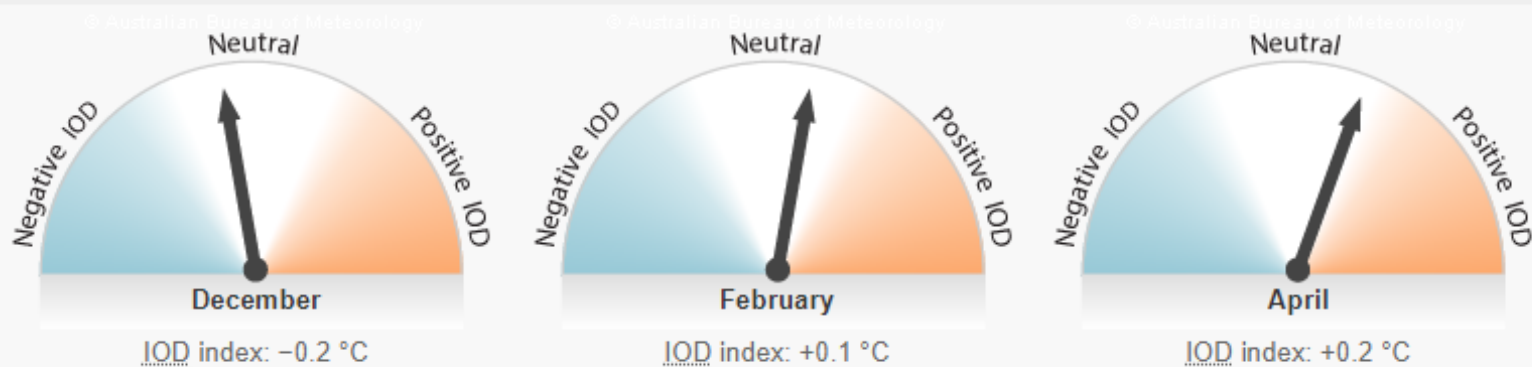
Climate Drivers



Average of international model outlooks for NINO3.4 Issued 8 December 2020

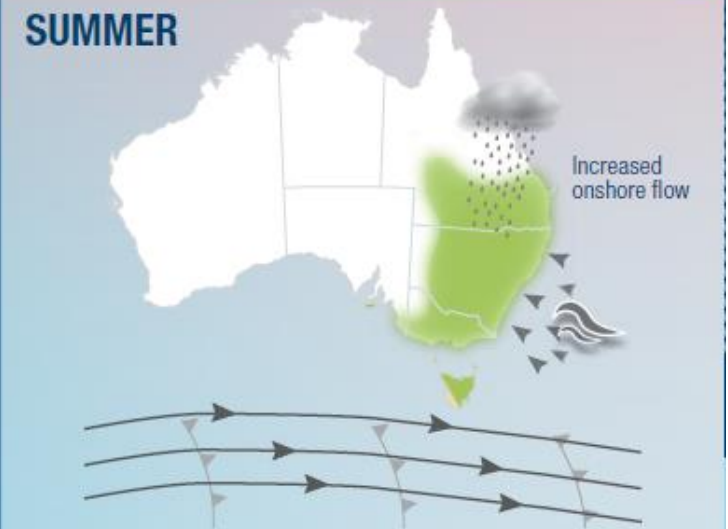


Average of international model outlooks for IOD Issued 8 December 2020



TYPICAL IMPACTS IN A POSITIVE PHASE

SUMMER



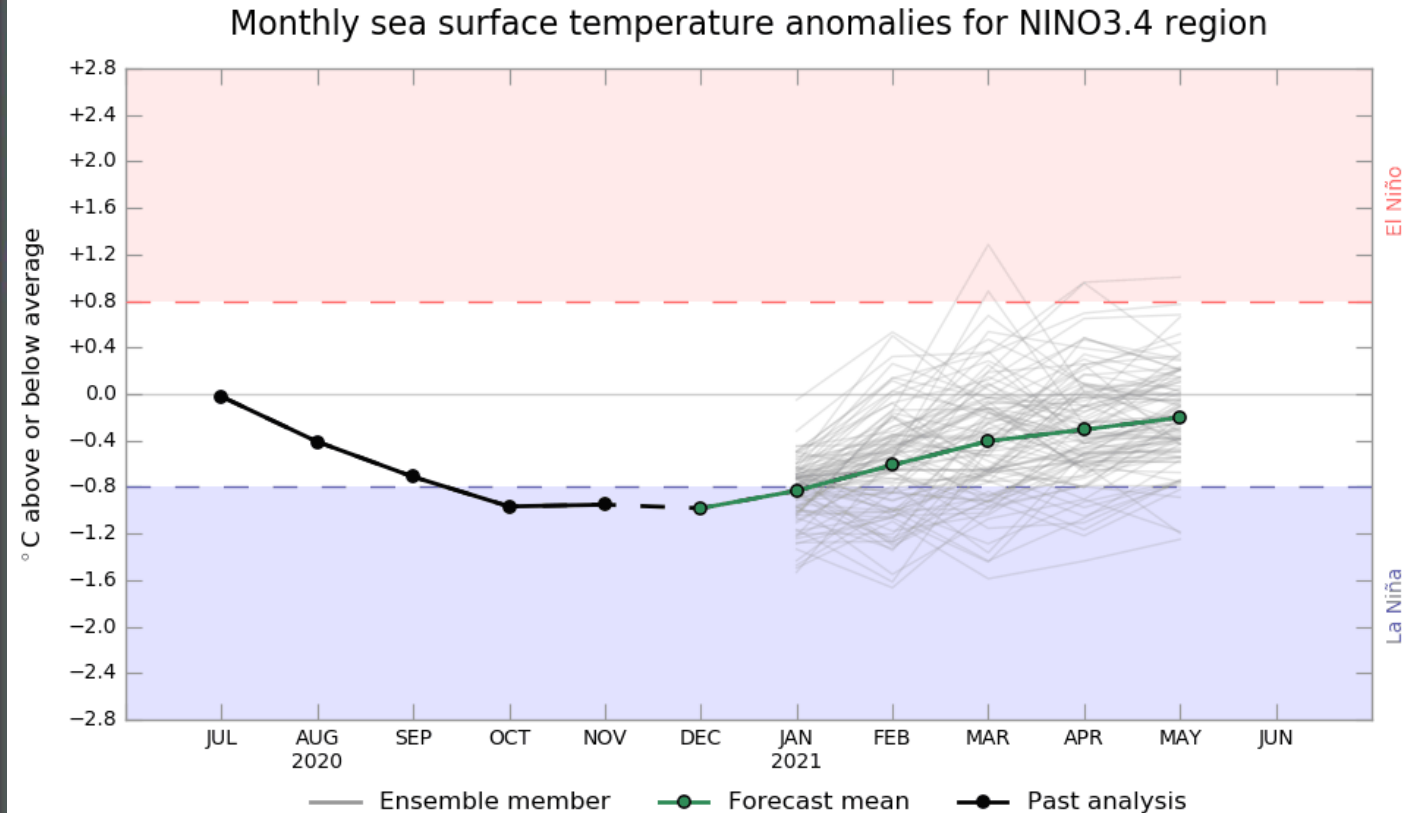
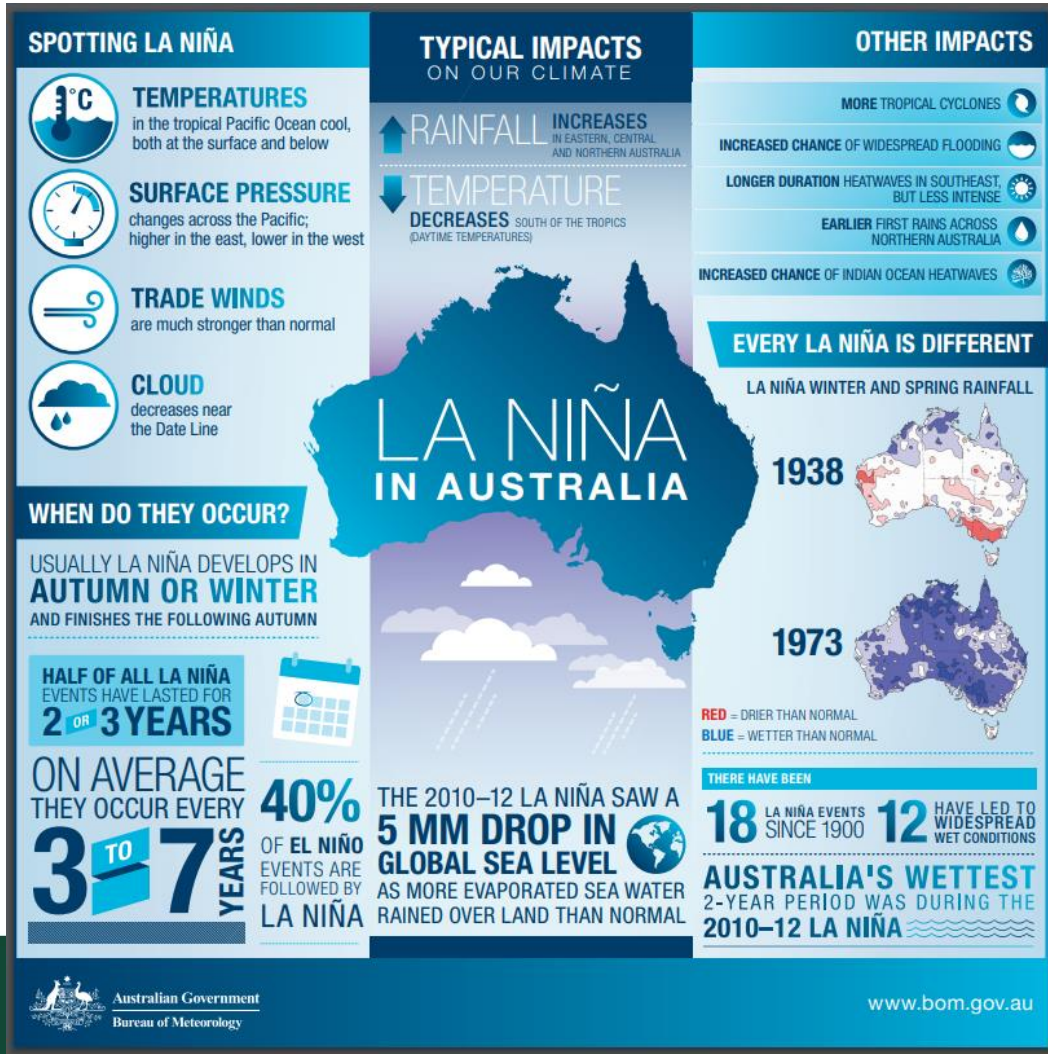
WETTER THAN NORMAL DRIER THAN NORMAL

 MORE RAINFALL IN THE EAST

 REDUCED CHANCE OF EXTREME HEAT IN SPRING AND SUMMER

 MORE FREQUENT WITH LA NIÑA

El Niño Southern Oscillation - La Niña

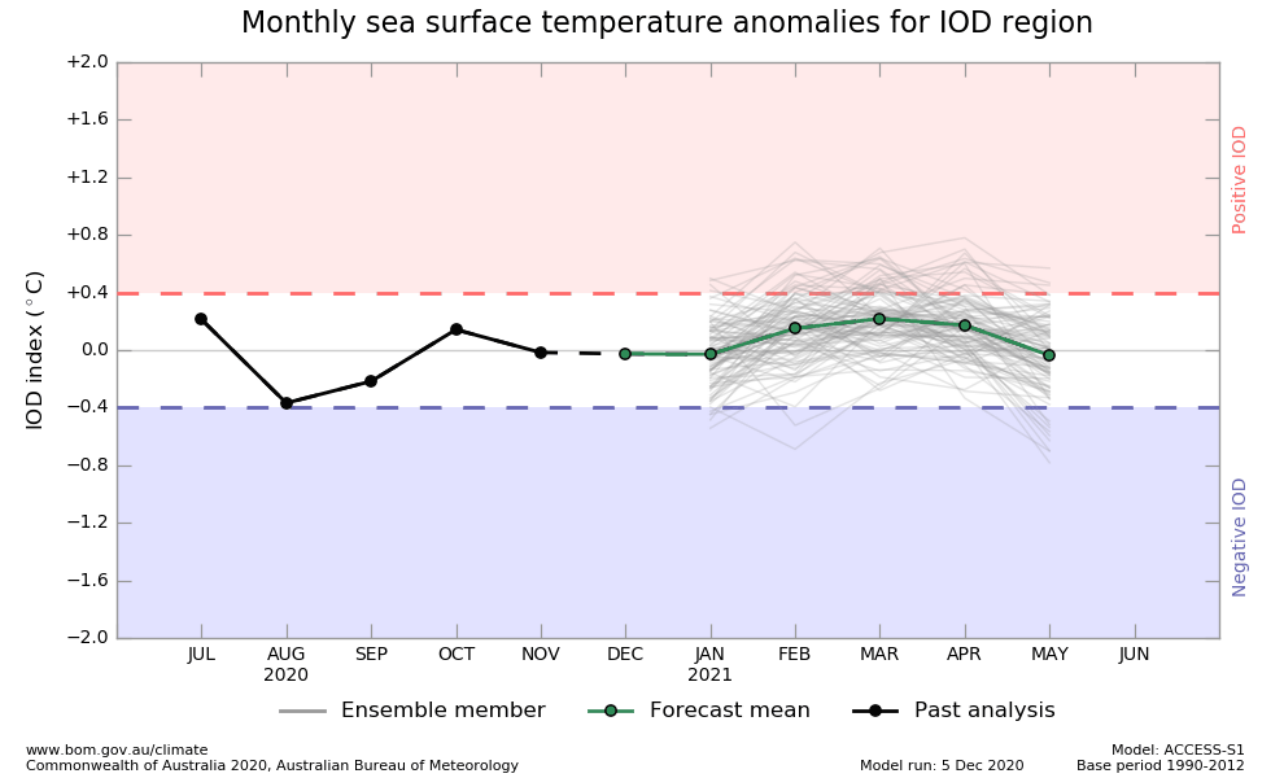
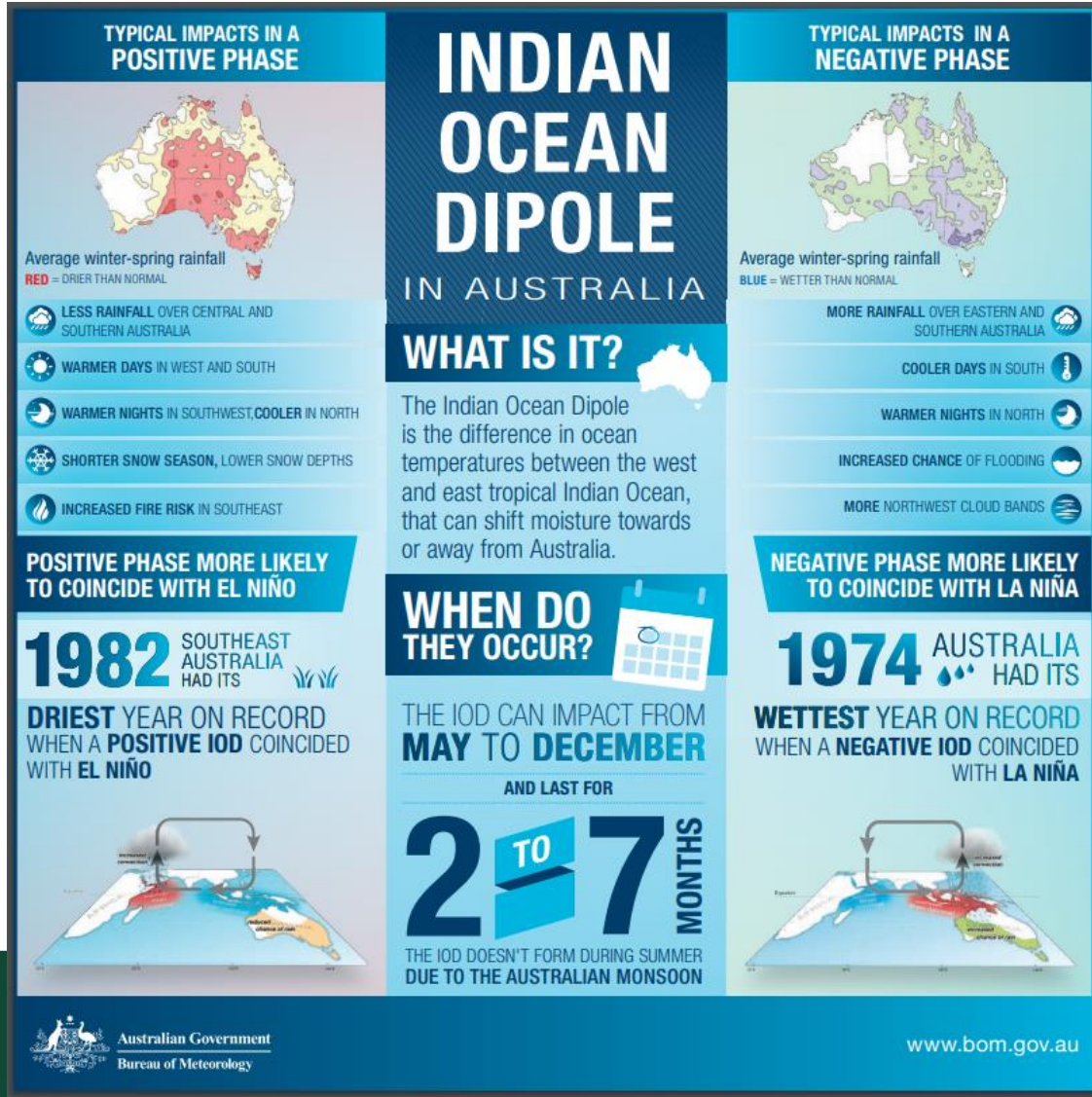


www.bom.gov.au/climate
Commonwealth of Australia 2020, Australian Bureau of Meteorology

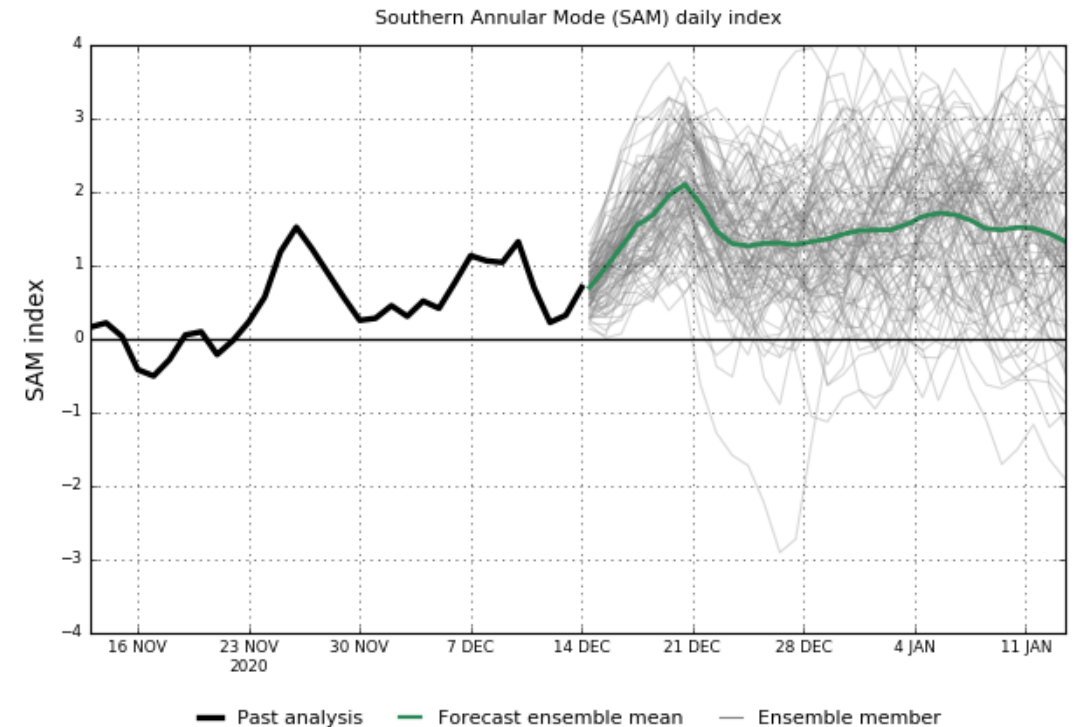
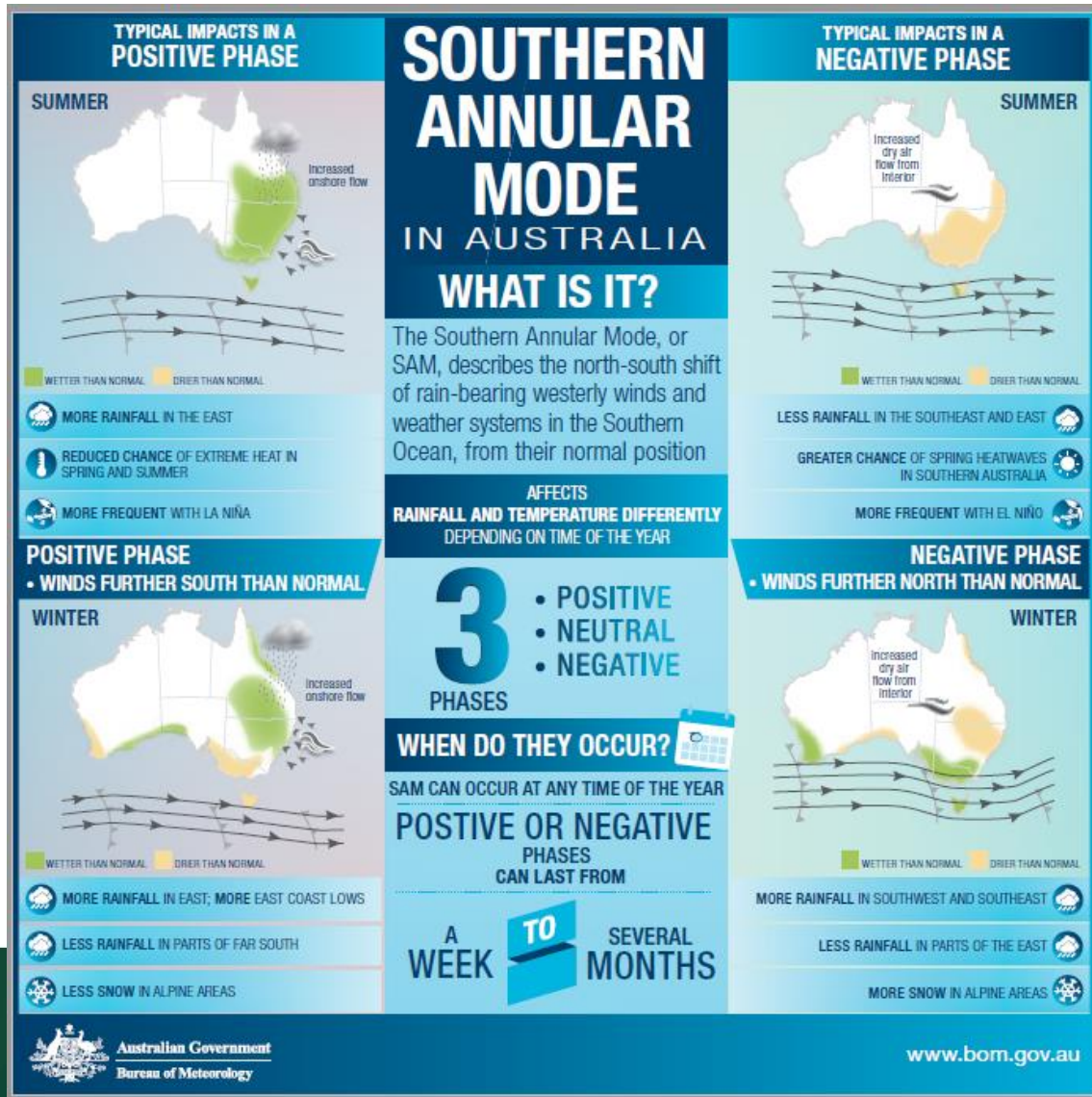
Model run: 5 Dec 2020

Model: ACCESS-S1
Base period 1990-2012

Indian Ocean Dipole



Southern Annular Mode



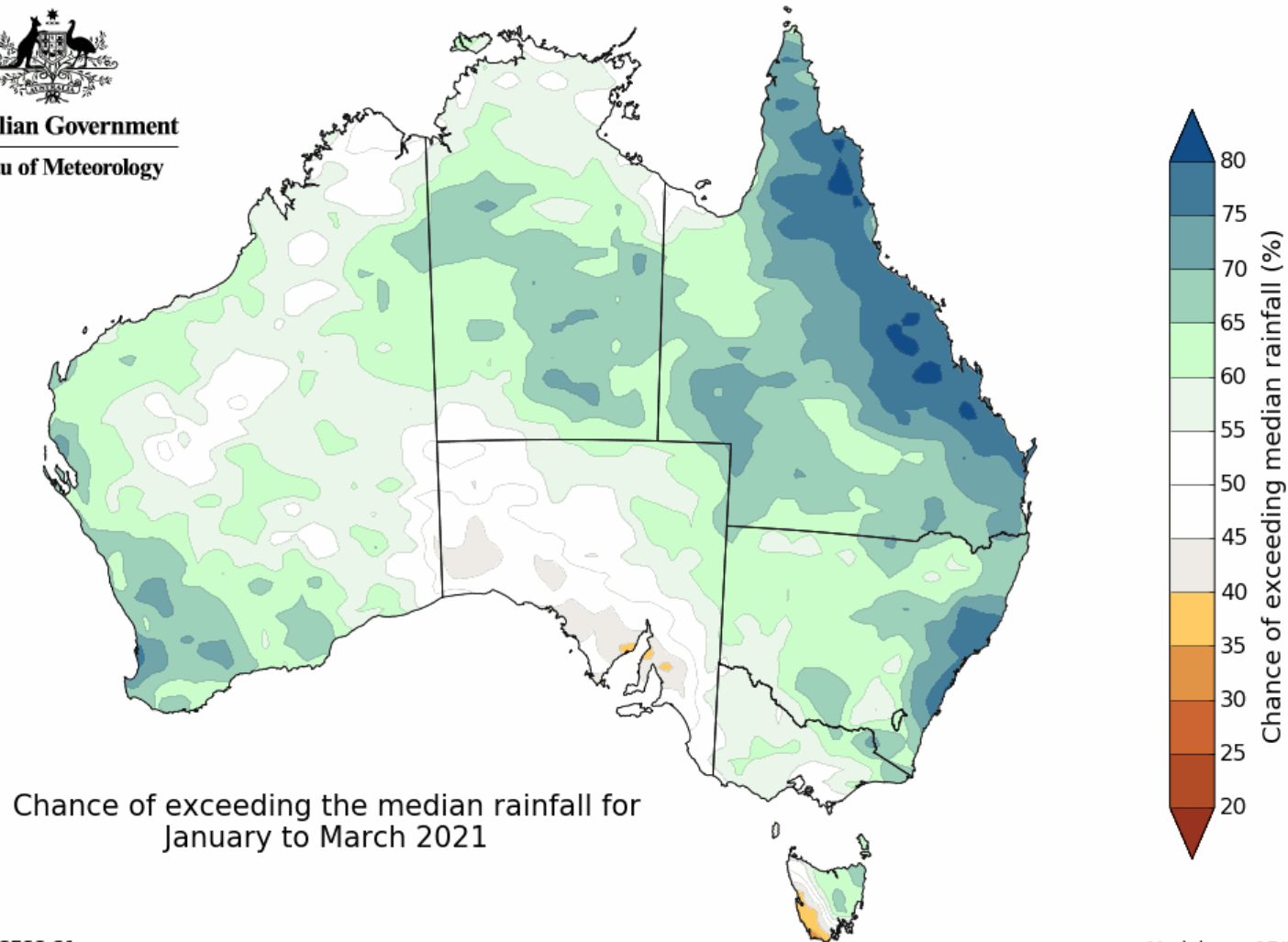
www.bom.gov.au/climate
Commonwealth of Australia 2020, Australian Bureau of Meteorology

Model: ACCESS-S1
Model run: 14 Dec 2020 Base period 1990-2012

Forecast rainfall

Chance of exceeding median rainfall January to March 2021

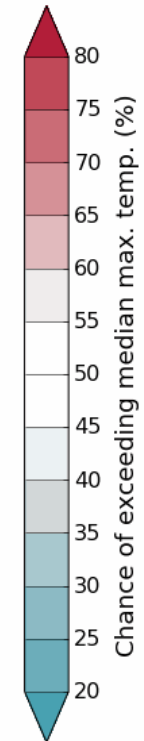
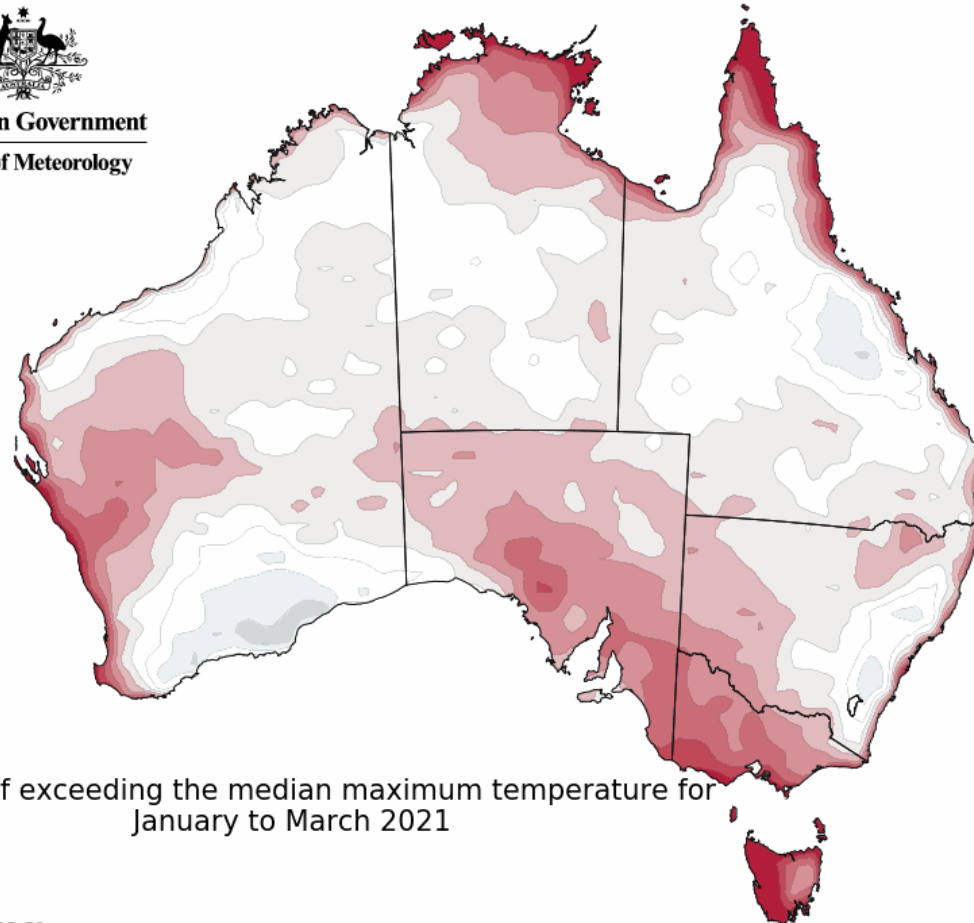

Australian Government
Bureau of Meteorology



Forecast temperature

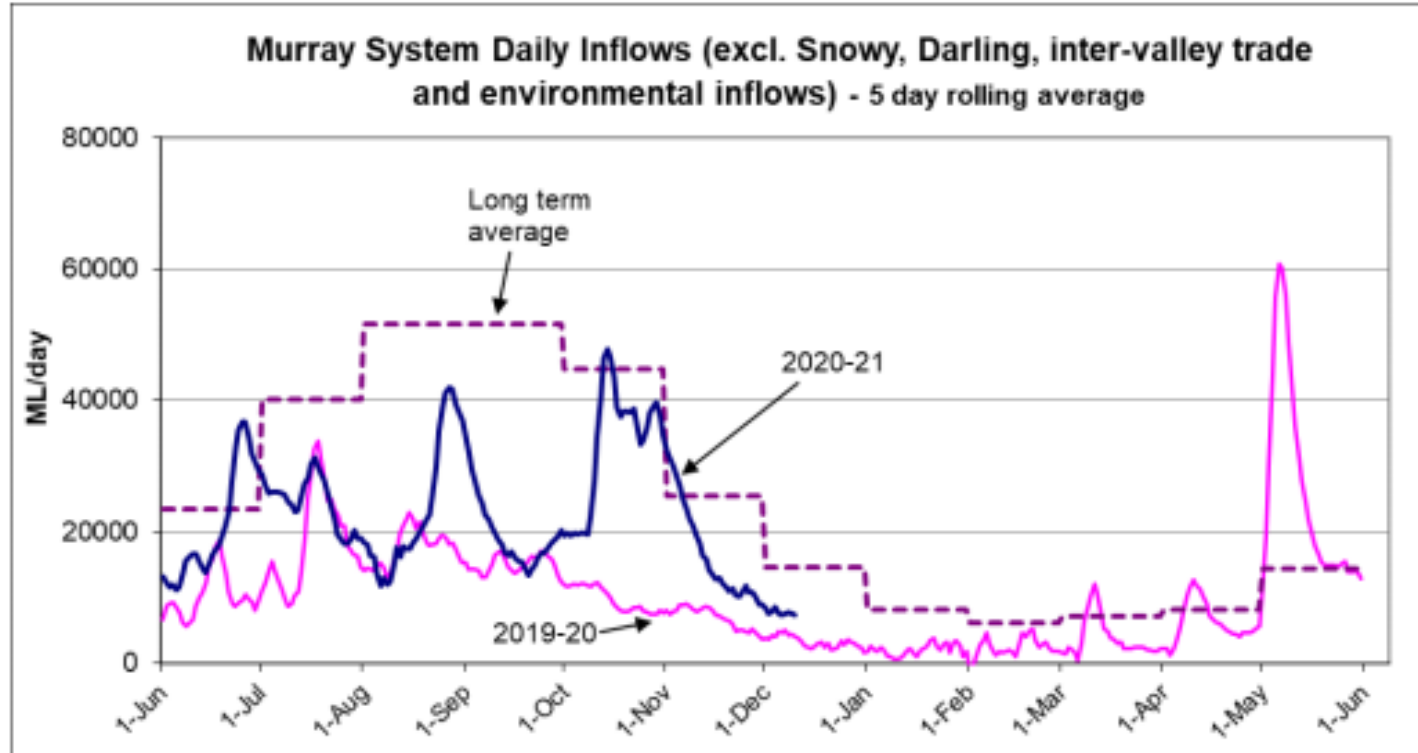
Chance of exceeding median maximum temperature January to March 2021


Australian Government
Bureau of Meteorology

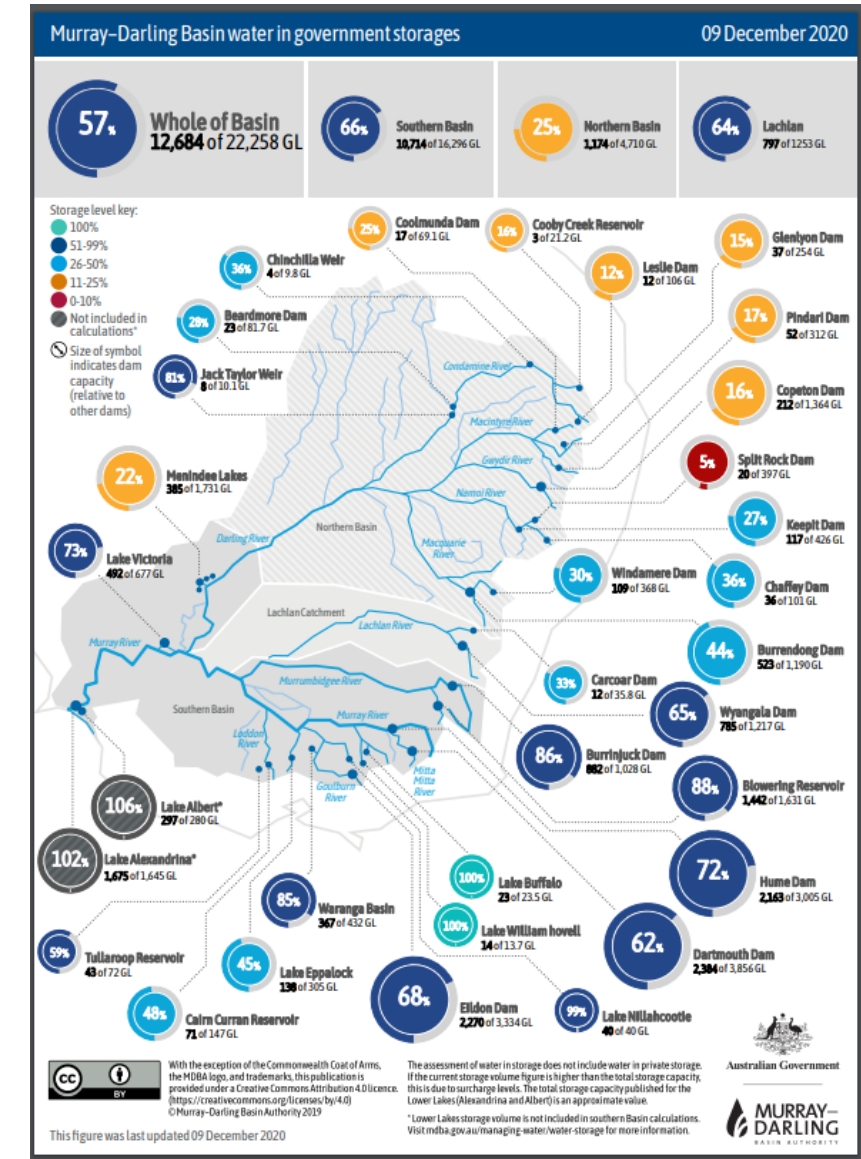


Chance of exceeding the median maximum temperature for
January to March 2021

River Murray inflows and storages



<https://www.mdba.gov.au/sites/default/files/weeklyreports/River-Murray-Operations-Weekly-Report-9-December-2020.pdf>



<https://www.mdba.gov.au/sites/default/files/water-in-storages/weeklybasinreports/Basin-Storage-20201209.pdf>

River Murray flow to SA

Flow to SA

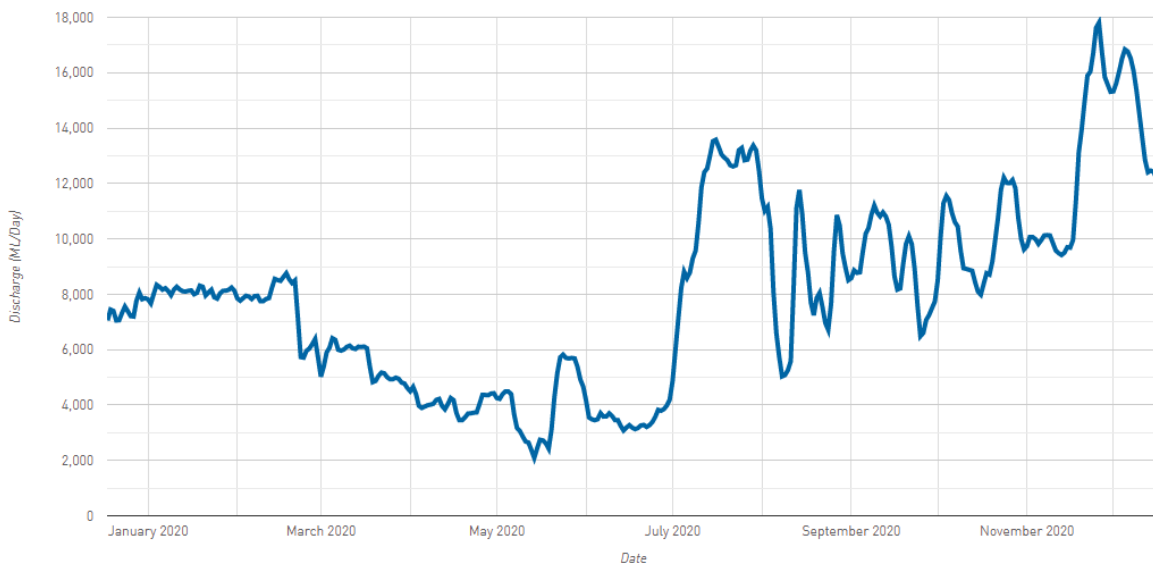
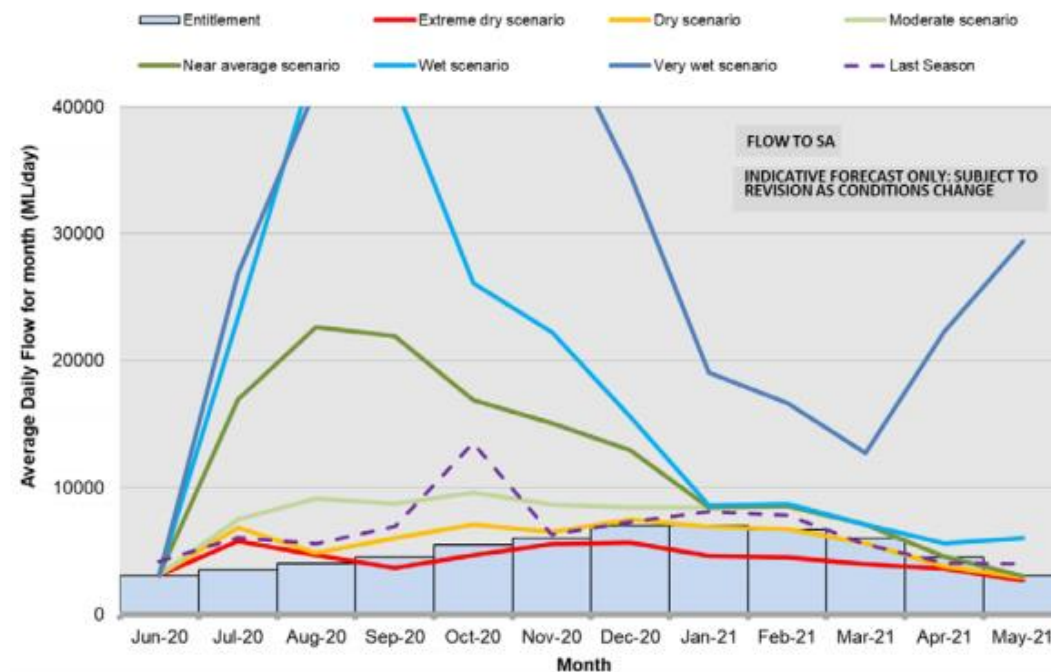


Chart data: 18/12/2019-17/12/2020

<https://riverdata.mdba.gov.au/flow-south-australia-calculated>

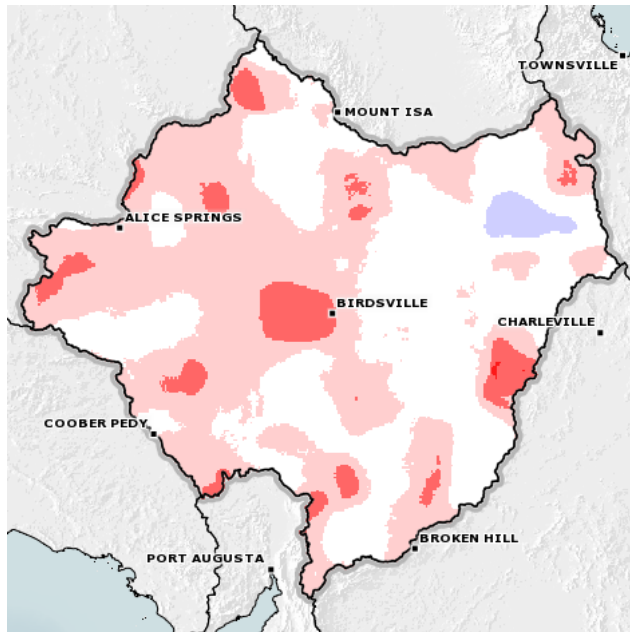
2020-21 flow to SA outlook



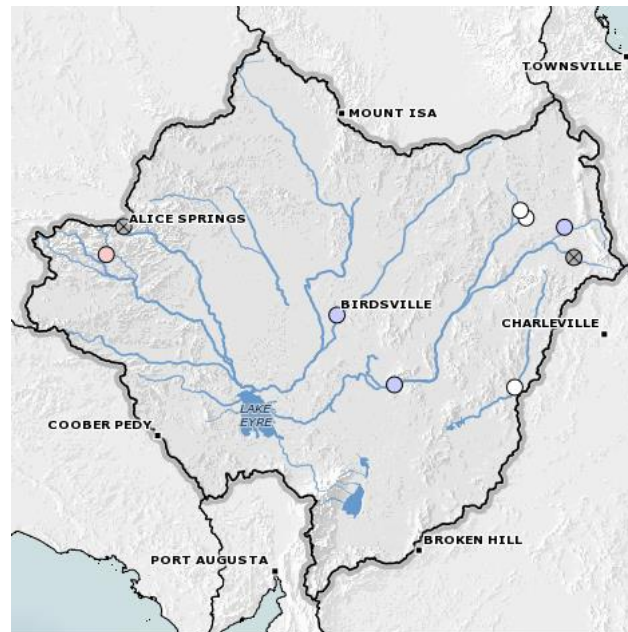
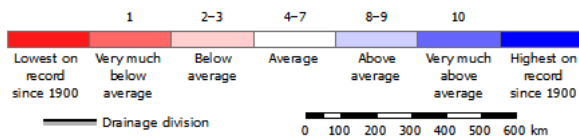
Murray-Darling Basin Authority (2020) River Murray System Annual Operating Outlook 2020-21 water year 1 June 2020 – 31 May 2021, MDBA, Canberra

Lake Eyre Basin

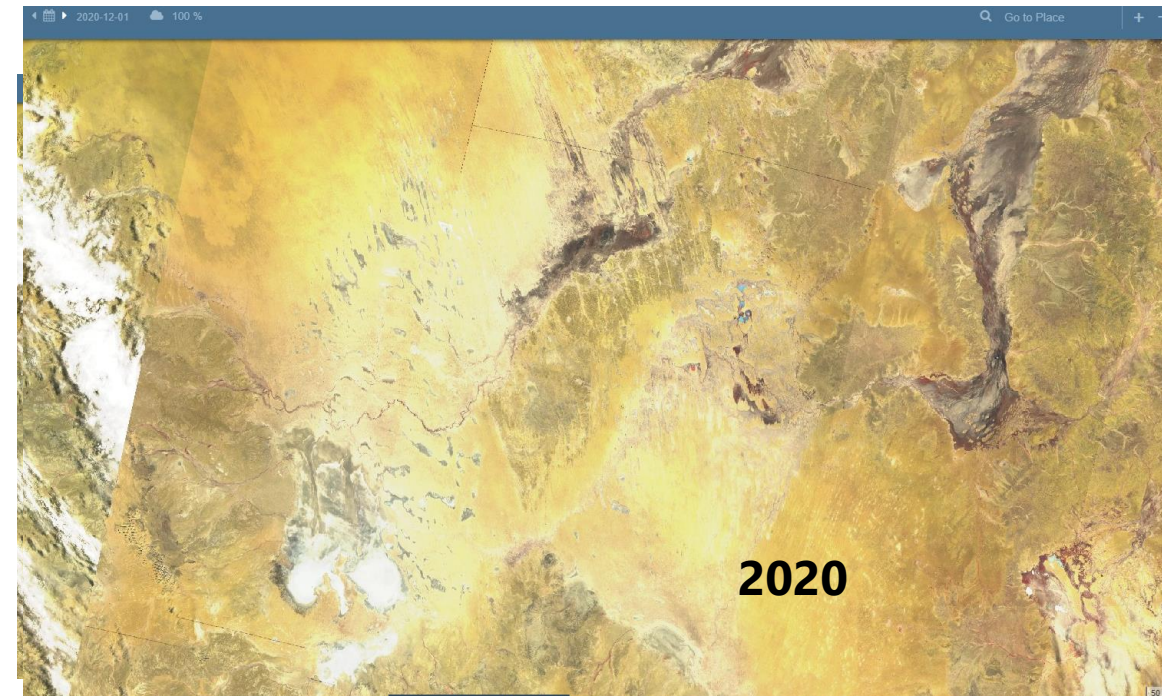
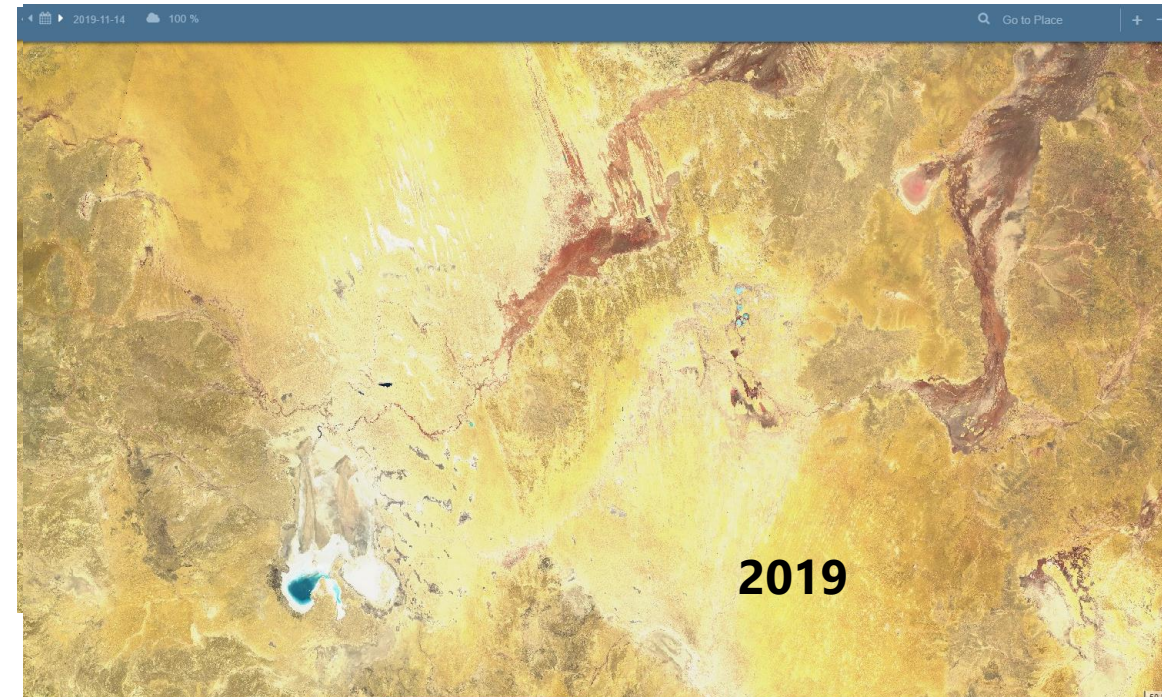
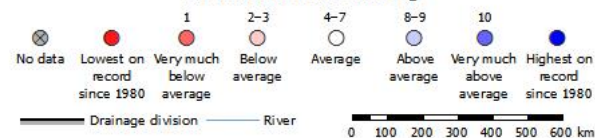
November 2020



Rainfall decile ranking



Streamflow decile ranking



Climate – review and outlook summary

Rainfall summary

Near average for much of Australia at the 12 month scale; some above average areas in SA, NSW, SW QLD; below average across much of Qld, NT and WA.

Through southern winter, rainfall was average or above average across much of the MDB, except SE Qld.

July, July and November mostly average or below average across MDB, average or above average August to October.

3 & 4 year rainfall well below average across much of SE Australia.

Climate drivers

La Niña

Likely wet summer, forecast to decay from January.

IOD

Neutral, forecast to be trending positive in 2021.

Southern Annular Mode

Positive, wetter than normal in SE Australia, linked with La Niña.

Climate – review and outlook summary cont.

Summer rainfall forecast

High likelihood of exceeding average rainfall over most of Australia.

Some low likelihood areas in SA.

Summer temperature forecast

High likelihood of exceeding average temperature over most of South Australia, Victoria and Tasmania.

MDB inflow and storage

Inflow at or below average.

Whole of basin storage at 57%, southern basin at 66%, northern basin at 25%.

Flow to SA

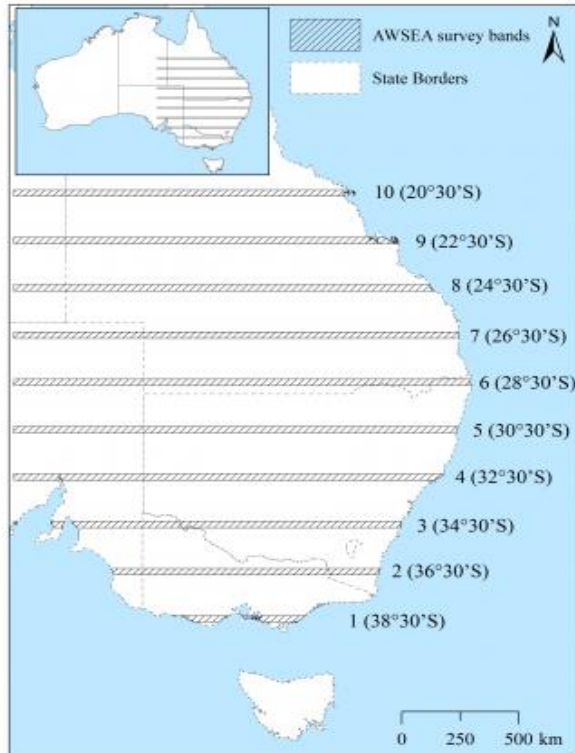
Entitlement flows supplemented by environmental water.

Waterfowl Abundance and Distribution, and Habitat Availability

- Eastern Australian Waterbird Survey
- DEW Wetlands and Waterfowl Surveys
- SA Aerial Surveys

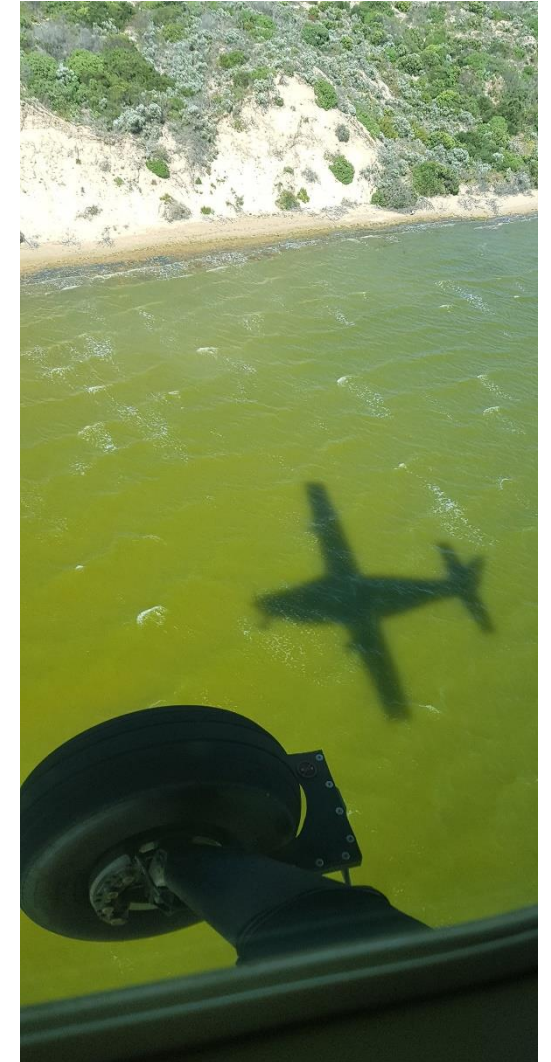


Eastern Australian Waterbird Survey (EAWS)



Key to wetlands from W-E, by band

- 10 Lake Moondarra, Cloncurry River, Flinders River, Campaspe R, Burdekin R
- 9 Georgina R, Eyre Ck, Hamilton R, Diamantina R, Lake Galilee, Styx R
- 8 Mumbleberry-Torquinnie Lakes, Eyre Ck, Diamantina R, Thomson R, Barcoo R, various small coastal wetlands
- 7 Goyder Lagoon, Lake Yamma Yamma, Cooper Ck, Bulloo R, Paroo R, Warrego R
- 6 Lake Eyre, Lake Hope, Bulloo R, Paroo R, Warrego R, Balonne R,
- 5 Lake Frome, Paroo O'flow, Darling R, Macquarie Marshes
- 4 Menindee Lakes, Talywalka Lakes, Myall Lakes
- 3 Murray River Lakes, Lowbidgee wetlands
- 2 Coorong, Cooper + Mokoan Lakes, Cooma-Monaro
- 1 Curdies Inlet, Jack Smith Lake



■Porter J.L., Kingsford R.T., Francis R., and Brandis K. (2020) *Aerial Survey of Wetland Birds in Eastern Australia- October 2020 Annual Summary Report*, University of New South Wales

EAWS - Wetland Index & Distribution

2020 Wetland area index 104,015 ha

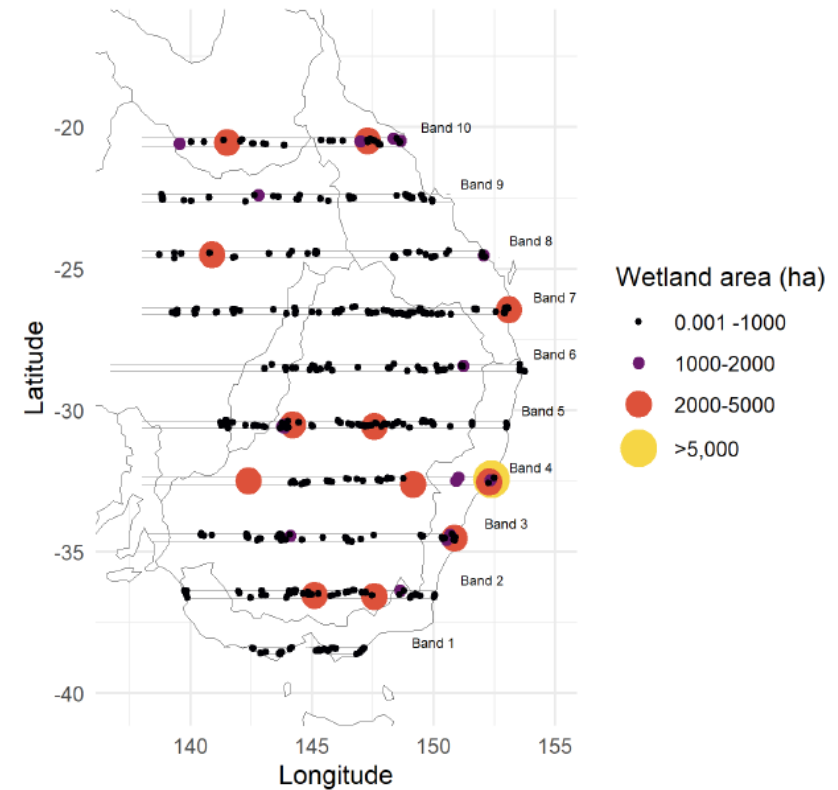
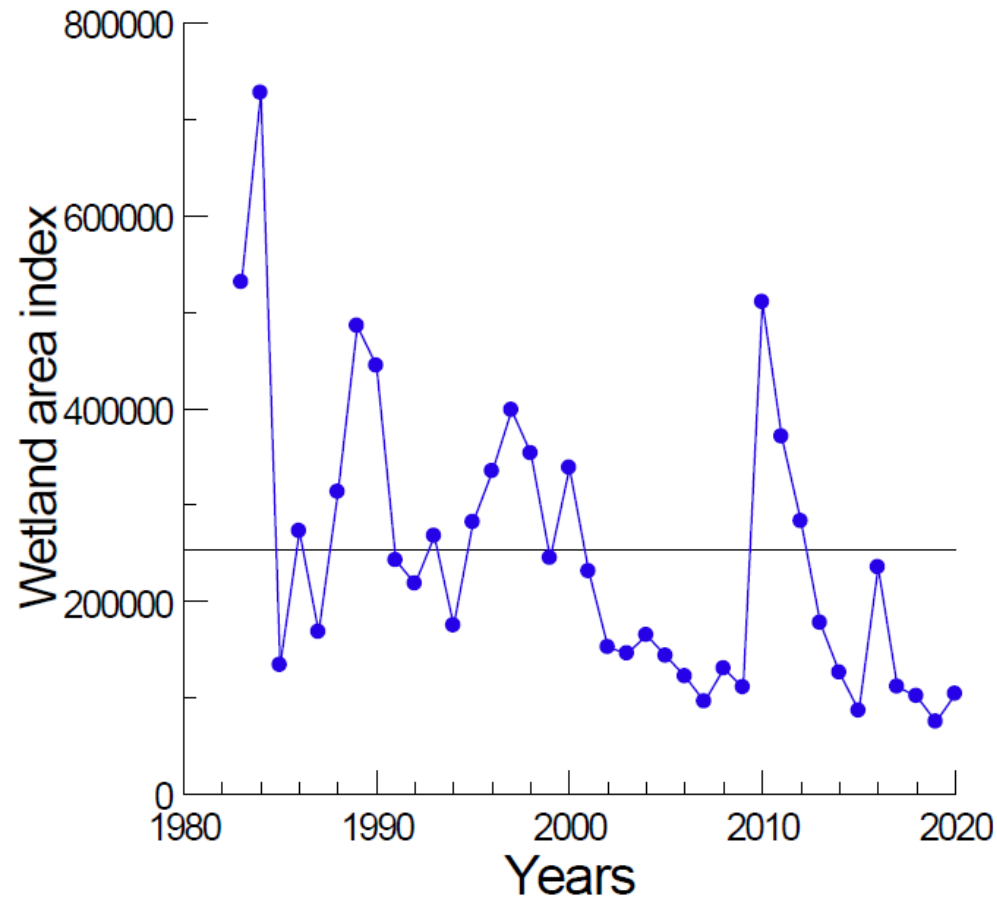


Figure 7. Distribution of wetland area in the 2020 Eastern Australian Waterbird Survey. All surveyed wetlands with surface water present are plotted; dry wetlands not plotted.

EAWS - Waterbird abundance & distribution

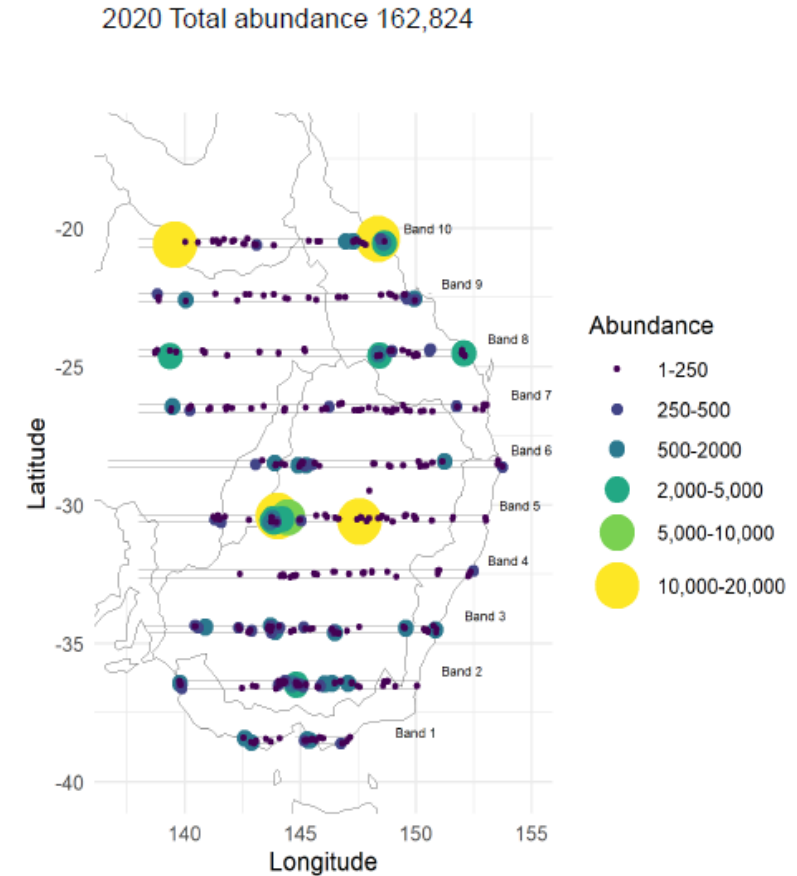
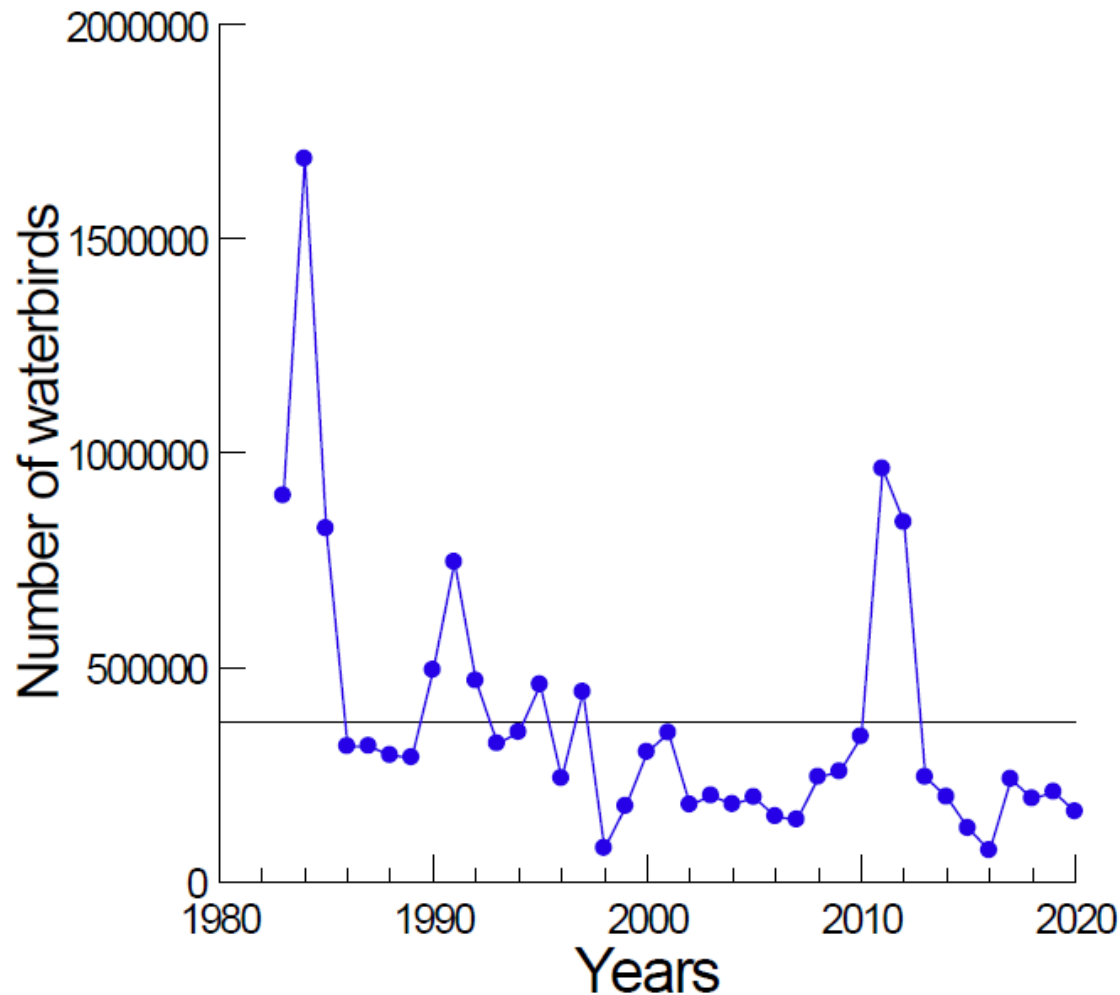
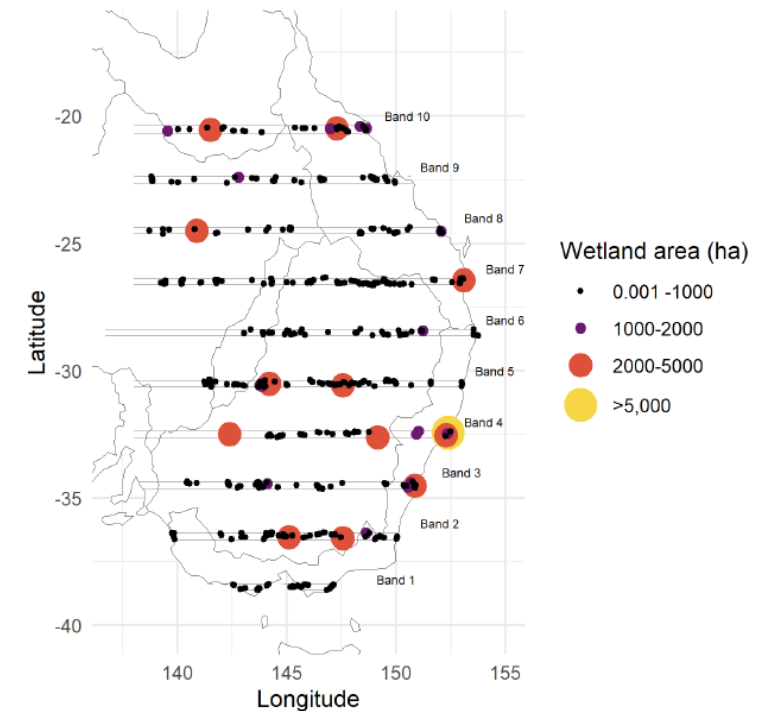
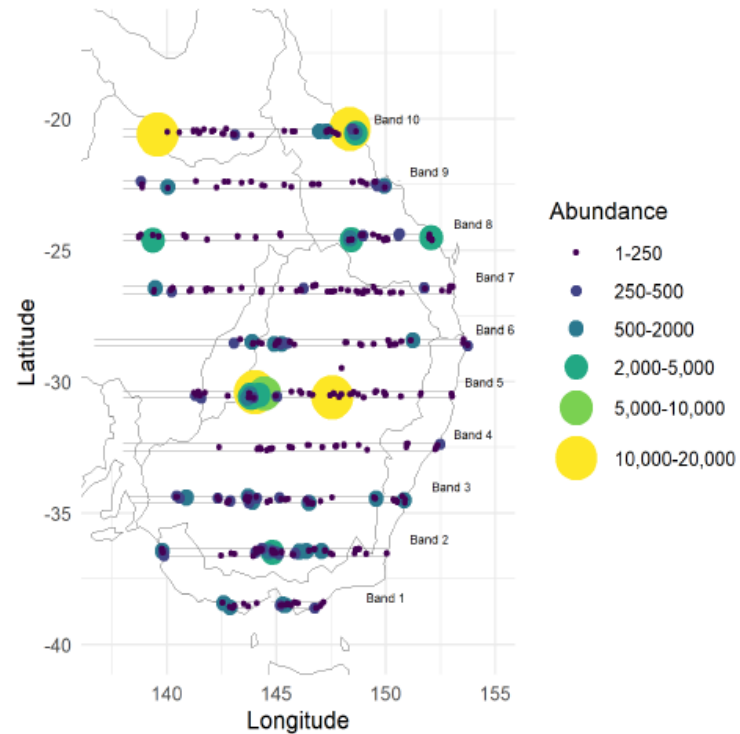
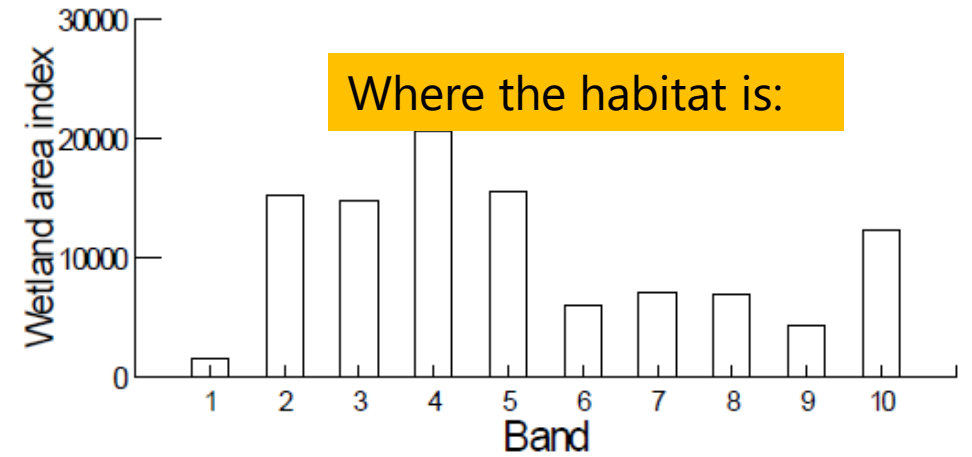
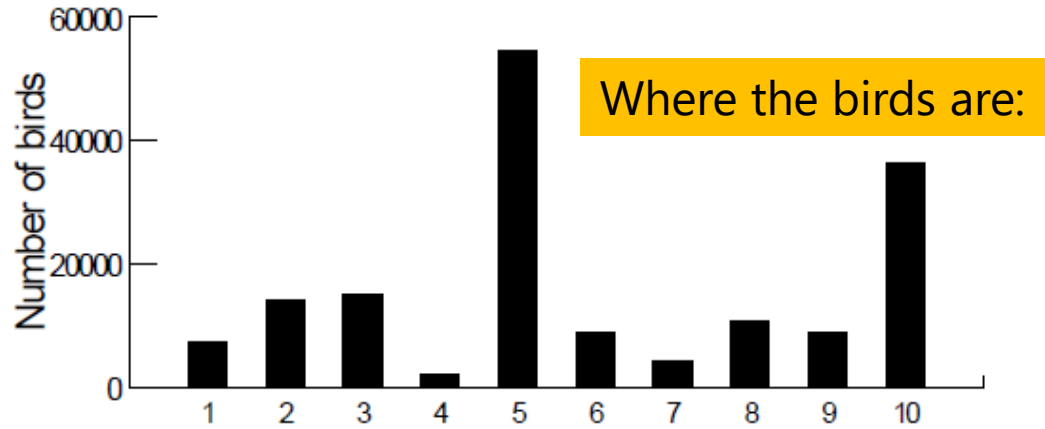


Figure 5. Distribution and abundance of waterbirds in the 2020 Eastern Australian Waterbird Survey. Dry wetlands and those with zero waterbirds not plotted.

EAWS - Waterbird locations



EAWS – Waterbird Breeding

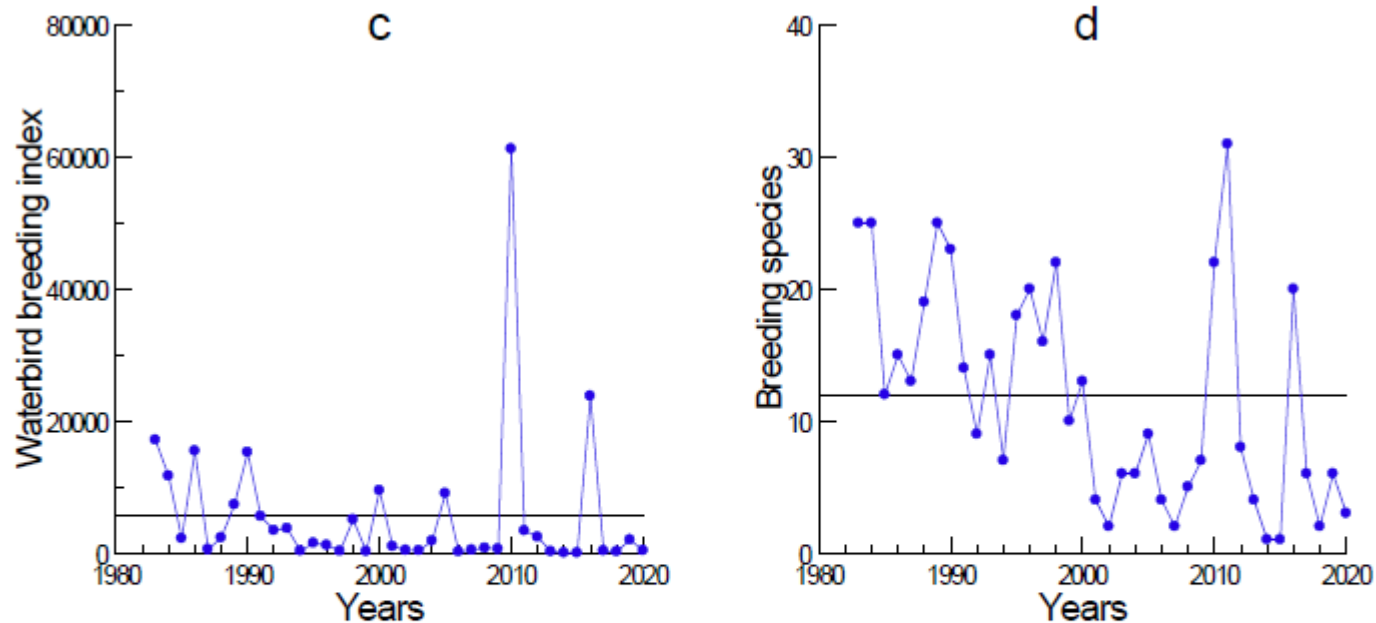


Figure 1. Changes over time in a) total abundance, b) wetland area, c) breeding and d) number of breeding species in the Eastern Australian Waterbird Survey (1983-2020); horizontal lines show long-term averages.

2020 Breeding index 364

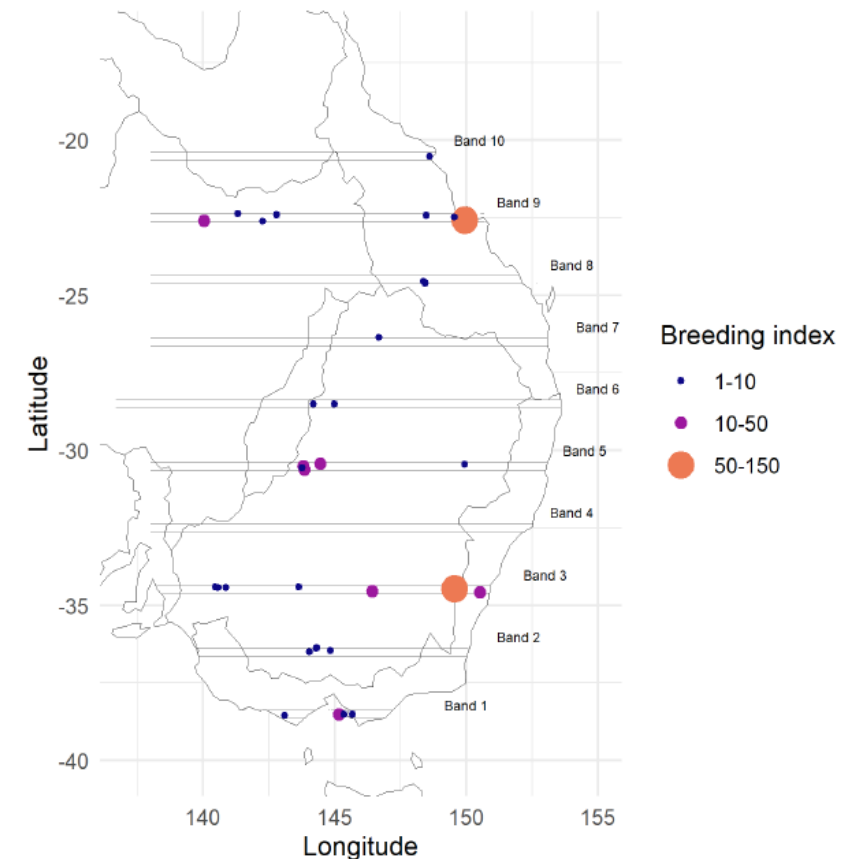


Figure 6. Distribution of waterbird breeding in the 2020 Eastern Australian Waterbird Survey. Only wetlands with breeding recorded are plotted.

EAWS – Game Duck

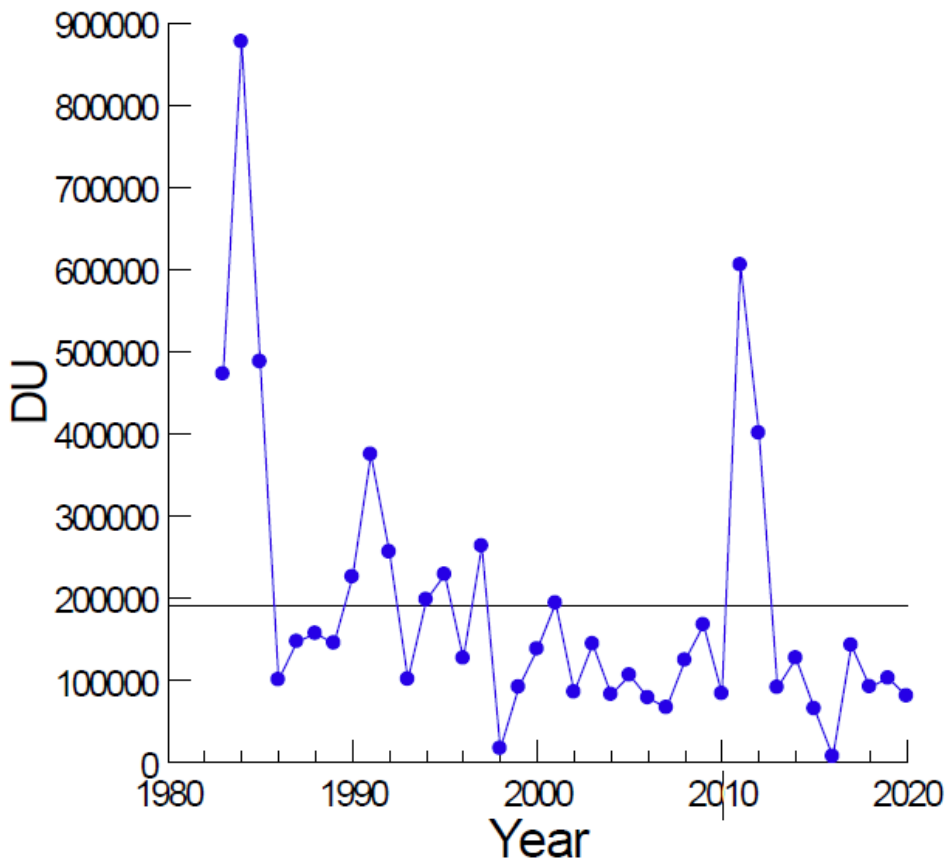
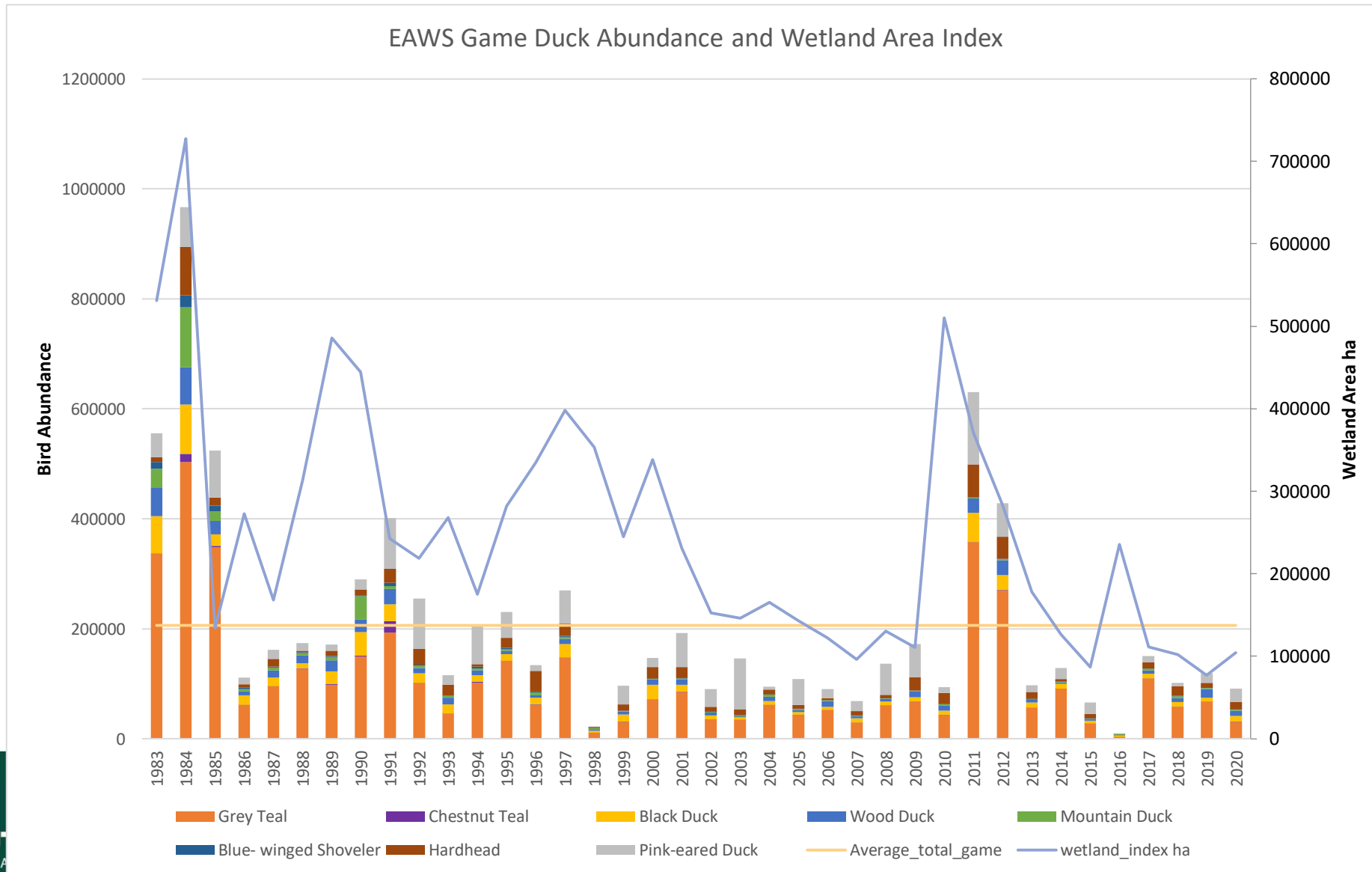


Table 3. Trends in abundances of game species from the Eastern Australian Waterbird Survey (1983-2020).

Species	Trend	Regression all years	Trend	Regression 1983-84 omitted
Pacific black duck	decline	$r^2=0.31$, $p<0.001$	decline	$r^2=0.19$, $p<0.007$
Australasian shoveler	decline	$r^2=0.54$, $p<0.001$	decline	$r^2=0.48$, $p<0.001$
Chestnut teal	no trend	$r^2=0.09$, $p=0.064$	no trend	$r^2=0.06$, $p=0.148$
Grey teal	decline	$r^2=0.21$, $p=0.004$	decline	$r^2=0.11$, $p=0.045$
Hardhead	no trend	$r^2=0.03$, $p=0.344$	no trend	$r^2=0.01$, $p=0.687$
Mountain duck	decline	$r^2=0.41$, $p<0.001$	decline	$r^2=0.35$, $p<0.001$
Pink-eared duck	no trend	$r^2=0.06$, $p=0.157$	no trend	$r^2=0.03$, $p=0.299$
Australian Wood duck	decline	$r^2=0.22$, $p=0.003$	no trend	$r^2=0.10$, $p=0.056$

EAWS game duck species composition



SA Wetland and Waterfowl Surveys

- Annual DEW volunteer-based survey (since 2003)
 - Thanks to all volunteers and DEW who assisted with the 2020 surveys
- Provides snapshot of suite of wetlands
- Indication of trends - not intended as absolute measure
- 90 wetlands surveyed in 2020 (total wetlands 100+ in register)
 - Covering 23,000+ ha
 - Nearly 50% increase on the number of wetlands surveyed in 2019
 - 130+ survey visits
 - 300+ hours of survey effort
 - Most area ever surveyed. NB the increased area covered in 2020 largely reflects both increased survey effort and increased effort by DEW to confirm area surveyed
 - Only four other years have had more wetlands surveyed

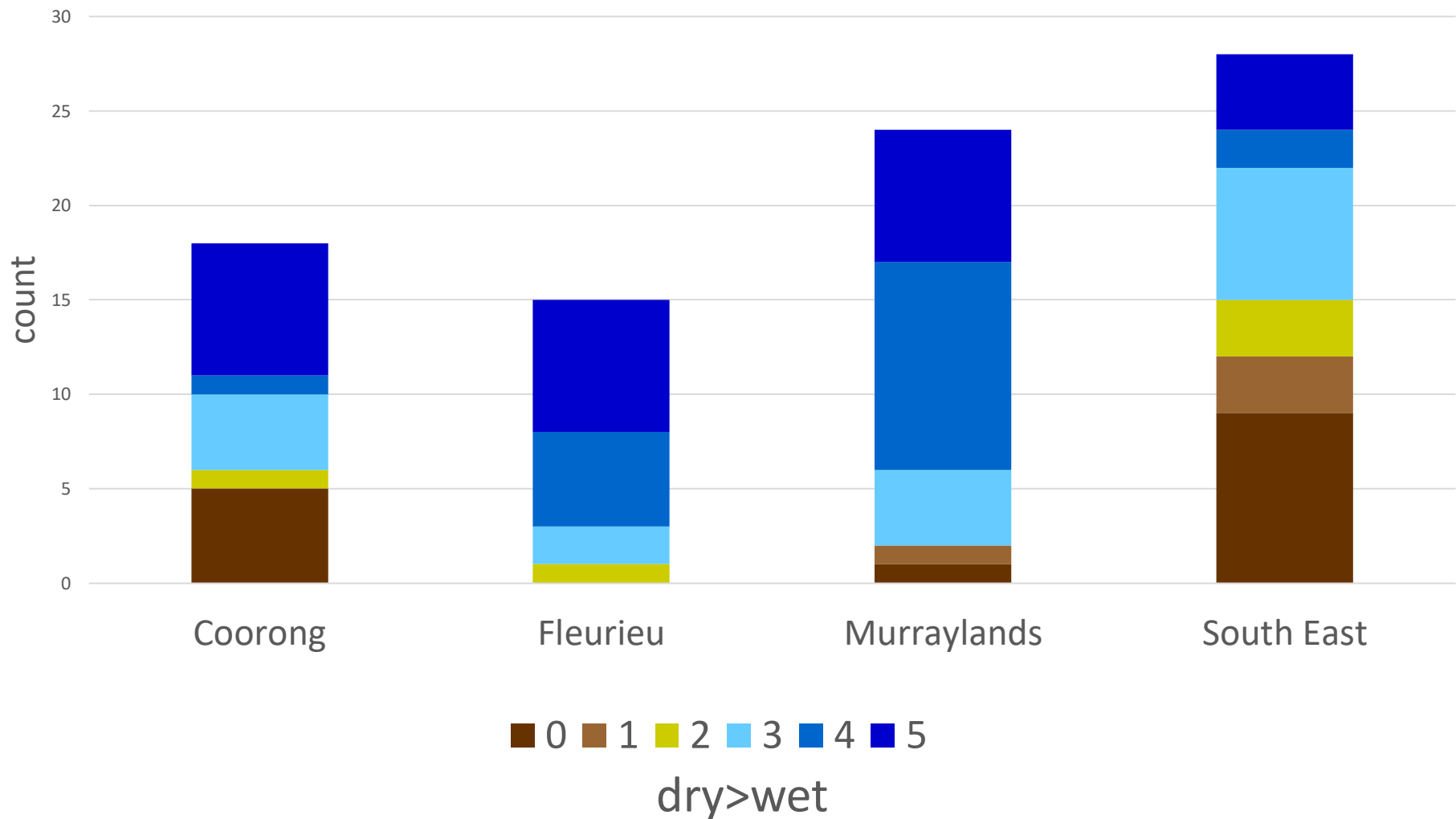


SA Wetland and Waterfowl Surveys – effort summary

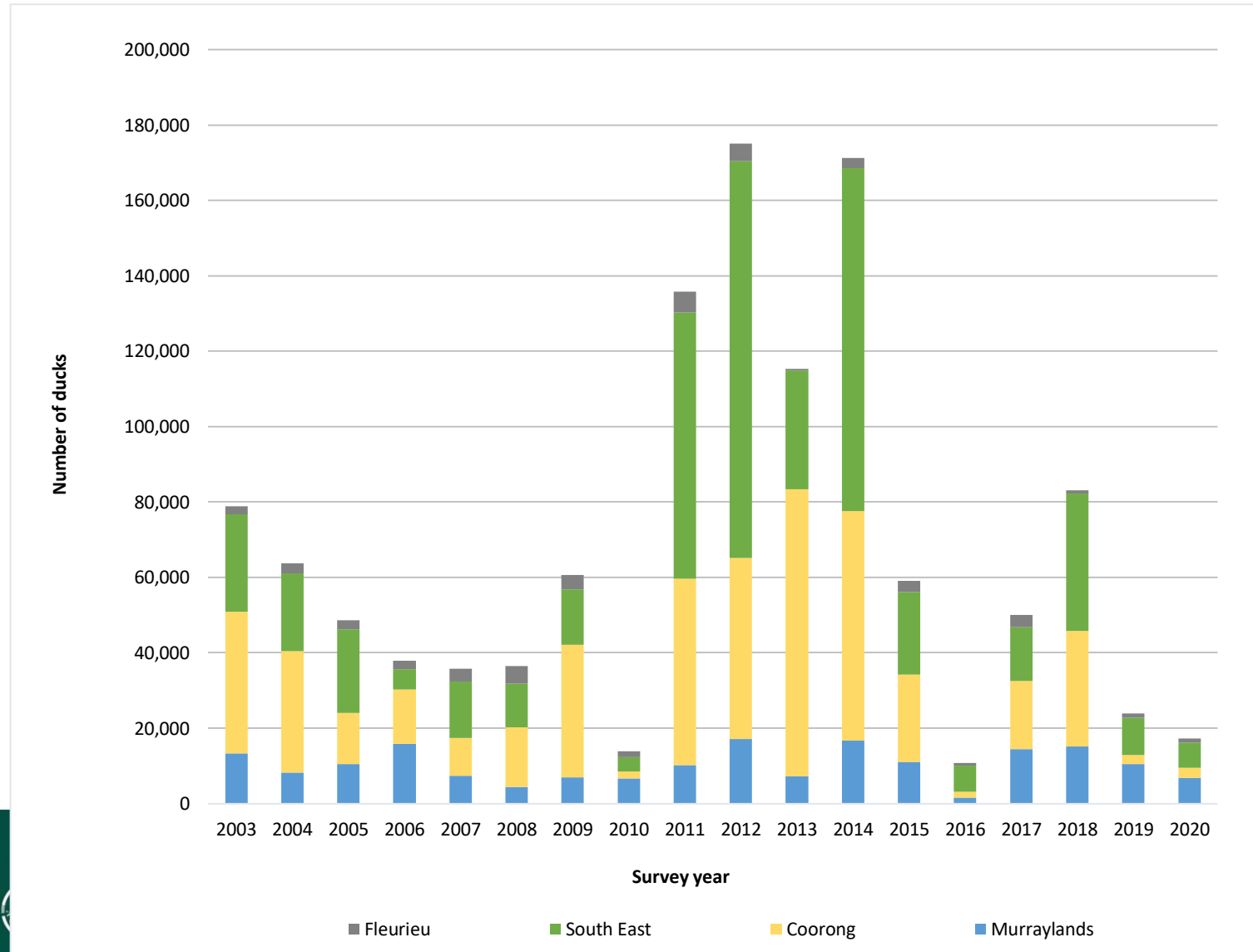
	Murraylands		Fleurieu		Coorong		South East		Total	
Year	No. of Wetlands Surveyed	Wetland Area surveyed (ha)	No. of Wetlands Surveyed	Wetland Area surveyed (ha)	No. of Wetlands Surveyed	Wetland Area surveyed (ha)	No. of Wetlands Surveyed	Wetland Area surveyed (ha)	No. of Wetlands Surveyed	Wetland Area surveyed (ha)
2003	23	1450	15	518	22	3392	28	7175	88	12535
2004	21	1594	15	488	25	3020	25	4251	86	9353
2005	22	1639	15	507	25	2205	24	3783	86	8134
2006	24	1650	15	512	28	3560	24	3283	91	9005
2007	25	2890	12	502	28	3365	26	3105	91	9862
2008	26	2790	14	562	27	3100	28	2618	95	9070
2009	24	2750	12	564	27	3210	28	2710	91	9234
2010	25	3570	14	466	22	3405	26	2196	87	9637
2011	19	2970	16	1695	17	4147	25	3128	77	11940
2012	20	3070	16	1695	18	4247	25	3128	79	12140
2013	13	2670	5	16	12	2725	19	6406	49	11817
2014	24	4785	12	307	19	5680	22	7223	77	17995
2015	23	3744	13	3990	20	3009	23	2298	79	13040
2016	22	6701	16	1798	17	3883	30	5492	85	17874
2017	17	3504	14	1102	13	2438	17	3852	61	10896
2018	21	2406	15	316	20	2902	25	8812	81	14436
2019	16	2247	14	232	10	307	22	1886	62	4672
2020	24	3329	16	277	21	4235	29	15714	90	23555
Average	22	2987	14	864	21	3268	25	4837	81	11955



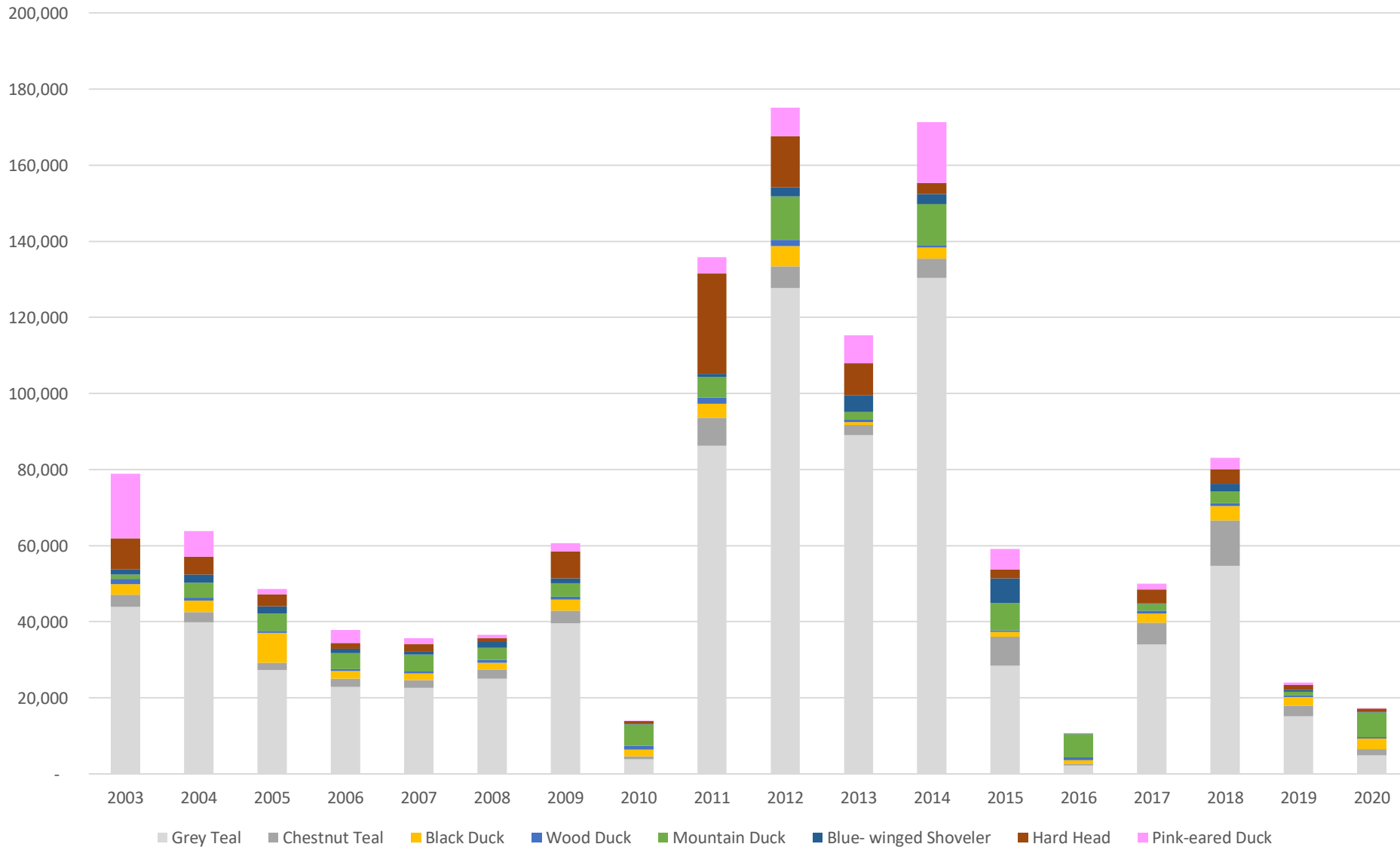
SA Surveys – Wetland Capacity



SA Surveys – Waterfowl Distribution



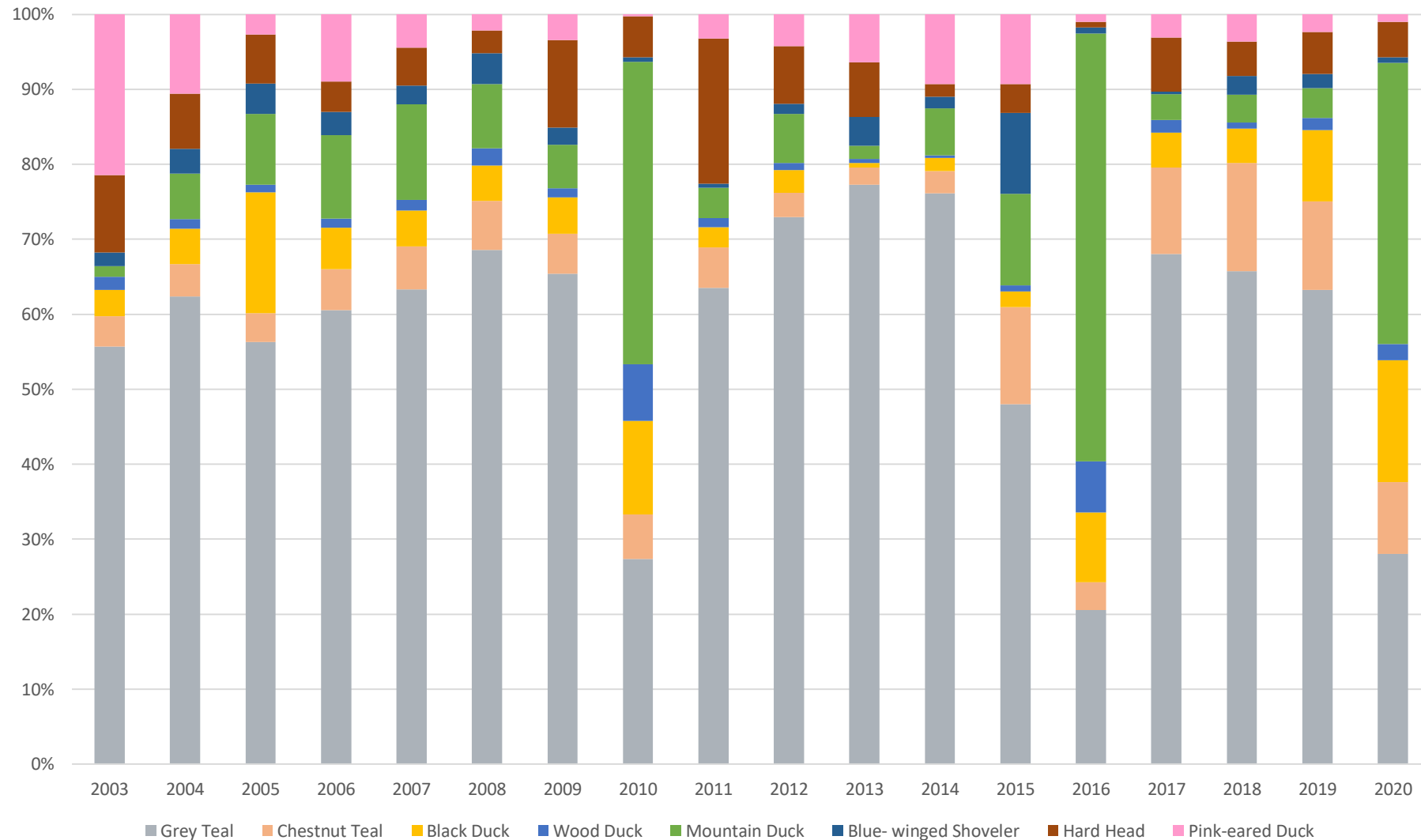
SA Surveys – Waterfowl Composition



SOUTH AUSTRALIA

Land and Water

SA Surveys – Waterfowl Species Proportions



Game duck abundance

Year	Grey Teal	Chestnut Teal	Black Duck	Wood Duck	Mountain Duck	Blue- winged Shoveler	Hard Head	Pink-eared Duck	Totals
2003	43,948	3,177	2,801	1,389	1,102	1,428	8,126	16,946	78,917
2004	39,789	2,746	3,038	801	3,869	2,118	4,673	6,762	63,796
2005	27,339	1,848	7,824	522	4,583	1,956	3,190	1,292	48,554
2006	22,881	2,078	2,096	441	4,216	1,178	1,520	3,396	37,806
2007	22,594	2,055	1,709	501	4,537	908	1,792	1,589	35,685
2008	25,031	2,398	1,724	819	3,129	1,518	1,093	794	36,506
2009	39,626	3,232	2,955	724	3,539	1,364	7,084	2,088	60,612
2010	3,801	826	1,733	1,051	5,609	86	760	33	13,899
2011	86,256	7,341	3,689	1,661	5,482	715	26,342	4,358	135,844
2012	127,695	5,734	5,311	1,686	11,422	2,331	13,434	7,472	175,085
2013	89,105	2,658	689	627	2,052	4,419	8,435	7,353	115,337
2014	130,353	5,084	2,982	613	10,730	2,634	2,967	15,915	171,277
2015	28,392	7,630	1,243	464	7,251	6,374	2,277	5,487	59,117
2016	2,200	401	997	724	6,112	87	83	107	10,709
2017	34,009	5,776	2,324	841	1,692	171	3,636	1,535	49,983
2018	54,665	11,946	3,839	672	3,082	2,076	3,809	3,028	83,114
2019	15,151	2,818	2,283	395	955	438	1,341	572	23,954
2020	4,845	1,656	2,797	375	6,478	134	809	178	17,272
average	44,316	3,856	2,780	795	4,769	1,663	5,076	4,384	67,637

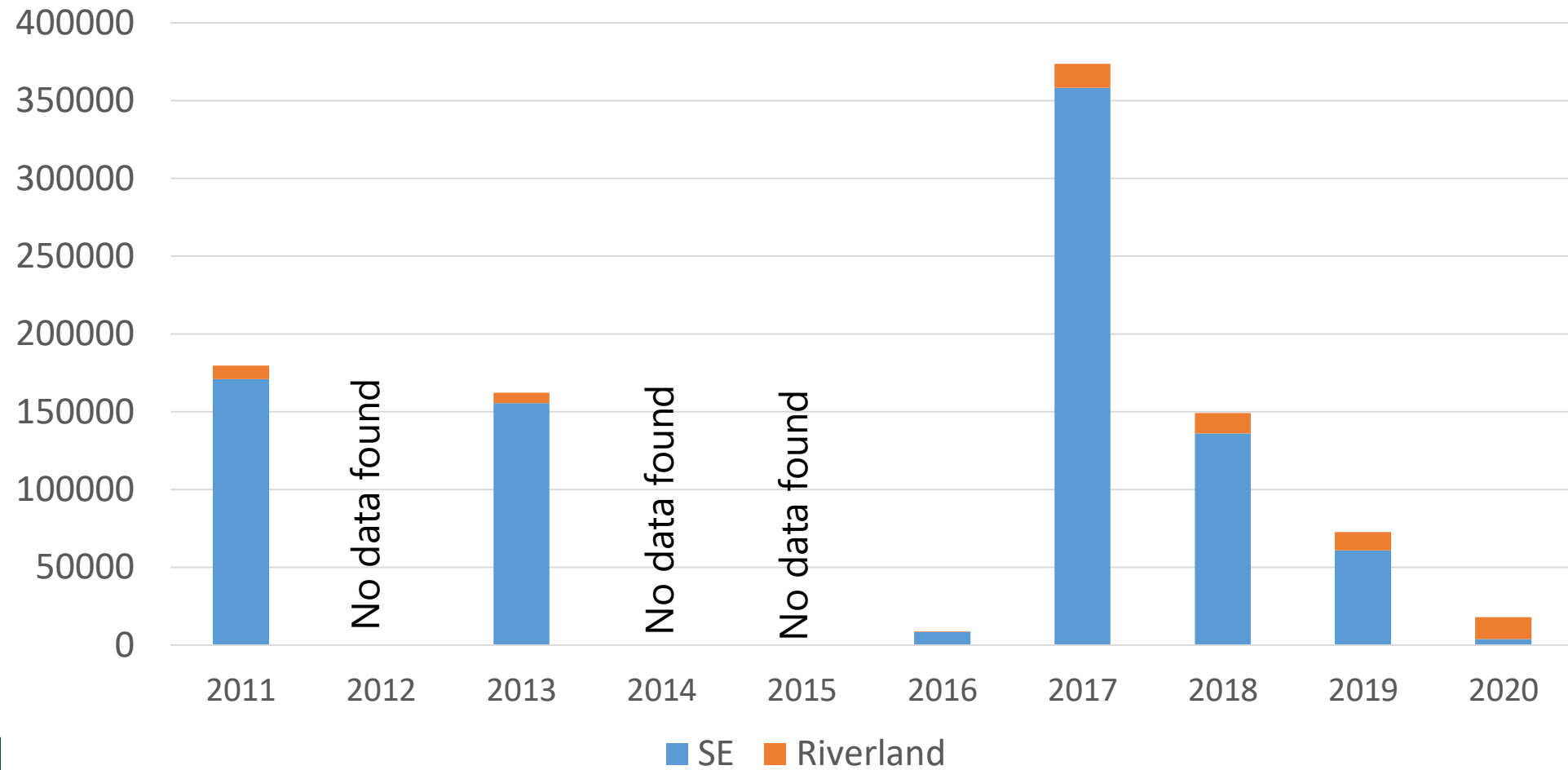
Species proportions

Year	Grey Teal	Chestnut Teal	Black Duck	Wood Duck	Mountain Duck	Blue-winged Shoveler	Hard Head	Pink-eared Duck
2003	55.7	4.0	3.5	1.8	1.4	1.8	10.3	21.5
2004	62.4	4.3	4.8	1.3	6.1	3.3	7.3	10.6
2005	56.3	3.8	16.1	1.1	9.4	4.0	6.6	2.7
2006	60.5	5.5	5.5	1.2	11.2	3.1	4.0	9.0
2007	63.3	5.8	4.8	1.4	12.7	2.5	5.0	4.5
2008	68.6	6.6	4.7	2.2	8.6	4.2	3.0	2.2
2009	65.4	5.3	4.9	1.2	5.8	2.3	11.7	3.4
2010	27.3	5.9	12.5	7.6	40.4	0.6	5.5	0.2
2011	63.5	5.4	2.7	1.2	4.0	0.5	19.4	3.2
2012	72.9	3.3	3.0	1.0	6.5	1.3	7.7	4.3
2013	77.3	2.3	0.6	0.5	1.8	3.8	7.3	6.4
2014	76.1	3.0	1.7	0.4	6.3	1.5	1.7	9.3
2015	48.0	12.9	2.1	0.8	12.3	10.8	3.9	9.3
2016	20.5	3.7	9.3	6.8	57.1	0.8	0.8	1.0
2017	68.0	11.6	4.6	1.7	3.4	0.3	7.3	3.1
2018	65.8	14.4	4.6	0.8	3.7	2.5	4.6	3.6
2019	63.2	11.8	9.5	1.7	4.0	1.8	5.6	2.4
2020	28.1	9.6	16.2	2.2	37.5	0.8	4.7	1.0
Average	57.9	6.6	6.2	1.9	12.9	2.6	6.5	5.4

2020 abundances relative to long-term averages

		Grey Teal	Chestnut Teal	Black Duck	Wood Duck	Mountain Duck	Blue-winged Shoveler	Hard Head	Pink-eared Duck	Totals
SA W&W surveys	2020	4,845	1,656	2,797	375	6,478	134	809	178	17,272
	dataset average (2003-2020)	44,316	3,856	2,780	795	4,769	1,663	5,076	4,384	67,637
	2020 as % of dataset average	11	43	101	47	136	8	16	4	26
EAWS	2020	30,208	909	10,688	9,035	2,429	267	12,844	24,850	91,230
	dataset average (1983-2020)	110,727	1,328	17,578	12,831	7,729	2,174	16,711	37,271	206,347
	2020 as % of dataset average	27	68	61	70	31	12	77	67	44

SA Aerial Surveys



Waterfowl and habitat summary

South Australia

Wetland habitat in 90 SA wetlands

Nearly 50% dry, drying or low

Abundance of ducks

Third lowest since 2003 despite high survey effort, c. 25% long-term average

Abundance in the Coorong and SE about 10% and 23% of long-term average

Species dominance

Nearly 2:1 resident:nomadic species, on average around 1:4

Eastern Continental Scale

Wetland area index

Fifth lowest on record, well below long-term average

Total waterfowl abundance

Decreased marginally from 2019, continued long-term decline

Breeding index & # species breeding

Breeding index decreased from 2019, 3 species breeding

Game duck species

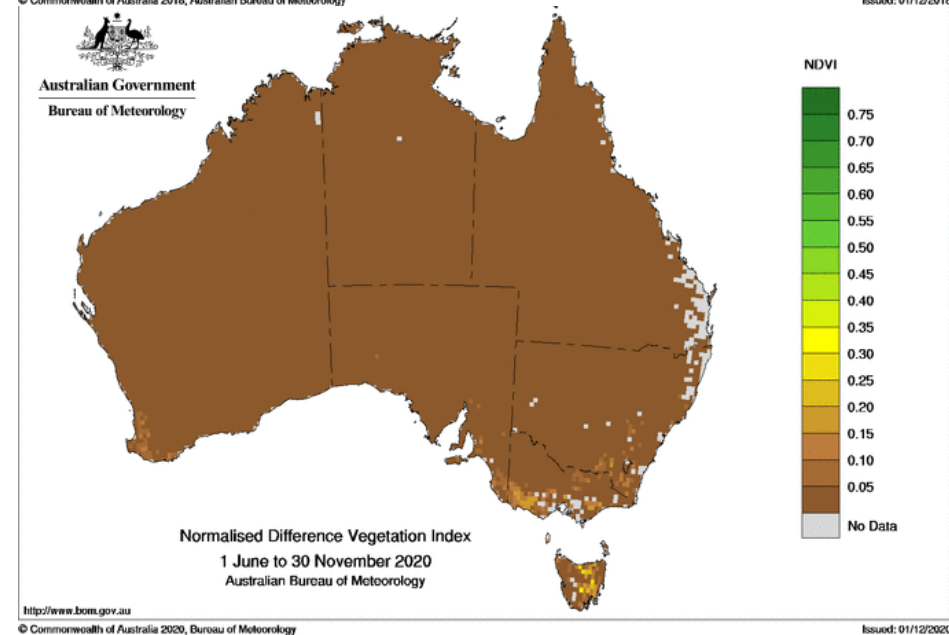
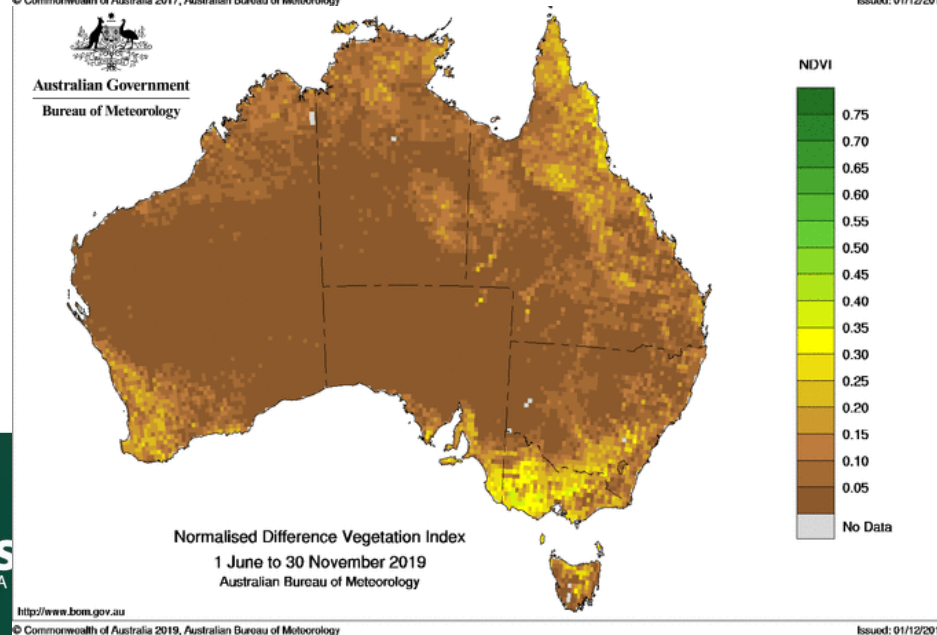
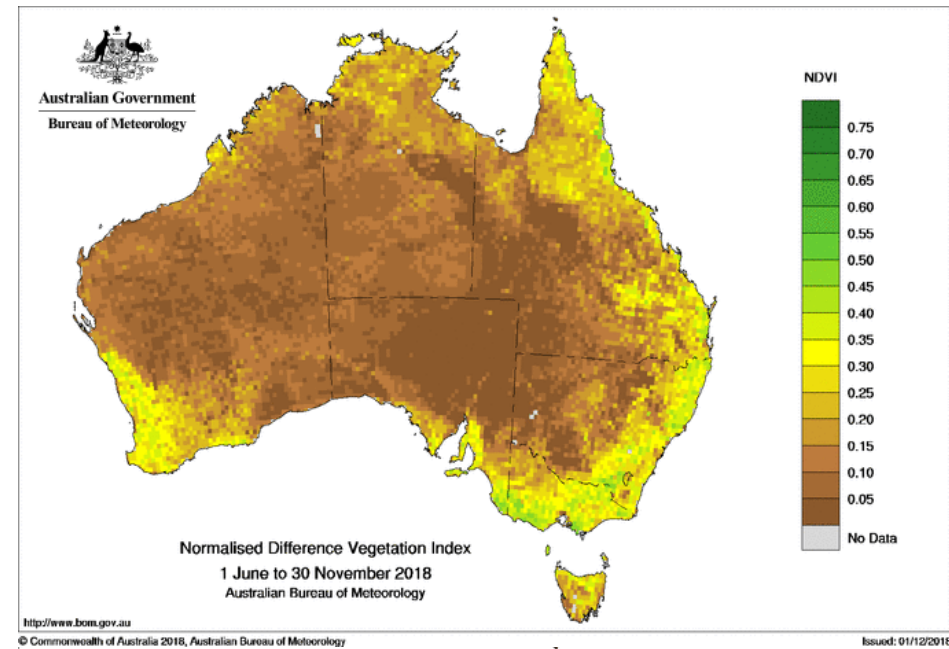
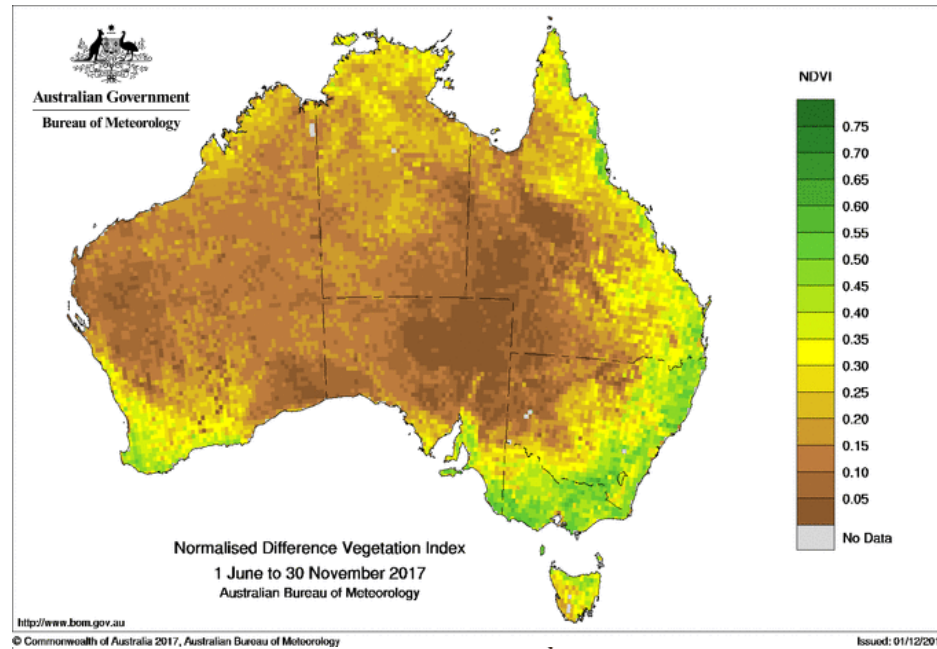
All abundances below long-term average, five of eight species show continued long-term decline

Landscape Condition

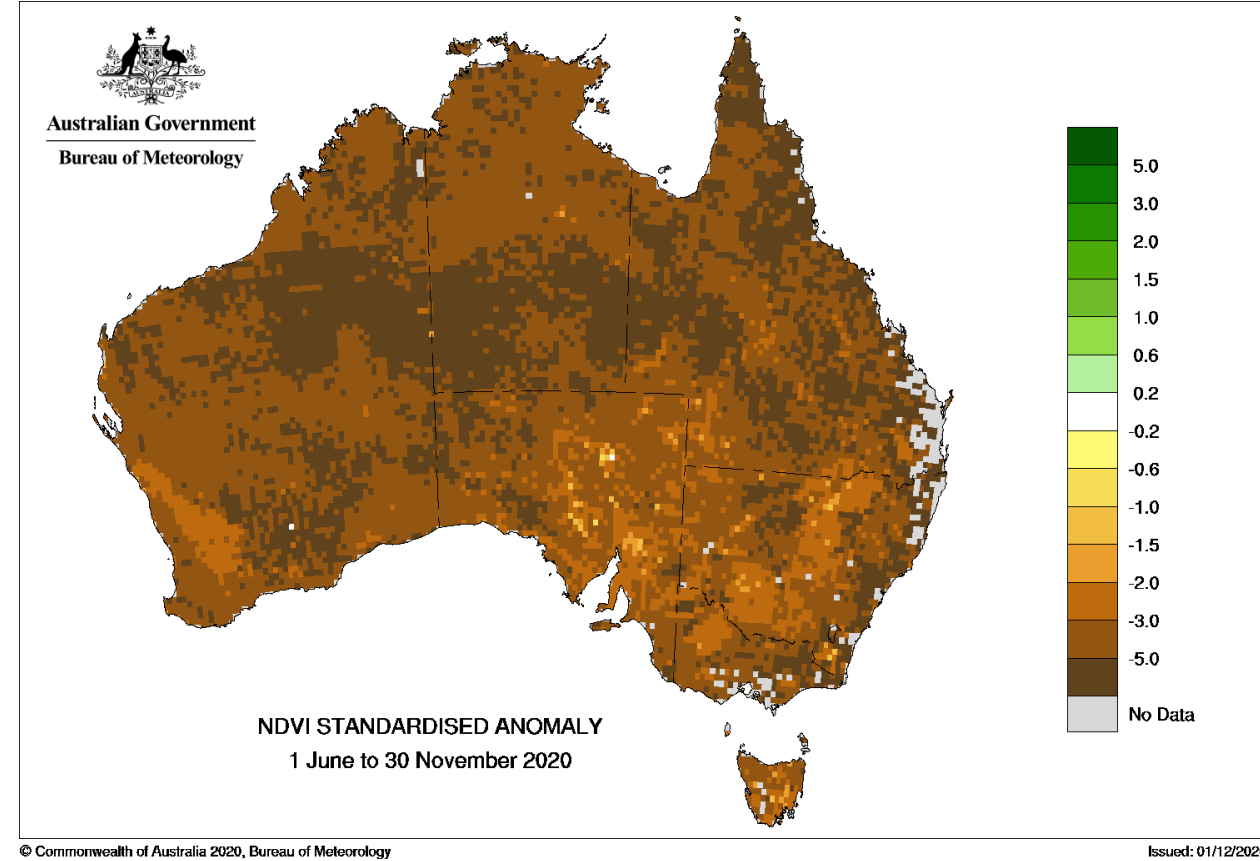
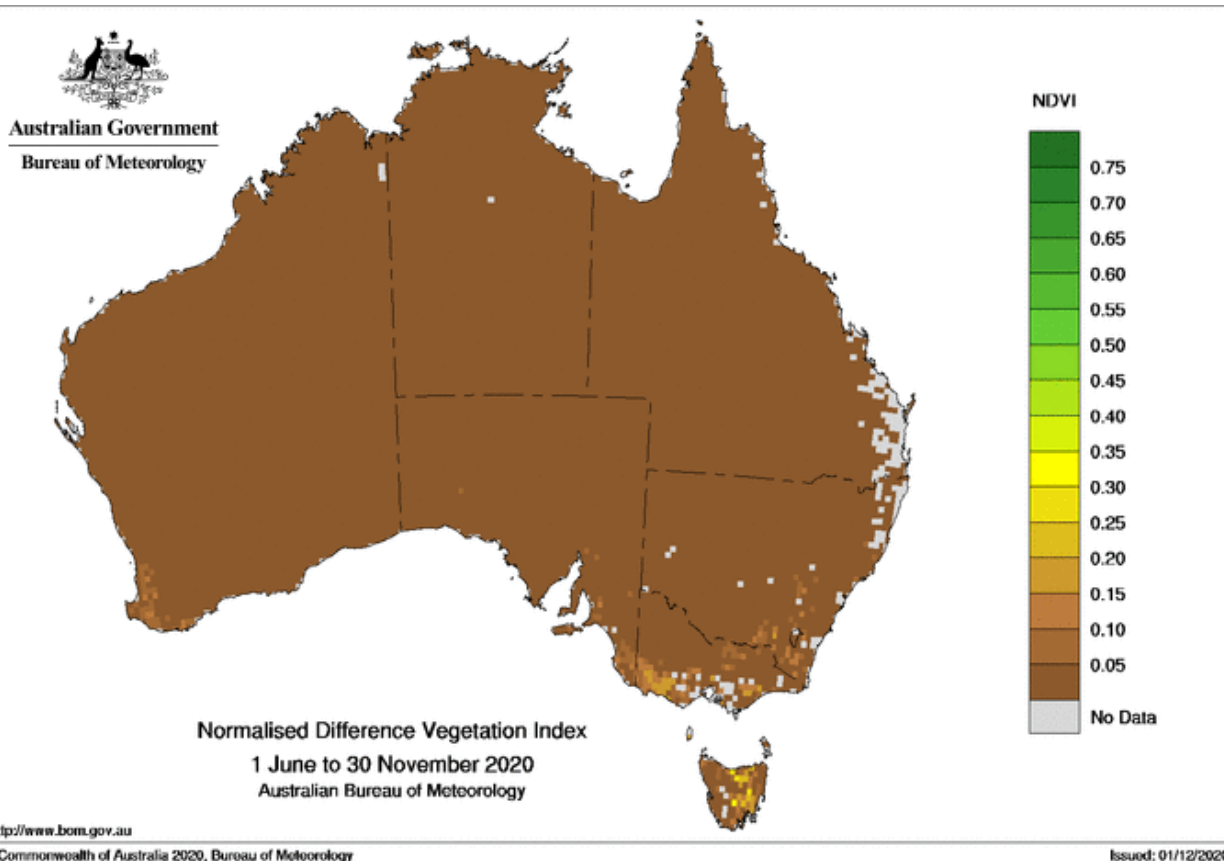
- Normalised Difference Vegetation Index
- Soil Moisture
- Pasture Biomass



Normalised Difference Vegetation Index (NDVI)



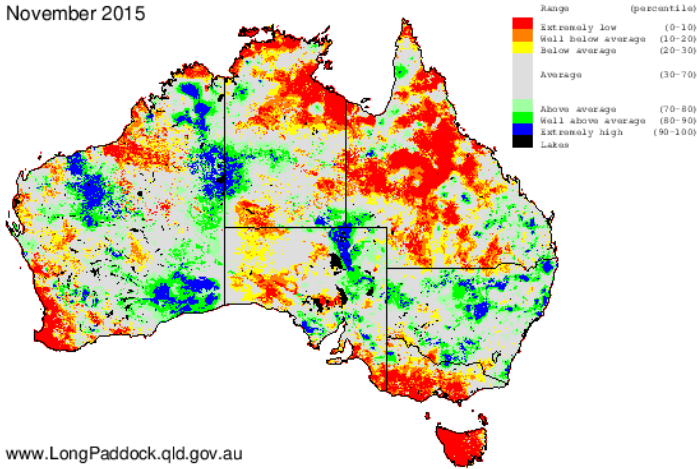
Normalised Difference Vegetation Index



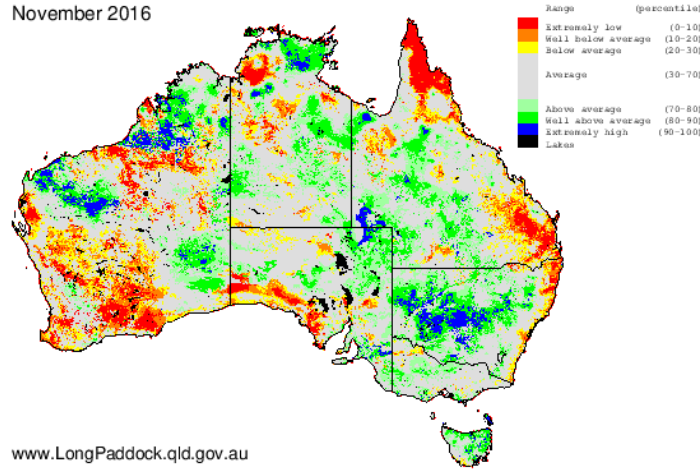
Available Soil Water (0-100cm)

(Relative to historical records from 1957)

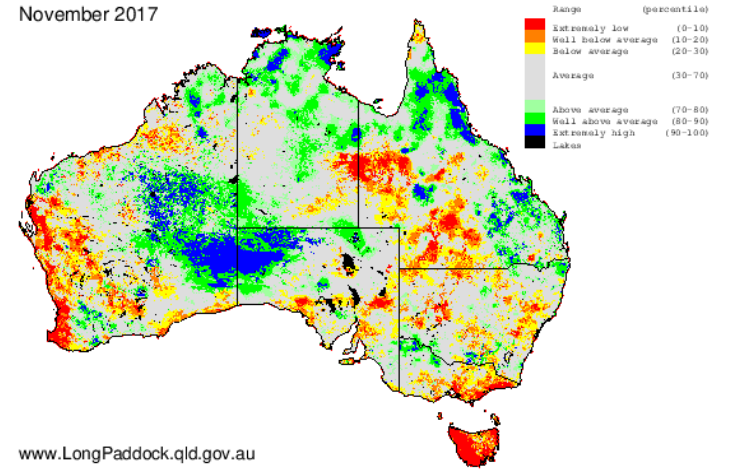
Available Soil Water (0-100 cm)
Relative to Historical Records from 1957
November 2015



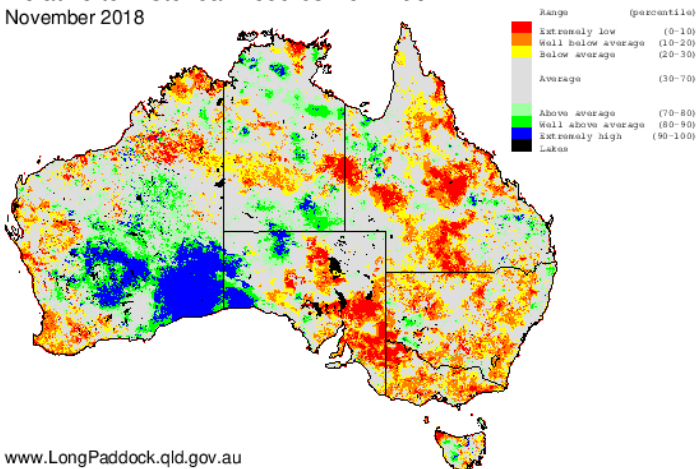
Available Soil Water (0-100 cm)
Relative to Historical Records from 1957
November 2016



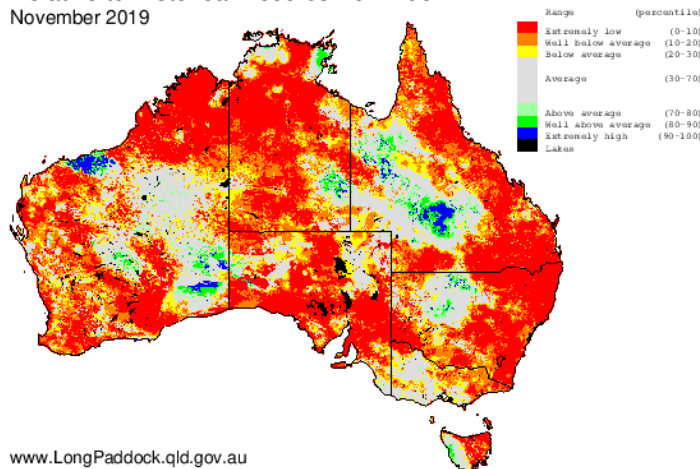
Available Soil Water (0-100 cm)
Relative to Historical Records from 1957
November 2017



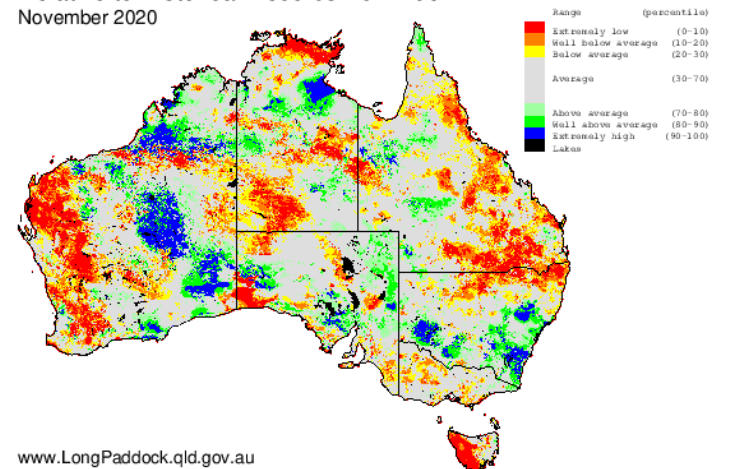
Available Soil Water (0-100 cm)
Relative to Historical Records from 1957
November 2018



Available Soil Water (0-100 cm)
Relative to Historical Records from 1957
November 2019



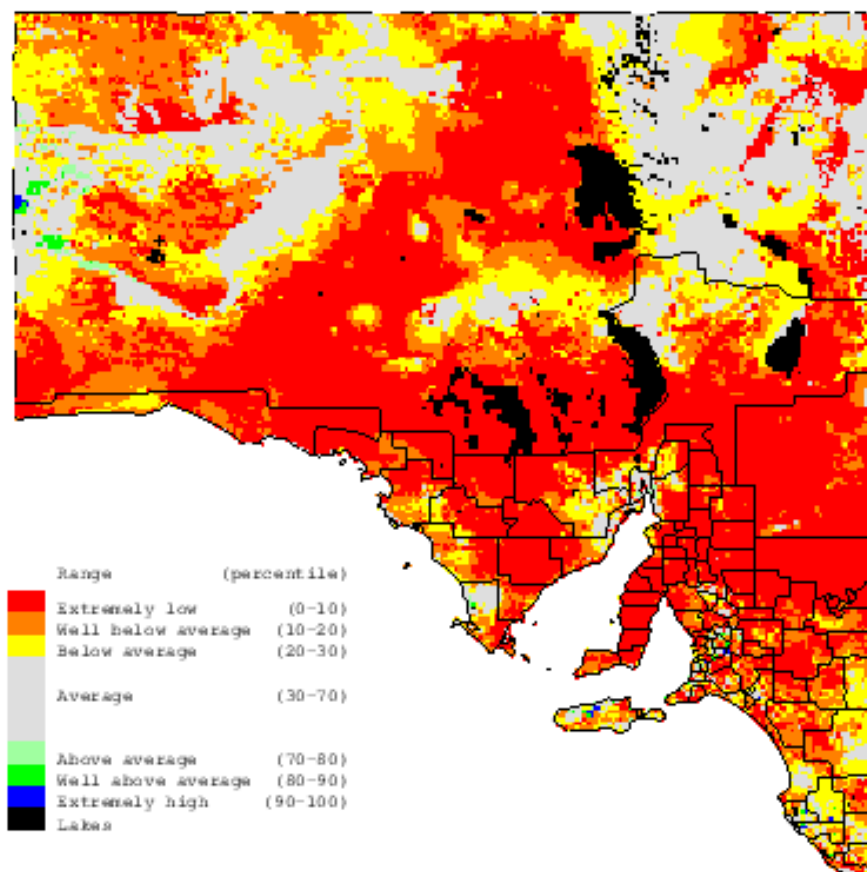
Available Soil Water (0-100 cm)
Relative to Historical Records from 1957
November 2020



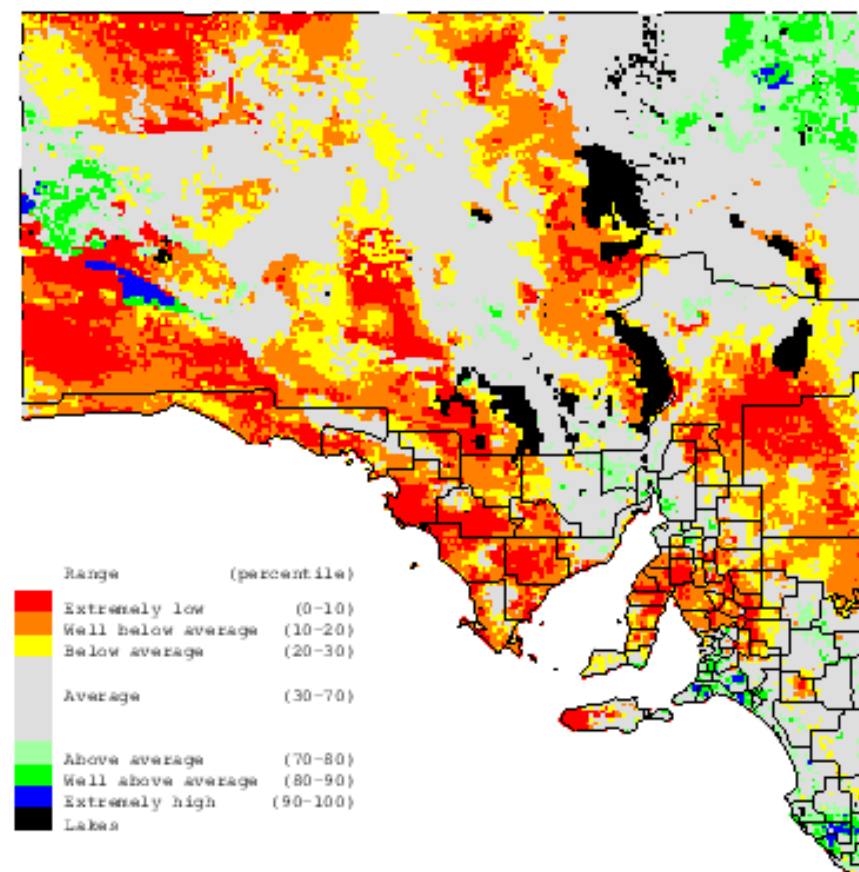
Available Soil Water (0-100cm)

(Relative to historical records from 1957)

Available Soil Water (0-100 cm)
Relative to Historical Records from 1957
December 2018 to November 2019

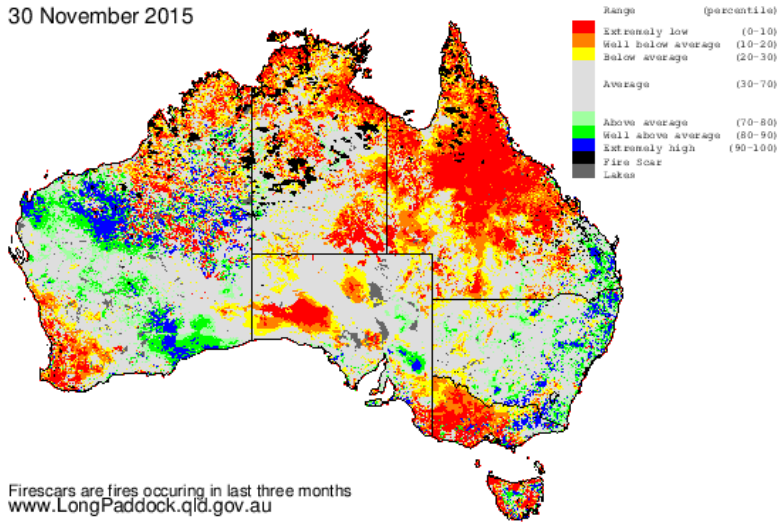


Available Soil Water (0-100 cm)
Relative to Historical Records from 1957
December 2019 to November 2020



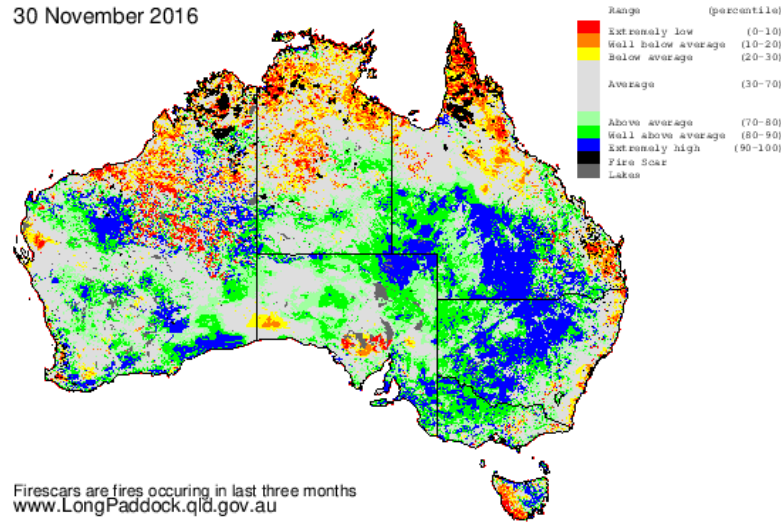
Pasture Biomass

TSDM Percentile
Relative to Historical Records from 1957
30 November 2015



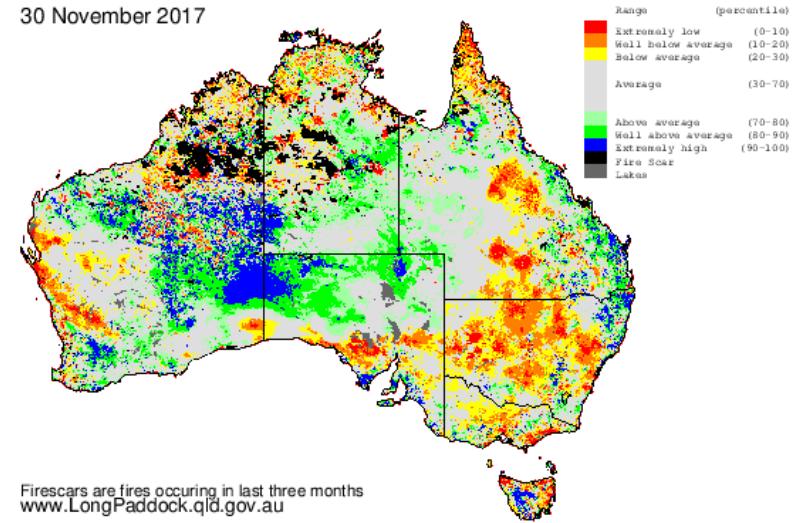
Firescars are fires occurring in last three months
www.LongPaddock.qld.gov.au

TSDM Percentile
Relative to Historical Records from 1957
30 November 2016



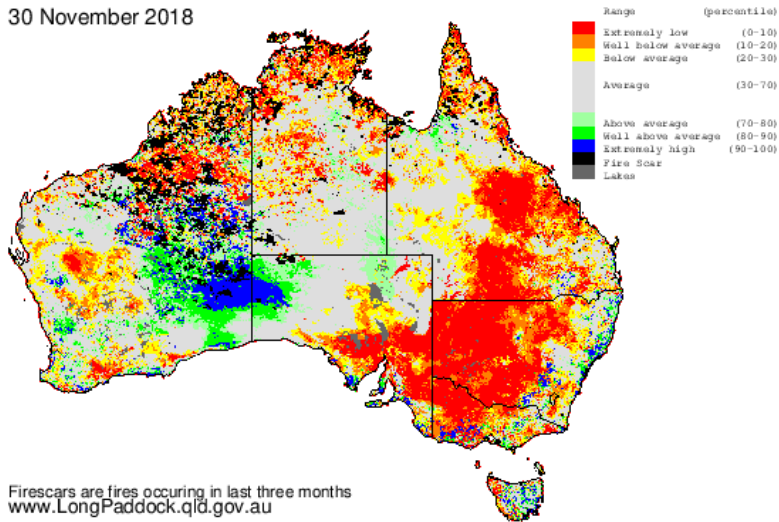
Firescars are fires occurring in last three months
www.LongPaddock.qld.gov.au

TSDM Percentile
Relative to Historical Records from 1957
30 November 2017



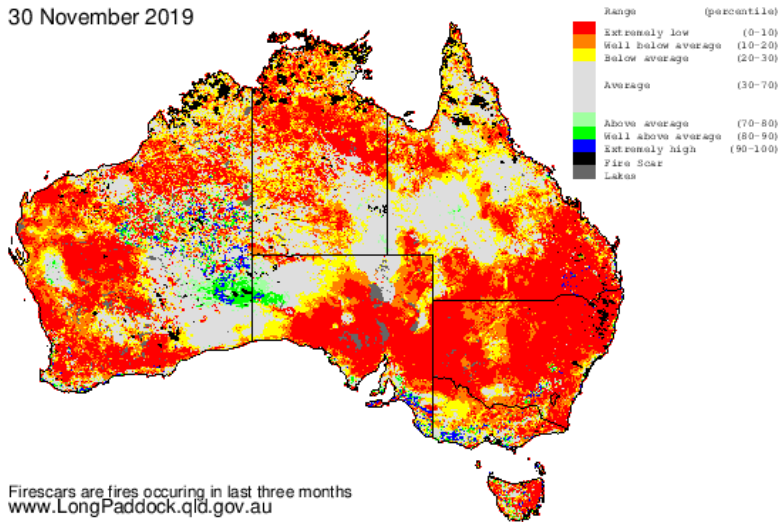
Firescars are fires occurring in last three months
www.LongPaddock.qld.gov.au

TSDM Percentile
Relative to Historical Records from 1957
30 November 2018



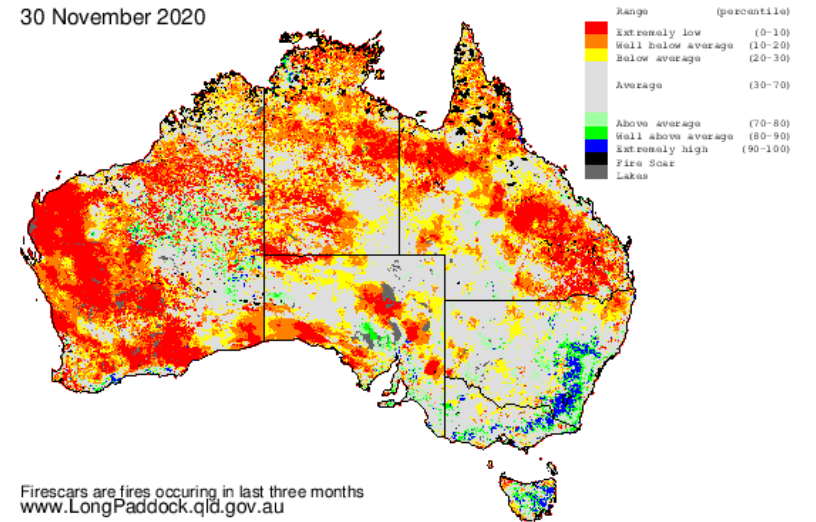
Firescars are fires occurring in last three months
www.LongPaddock.qld.gov.au

TSDM Percentile
Relative to Historical Records from 1957
30 November 2019



Firescars are fires occurring in last three months
www.LongPaddock.qld.gov.au

TSDM Percentile
Relative to Historical Records from 1957
30 November 2020



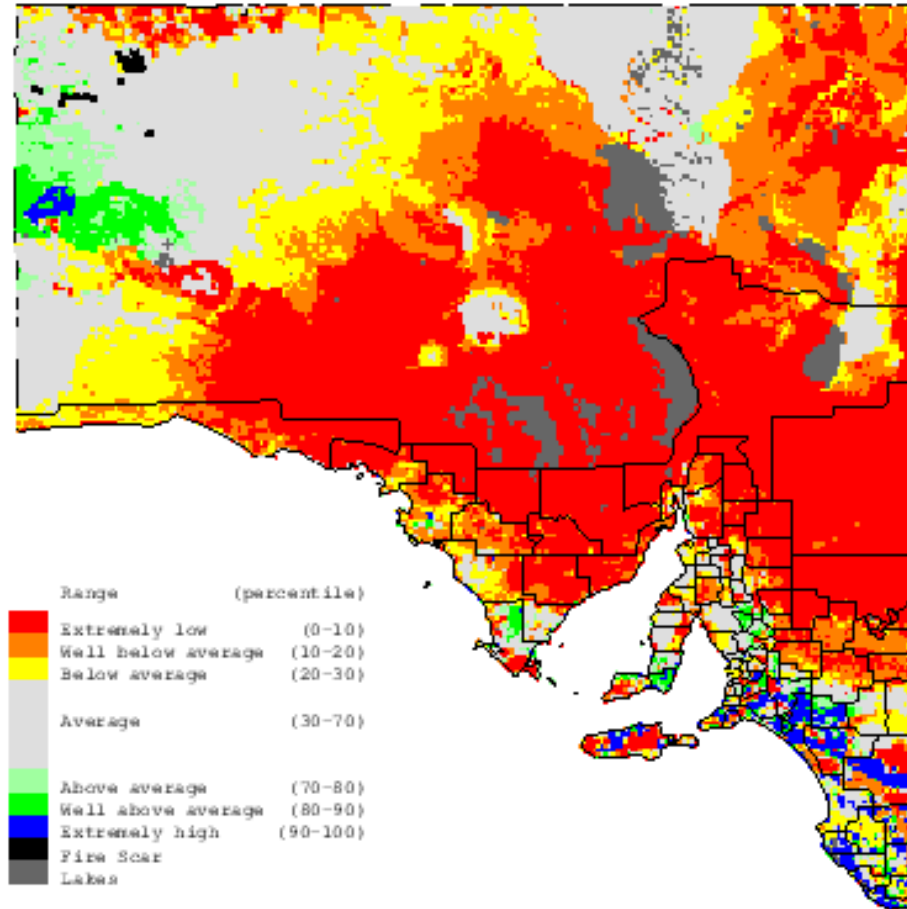
Firescars are fires occurring in last three months
www.LongPaddock.qld.gov.au

Pasture Biomass

TSDM Percentile

Relative to Historical Records from 1957

30 November 2019

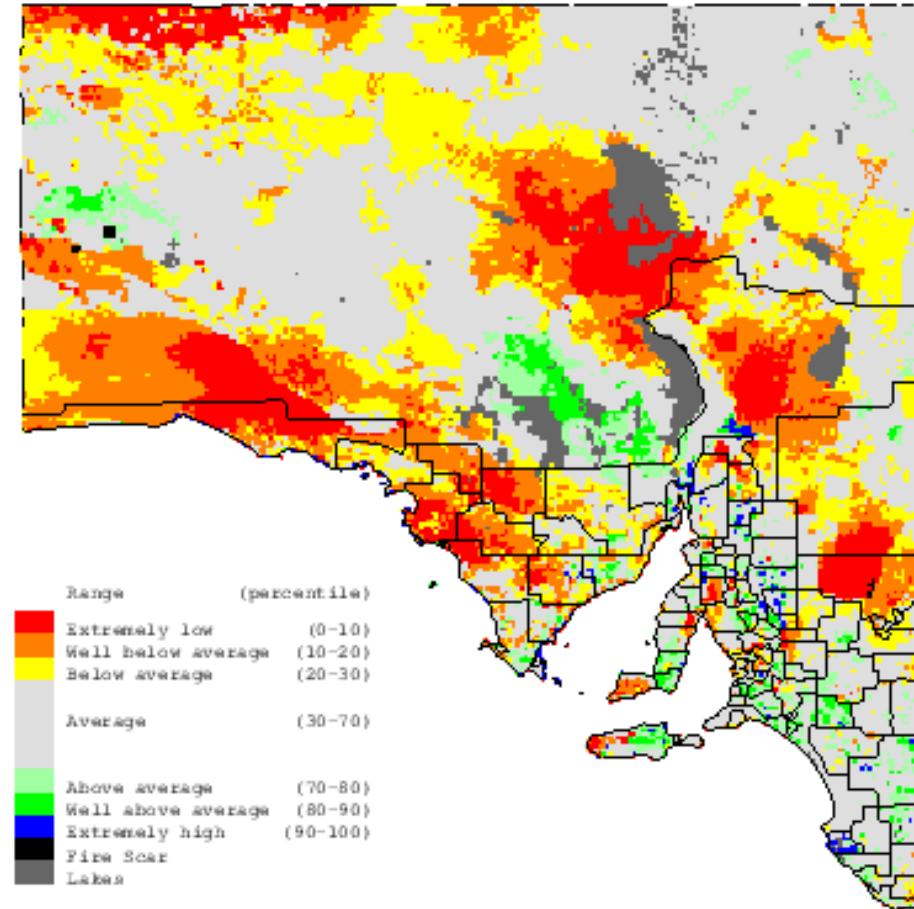


Firescars are fires occurring in last three months
www.LongPaddock.qld.gov.au

TSDM Percentile

Relative to Historical Records from 1957

30 November 2020



Firescars are fires occurring in last three months
www.LongPaddock.qld.gov.au



Landscape Condition summary

Continental NDVI

Continued 'browning' at a continental scale across June-November over last three years.

Almost all of Australia shows 'browning' anomaly in June-November 2020.

Available Soil Water

Continental scale soil moisture improving relative to 2010.

Soil moisture across SE, Riverland, Murraylands and much of pastoral land now average or better.

Pasture Biomass

Pasture biomass (as TDSM) improving (average or better) across SE Australia relative to 2018 and 2019.

Pasture biomass (as TDSM) now average or better across most of South Australia, deficiencies across part of LEB, Eastern Pastoral, western EP and West Coast.

References

- Bureau of Meteorology - www.bom.gov.au
- Jenouvrier S. (2013) Impacts of climate change on avian populations. *Glob Change Biol*, 19: 2036-2057. doi:[10.1111/gcb.12195](https://doi.org/10.1111/gcb.12195)
- Department for Environment and Water – www.environment.sa.gov.au
- Murray Darling Basin Authority – www.mdba.gov.au
- Murray-Darling Basin Authority (2020) River Murray System Annual Operating Outlook 2020-21 water year 1 June 2020 – 31 May 2021, MDBA, Canberra
- The Long Paddock- www.longpaddock.qld.gov.au



Government
of South Australia

Department for
Environment and Water