Considerations for the 2024 duck season

Current as at 19 December 2023

Game Management Authority

Climatic conditions and waterfowl

- Climatic conditions, such as large-scale oscillations (e.g. Southern Oscillation Index) and local weather (e.g. rainfall and temperature) can affect the distribution, productivity and size of waterfowl populations.

- In Australia, waterbird abundance is strongly related to river flows and rainfall (Kingsford *et al.* 2017).

- Large and extensive rainfall events can contribute to population increase as conditions are enhanced to support breeding and recruitment. Conversely, during dry periods, breeding may be modified or greatly reduced (see Kingsford and Norman 2002).

- Hunting during periods when there is little recruitment (e.g. dry periods) removes breeding adults which can negatively affect subsequent recruitment and further drive declines in hunted species (Kingsford *et al.* 2017).
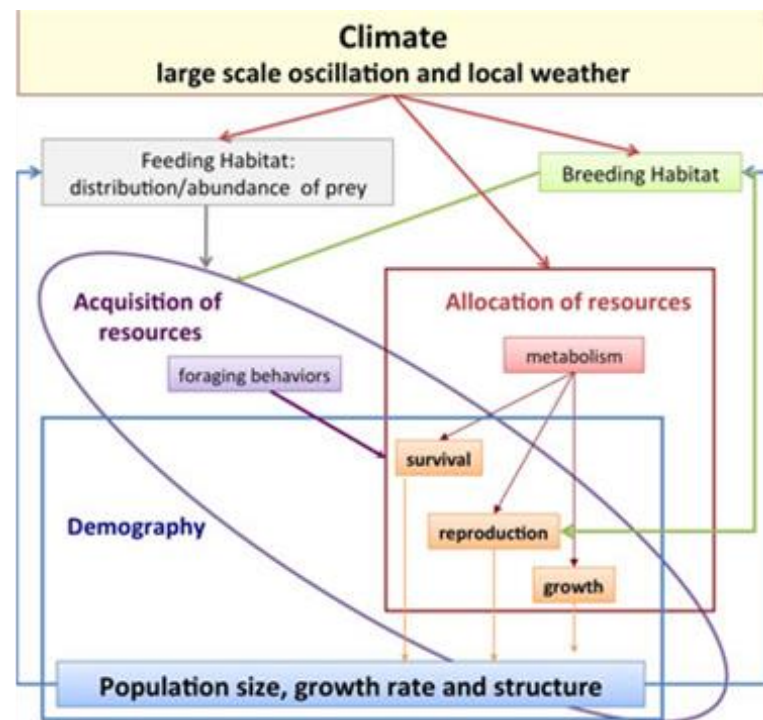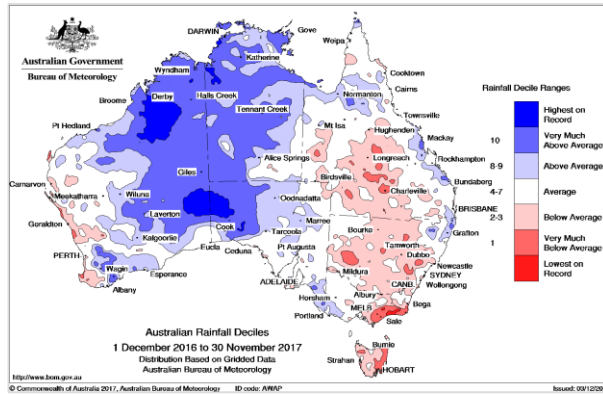

Climate effect on waterbird populations. Source: Jenouvrier 2013
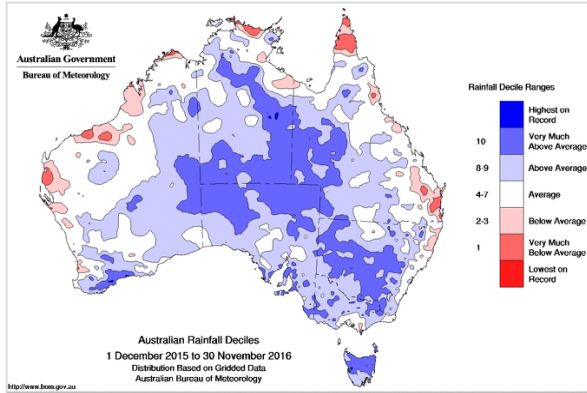
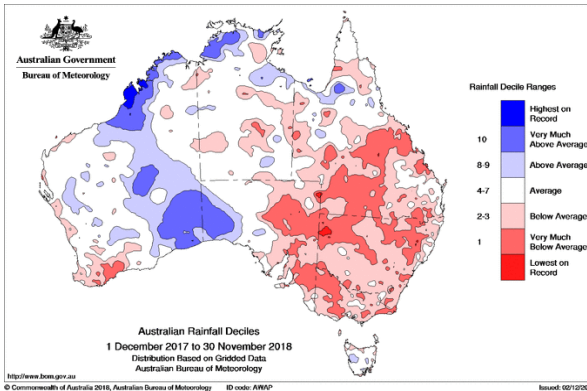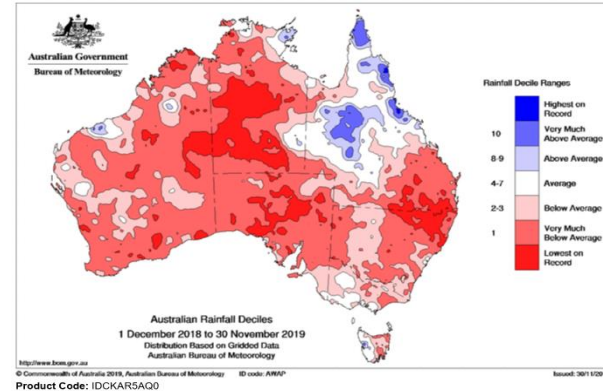# Annual rainfall deciles 2016 to 2023

2016

2017

2018

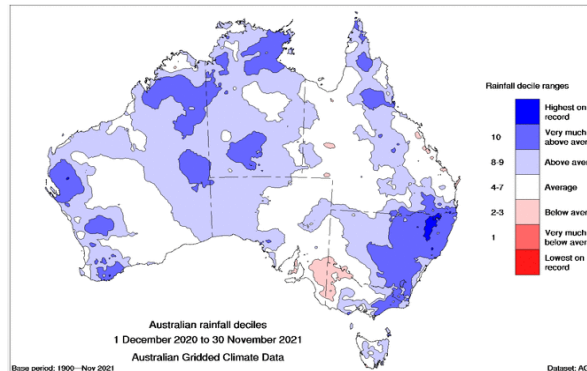**2019**

2020

2021

2022

2023

Source: www.bom.gov.au
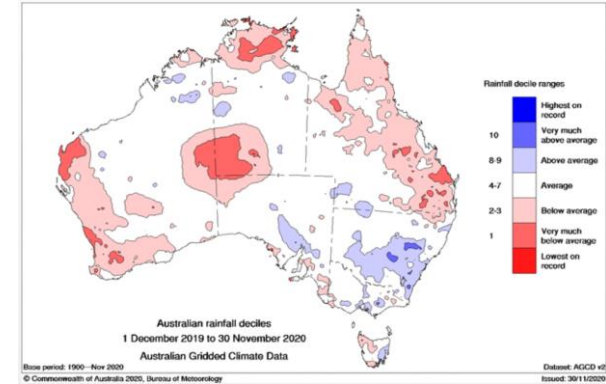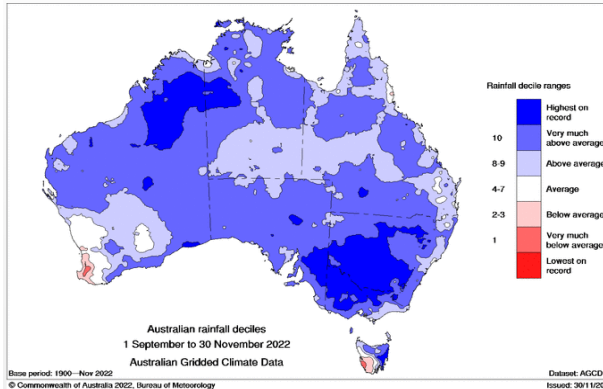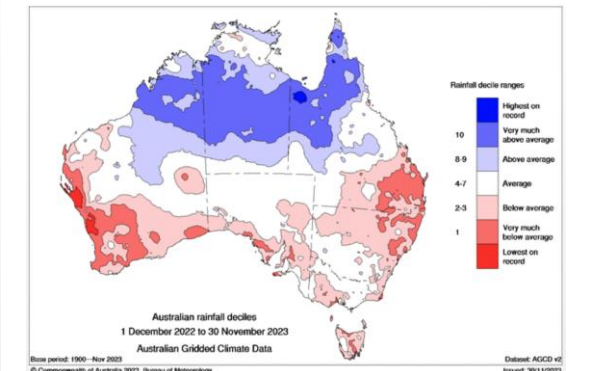
Year-to-date rainfall 2023

- Following three years of La Niña (wetter) climatic conditions, Australia is experiencing a drying phase as El Niño and a positive Indian Ocean Dipole are underway.

- The northern half of Queensland received above to very much above rainfall over the last 12 months. Large parts of southern QLD and northern NSW and parts of Victoria and SE South Australia received below average rainfall.

- For Australia as a whole, October rainfall was 65% below the 1961–1990 average, the fifth driest October on record and the driest since 2002.

- After a very dry September and October, widespread storms in November lifted the total spring rainfall across parts of northern and eastern Australia.

- A small proportion (9.7%) of Queensland was in drought or drought affected (as of November 2023); in New South Wales, 12.6% of the state was in drought or drought affected. Reports weren't available for South Australia or Victoria, however, far southwest Victoria and far south-east South Australia were experiencing 4-month rainfall deficiencies.

Source: www.bom.vic.gov.au, Porter *et al.* (2023)
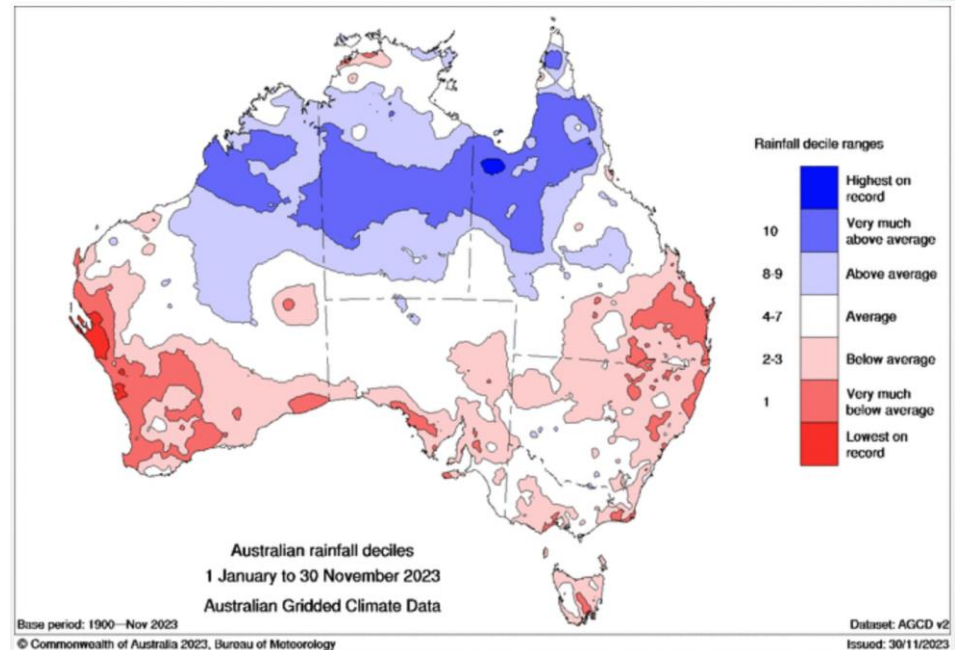
Rainfall through the seasons 2023
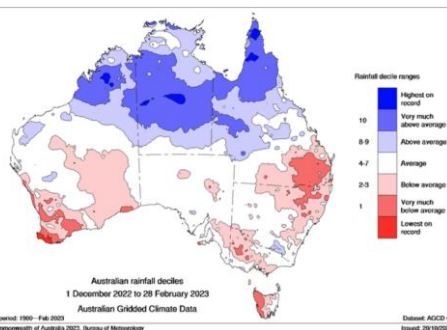
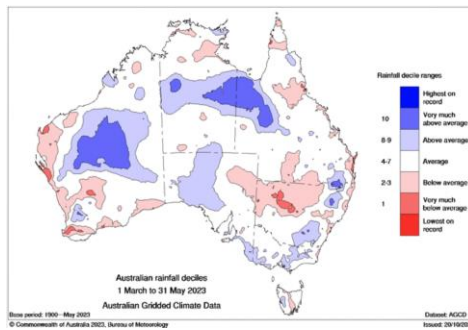| Summer	Autumn	Winter	Spring
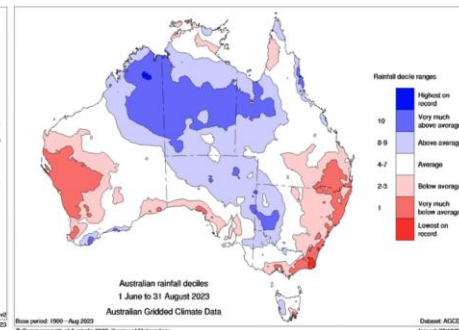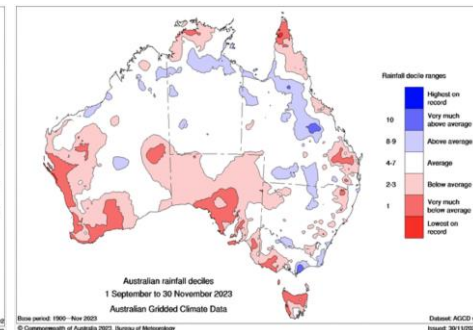
- **Summer:** In eastern Australia, northern Queensland received above to very much above average rainfall. Southern Queensland, northern New South Wales, western Victoria and south-east South Australia received below average to very much below average rainfall.

- **Autumn:** Northern New South Wales received below average rainfall. The Great Dividing Range from Victoria to southern Queensland received above average rainfall, as well as parts of central-western Queensland and coastal far-east South Australia and south-west Victoria.

- **Winter:** South-eastern Queensland, the eastern half of New South Wales and most of southern Victoria received below to very much below average rainfall. Western Queensland, western New South Wales and northern South Australia received above average rainfall.

- **Spring:** Generally, eastern Australia received average spring rainfall, but this was influenced by a wet November, following a dry September and October. Parts of New South Wales, Queensland and Victoria received above or below average rainfall.

Source: www.bom.gov.au

Soil moisture – December 2023

Root zone soil moisture (percentile rank)

Lowest 1%   Below Average   Above Average   Highest 1%
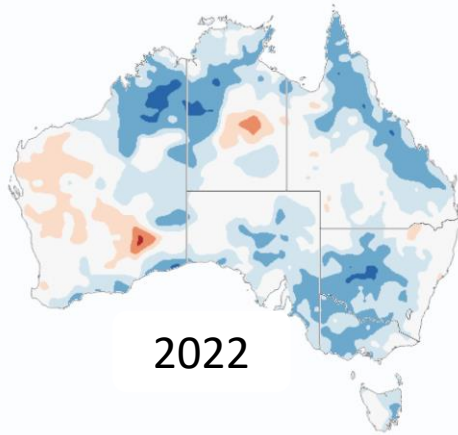
2022

1000 km

Root zone soil moisture (percentile rank)

Lowest 1%   Below Average   Above Average   Highest 1%
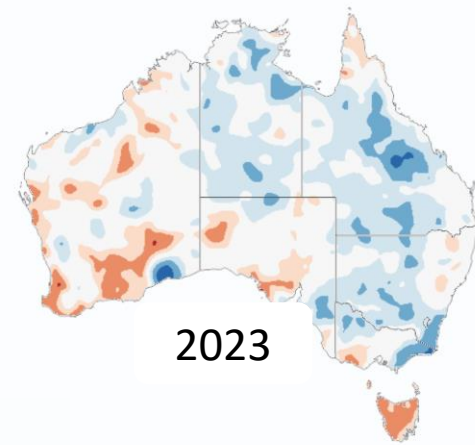
2023

1000 km

Last updated: 7 December 2023 at 11:05pm AEDT

- Root zone (0-100cm) soil moisture as at 7 December improved following a wet November for much of eastern Australia.
- This rectified the below average soil moisture caused by a dry August – October across most of eastern Australia.

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Source: www.bom.gov.au

Habitat availability

Australian water storage levels

Water storage levels provide an indicator of the availability of waterbird habitat and waterflows through feeder systems.

Often impoundments and storages can trap water and prevent it from entering creeks, streams and wetlands, thereby reducing available habitat. This information must be considered in context, particularly during dry periods.

Deep storages generally provide poor habitat for game ducks.

- In 2023, Australia's water storages declined by 2% from the same time last year, from 76.1% to 74.1%.

Accessible volume - Australia
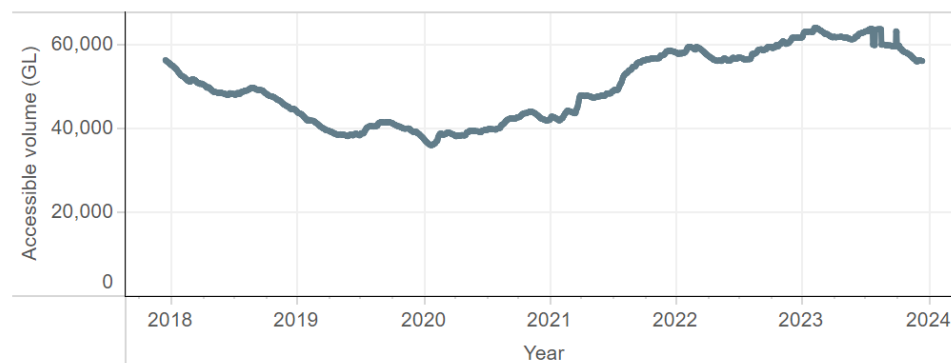
History - All
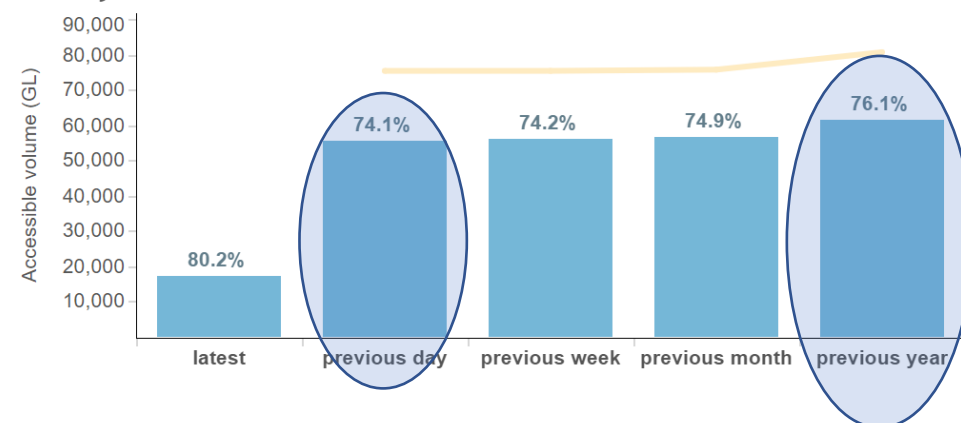
Australia

Percentage full (%):	74.1
Number of storages:	303
Accessible volume (ML):	55,880,337
Accessible capacity (ML):	75,449,421
Change since last year (%):	-2.0
Reported date:	13 December 2023

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Murray-Darling Basin water storage levels

The Murray–Darling Basin (MDB) is a critical area for waterfowl production and Australia's most developed river basin (240 dams storing 29,893 GL)
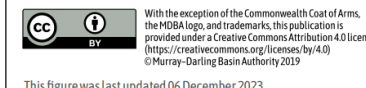
- Storage systems in the MDB are at 88% of capacity, which is 11% lower than at the same time last year (99%).

- Storage volumes in the northern basin are at 80%, down 23% from 103% in November last year.

- Storage volumes in the southern basin are at 91%, down from 98% in November last year.

- The Lachlan system is at 94%, down 3% from 97% last year.

Source: www.bom.gov.au

Lake Eyre Basin

- In 2022-23, northern Australia experienced its sixth wettest wet season since 1900.

- Significant rainfall events between October 2022 – April 2023 had a positive effect on the Lake Eyre Basin in the first six months of 2023, as water moved through the catchments. Lake Eyre partially filled, but has since dried.

- Some rivers and wetlands in the northern Lake Eyre Basin, including the Diamantina and Georgina rivers, retained water in deeper channels and pools after moderate flooding and supported large numbers of waterbirds
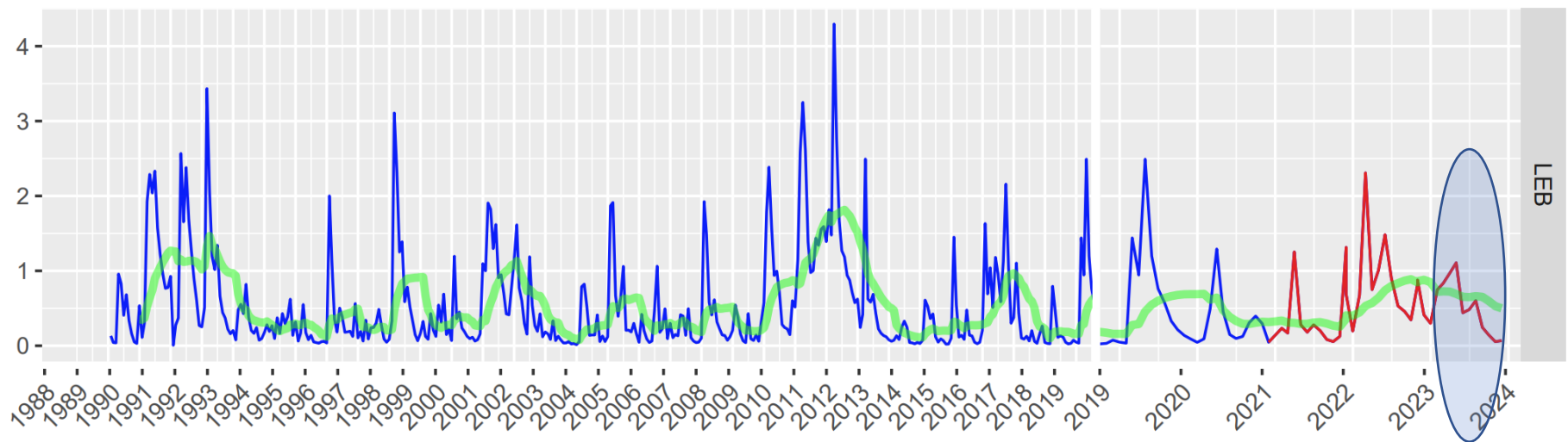
Percentage water surface area in the Lake Eyre Basin since 1990
Monthly values in blue. Last three years in red. Green line is 12 month rolling average

Source: Klaassen (2023)

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Victorian water storage levels

Accessible volume - Victoria
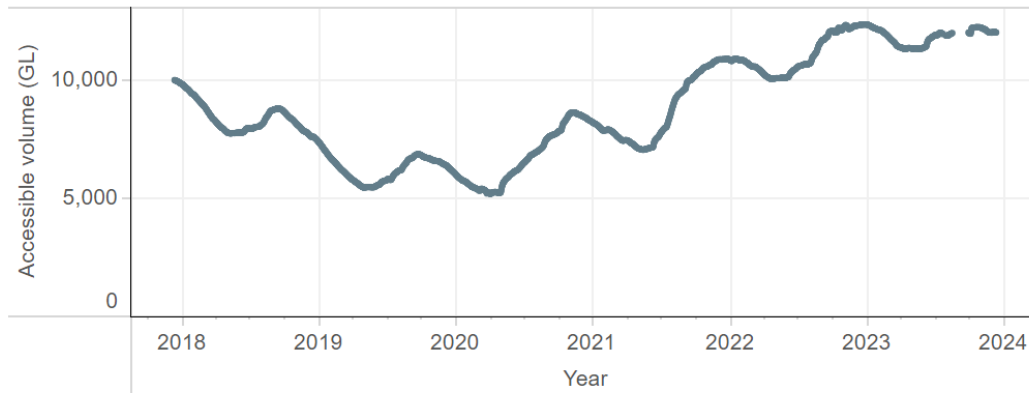
History - Victoria

- The total (Melbourne and regional) Victorian water storage levels are currently at 94.8% compared to 97.2% last year.

- Storage levels have decreased by 2.4% from this time last year.

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Source: www.bom.gov.au
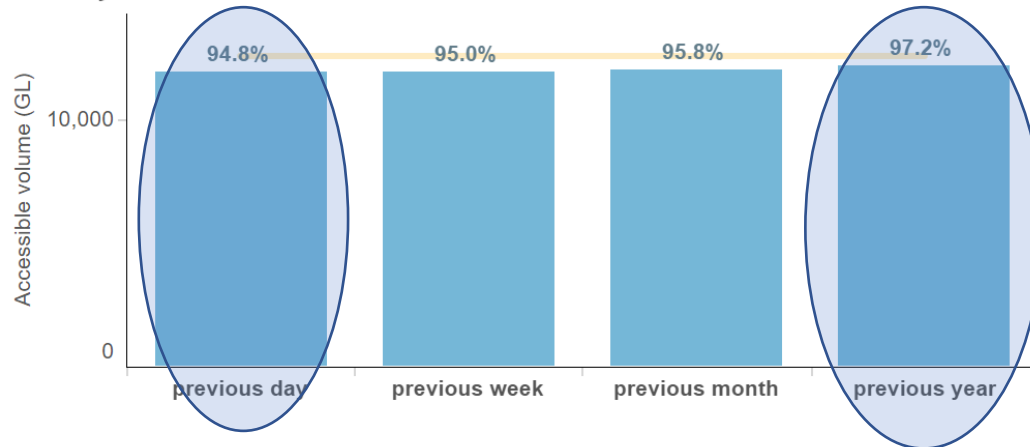
Victorian waterbody surface water estimate
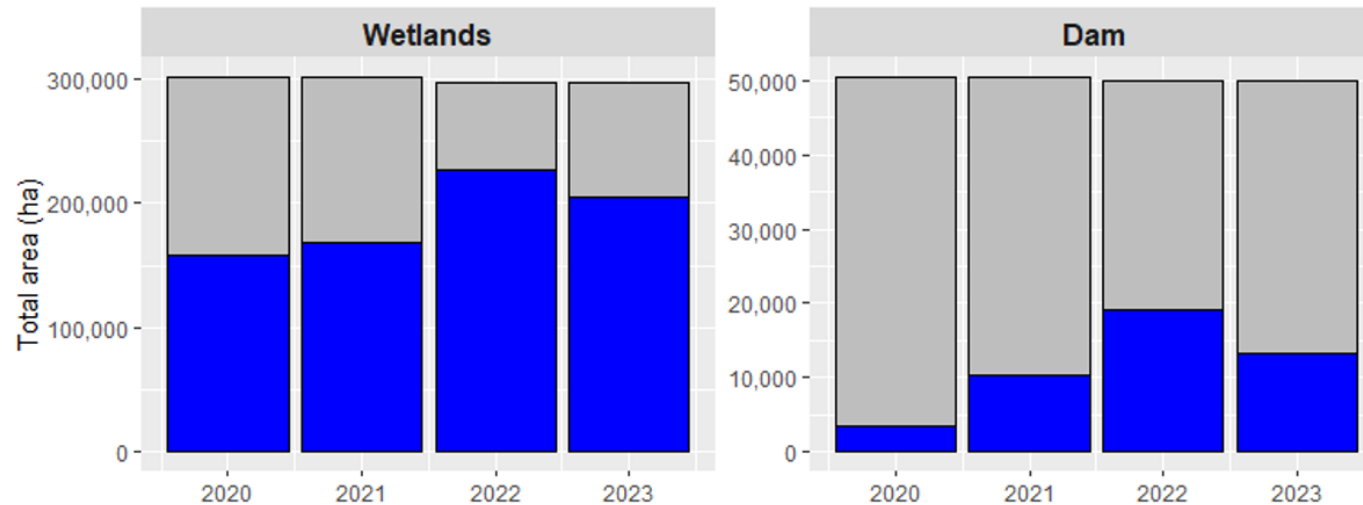
- Victoria's annual ground and aerial game duck abundance survey commenced on 16 October and concluded on 6 November 2023.

- 865 randomly selected wetlands, dams, sewerage treatment ponds, rivers and streams were surveyed.

- Surface water availability was estimated from analysis of Landsat and Sentinel-2 satellite imagery using the most recent images obtained within the spring period (September – November).

- Surface water availability in 2023 declined slightly since 2022 for both wetlands and dams, but was still higher than in 2020 and 2021.

Eastern Australian Waterbird Survey (EAWS)

The EAWS monitors changes in the abundance and distribution indices of 50 waterbird species in eastern Australia. It also tracks changes in waterbird habitat over time.

The EAWS was designed by Dr Graeme Caughley, CSIRO, to monitor game duck populations. It has been conducted annually in October since 1983. Waterbirds are counted from the air across ten aerial survey bands (each 30 km in width), every two degrees of latitude, crossing eastern Australia to monitor all wetlands over 1ha in size.

The EAWS provides:
- an index (not total count) of abundance of waterbirds, including game ducks
- information on the distribution of waterbird and game duck populations along survey bands
- the extent and distribution of habitat along survey bands, and
- information on waterbird breeding.

The information is valuable for examining waterbird trends on over one-third of continental Australia and over a long period.
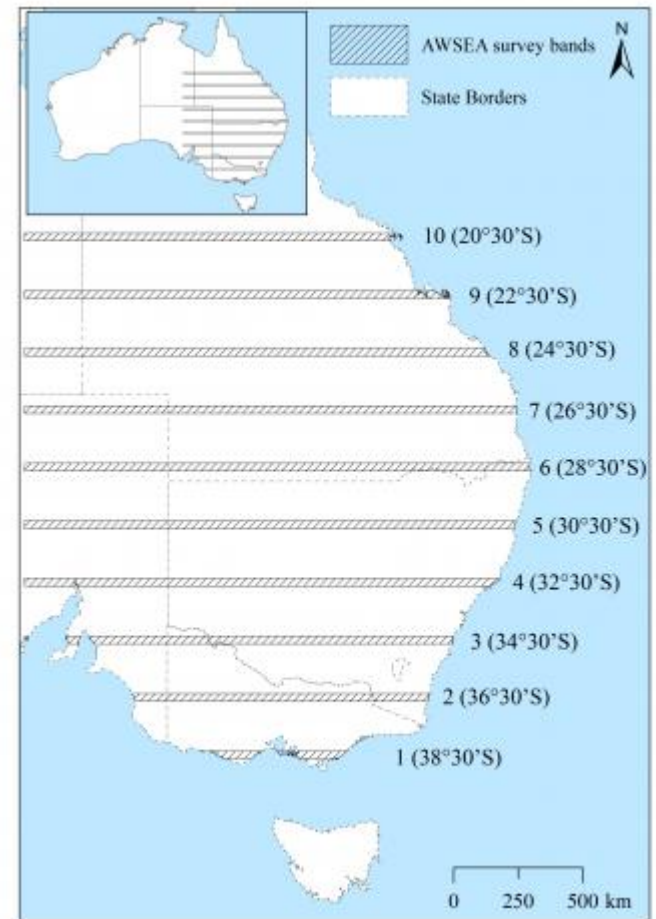
EAWS wetland area index

The wetland area index is a measure of wetland availability across all 10 EAWS transects (bands). This gives an indication of the extent and distribution of habitat available for waterbirds.

Long-term wetland area index
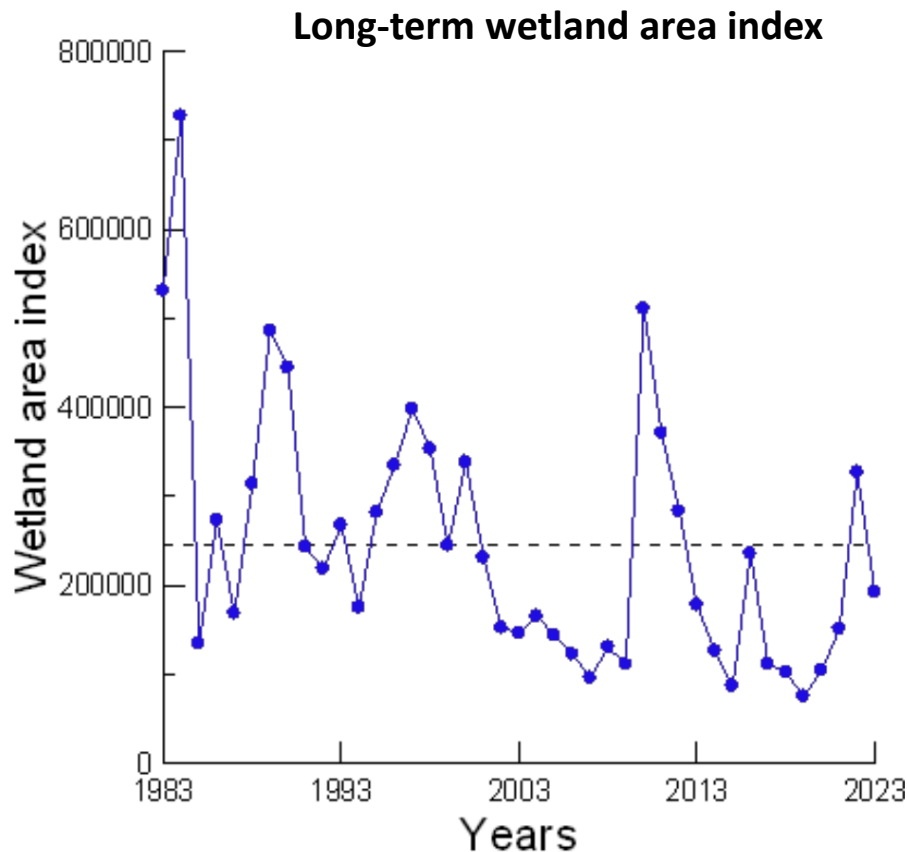
Dashed line shows long-term average

- The wetland area index (192,083 ha) for 2023 decreased considerably from the previous flood year, to 78% of the long-term average.

- The 2023 wetland area index ranked 22nd from the 41 surveys.

Source: Porter *et al.* (2023)

EAWS Wetland distribution 2022 and 2023

2022

2022 Wetland area index – 326,769 ha
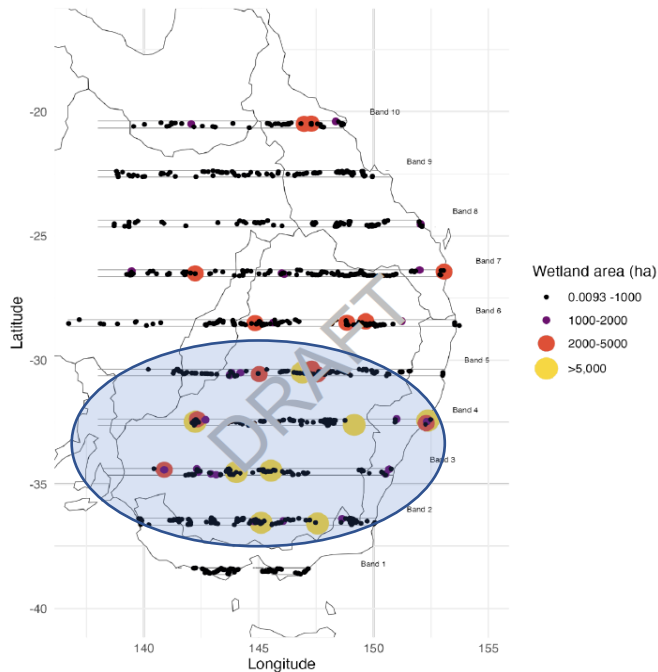
2023

2023 Wetland area index – 192,083 ha
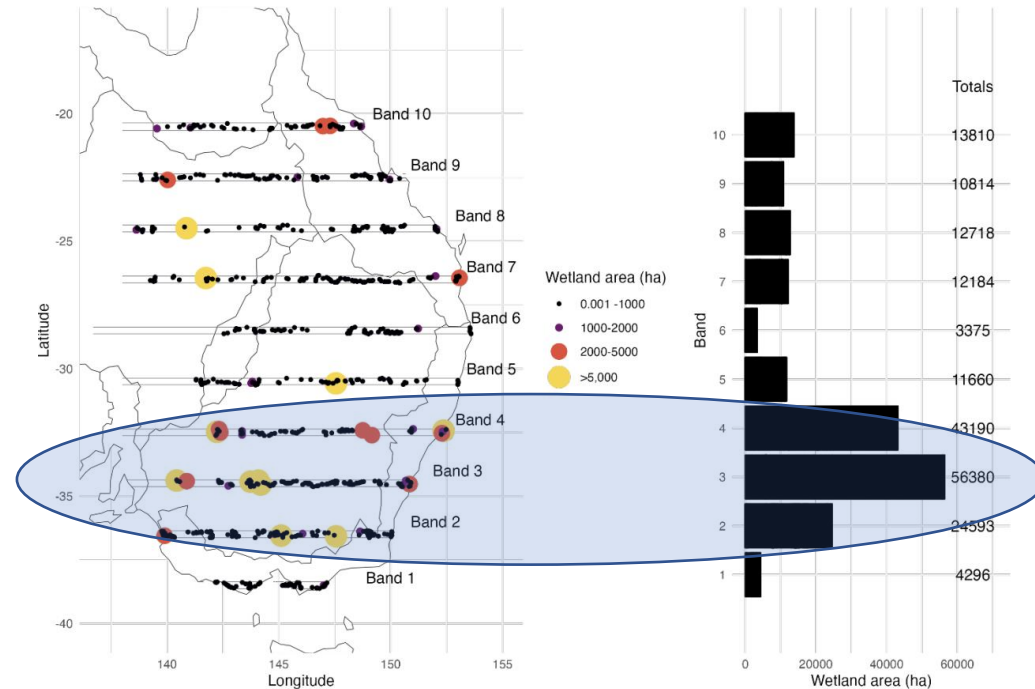
- Bands 2, 3 and 4, spanning northern Victoria to central New South Wales, contained the largest areas of waterbird habitat – comprising 64% of the inundated wetland area sampled.

- In the previous year, bands 2-5 contained the highest proportion of habitat.

Source: Porter *et al.* (2023)

Pasture conditions

Pasture Growth Percentile
Relative to Historical Records from 1957
December 2021 to November 2022

Range	(percentile)
Extremely low	(0-10)
Well below average	(10-20)
Below average	(20-30)
Average	(30-70)
Above average	(70-80)
Well above average	(80-90)
Extremely high	(90-100)
Lakes	
White = Seasonally low growth	

www.LongPaddock.qld.gov.au
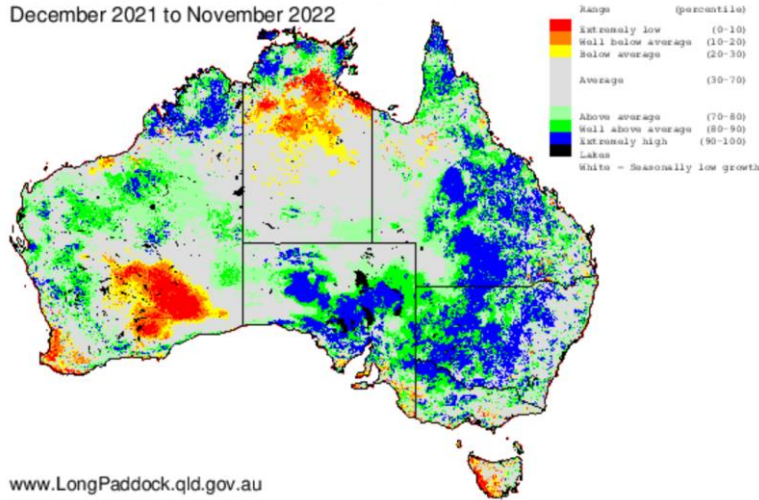
Pasture Growth Percentile
Relative to Historical Records from 1957
December 2022 to November 2023

Range	(percentile)
Extremely low	(0-10)
Well below average	(10-20)
Below average	(20-30)
Average	(30-70)
Above average	(70-80)
Well above average	(80-90)
Extremely high	(90-100)
Lakes	
White = Seasonally low growth	

www.LongPaddock.qld.gov.au
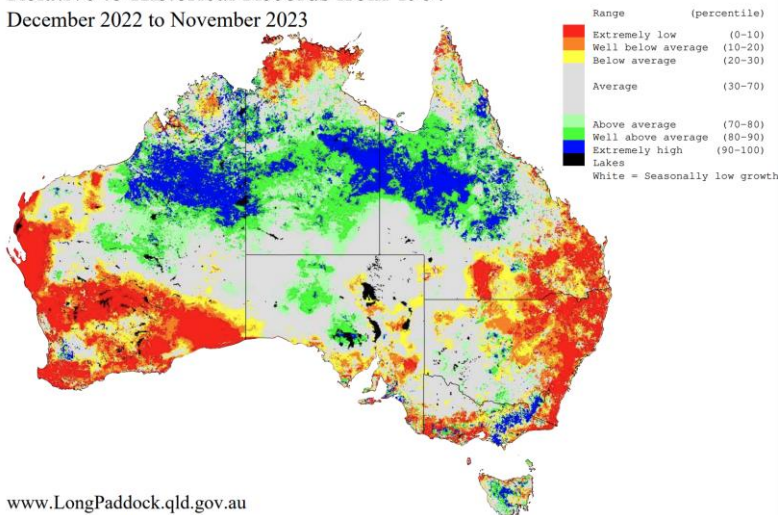
Pasture condition is a coarse indicator of potential feeding habitat for grazing species, such as Wood Duck and Mountain Duck, and nesting habitat for ground-nesting game ducks.

- Rainfall deficiencies have resulted in a reduction in pasture growth in 2023.

- Pasture growth has decreased to below average or more in southern Queensland, northern and eastern New South Wales, south-western Victoria and parts of south-eastern South Australia.

- Pasture growth in central Queensland was above average.

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Population indices of abundance, distribution and breeding

EAWS index of <u>waterbird</u> abundance (all waterbirds)
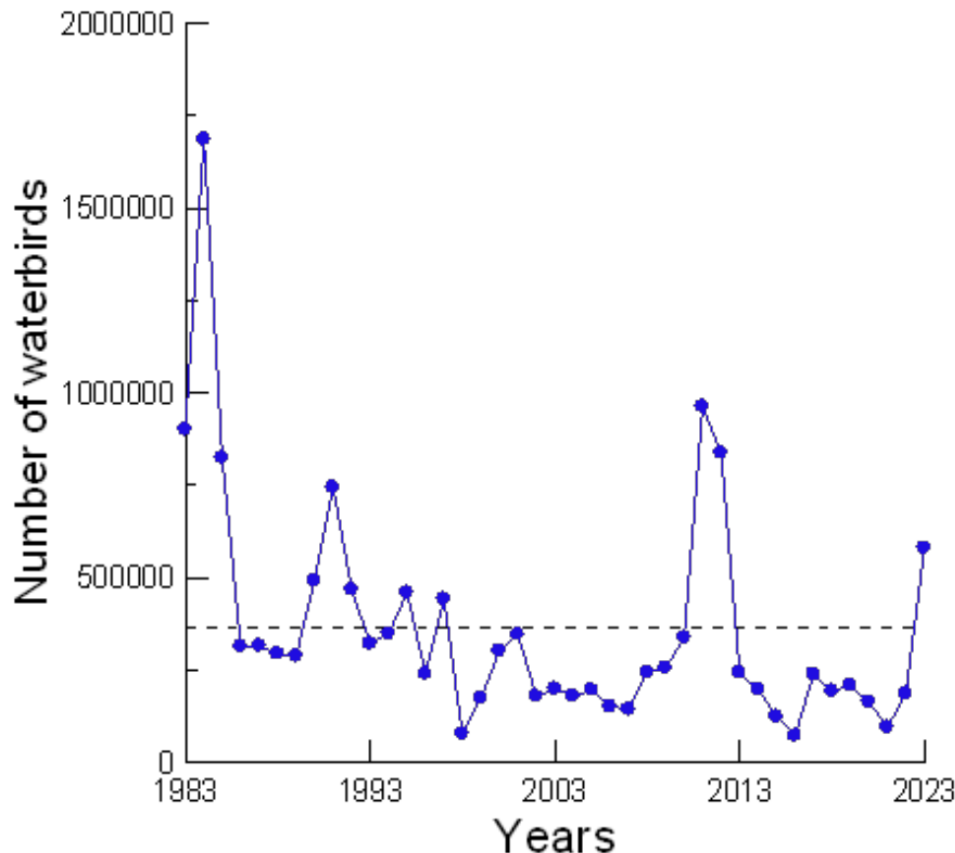
Up to 50 waterbirds species are surveyed in October each year and includes all Victorian game duck species and non-game species such as swans, Freckled Duck, ibis, coots etc.

- Total waterbird abundance in 2023 (n=579,641) increased significantly from 2022 to well above the long-term average and was the 7th highest recorded in 41 years.

- The abundance index is not a total count. It provides information on the trends in waterbird abundance along the survey bands.

Source: Porter *et al.* (2023)

EAWS Distribution of waterbirds
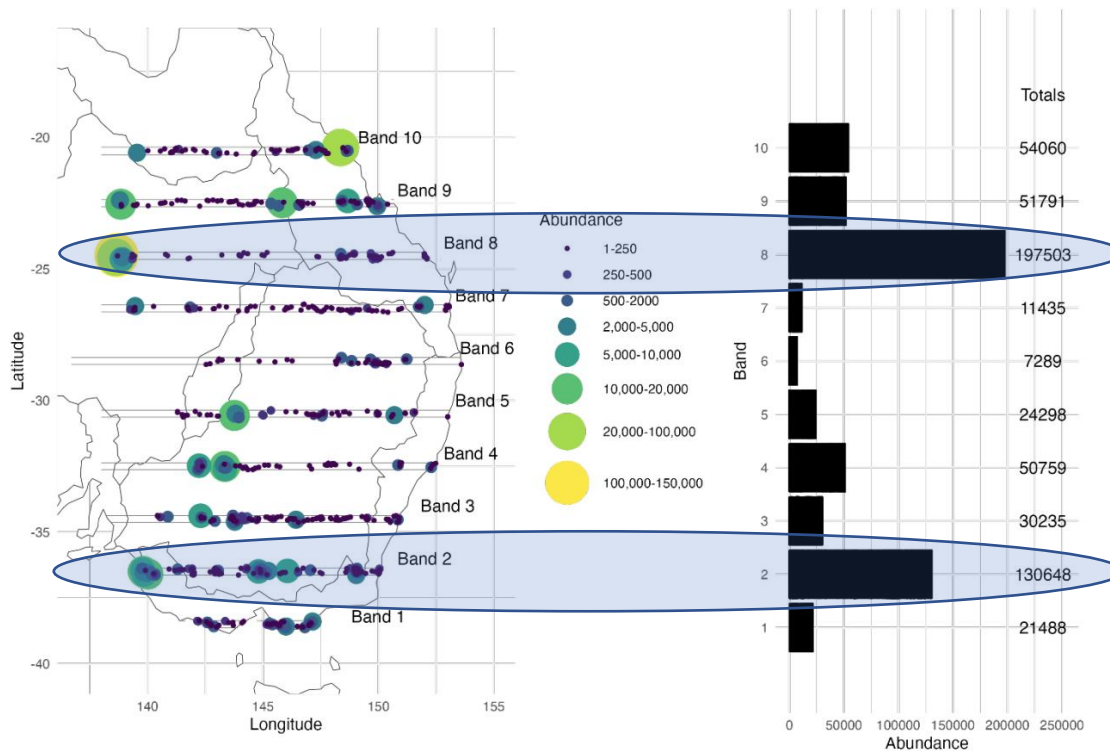
- The highest abundance of birds was found in bands 2 and 8.

- 72% of total abundance was distributed across 30 wetlands, making them less spatially concentrated and more evenly spread than the previous year.

- Two Band 8 wetlands (Lakes Torquinnie and Mumbleberry) supported more than 180,000 waterbirds representing 31% of the total abundance.

- Around 40% of surveyed wetlands supported no waterbirds (including wetlands that were dry).

Source: Porter *et al.* (2023)

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EAWS waterbird distribution cont..
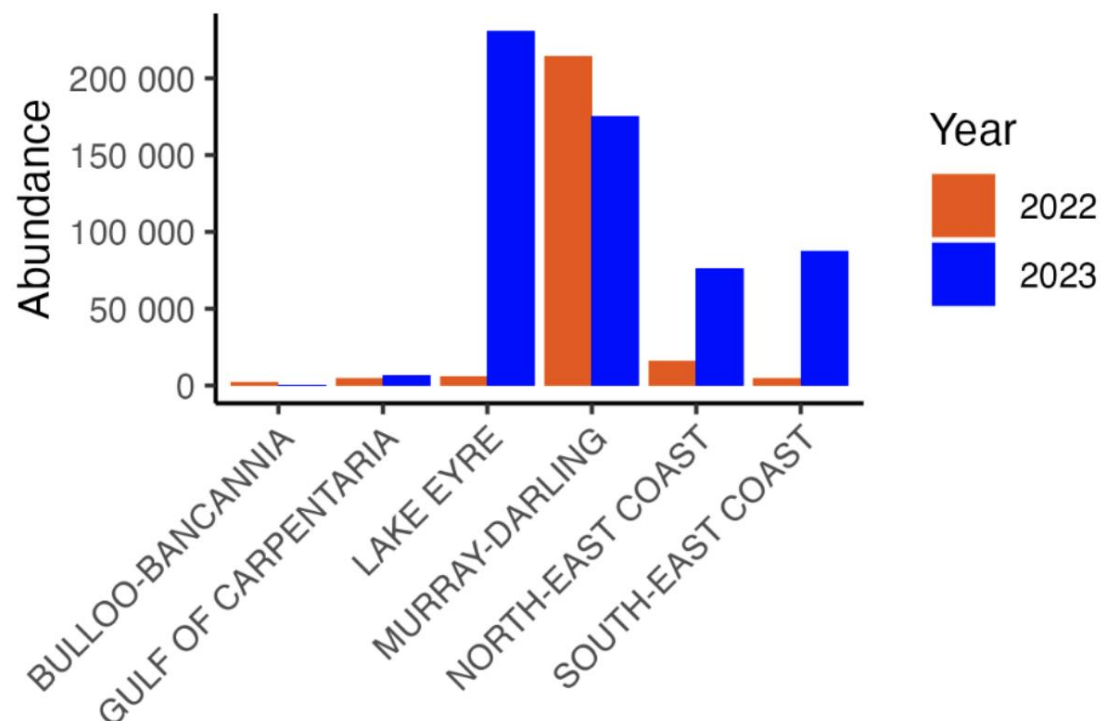
- Waterbird abundance increased significantly in the Lake Eyre Basin from the previous year and declined in the Murray-Darling Basin.

- Abundance also increased on the north-east and south-east coasts.

Source: Porter *et al.* (2023)

EAWS game duck abundance index

Source: Porter *et al.* (2023)

This index provides information on game ducks only.
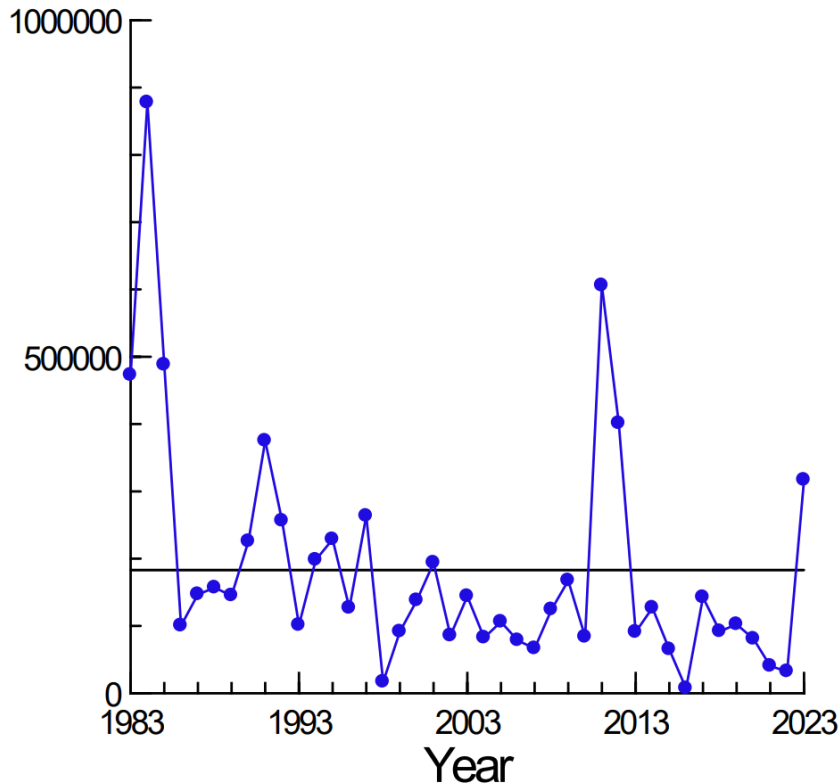
- The eastern Australian game duck abundance index increased by almost seven-fold from 2022 (48,748 vs 337,081).

- The 2023 game duck abundance index has increased from the 3rd lowest recorded in 40 years to the 7th highest in 41 years and is approximately 60% above the long-term average.

- Most game duck species had abundances well above long-term averages, in some cases by an order of magnitude.

- Chestnut Teal increased sharply from the previous year to their highest abundance since 1991. Pink-eared duck recorded their second highest abundance in 41 years. Australian Shelduck abundance declined in 2022.

- Five out of the eight game duck species show long-term declines in abundance believed to be in response to a reduction in habitat quantity and quality.

EAWS game duck abundance index bands 1 and 2 (Victoria)

Game duck index bands 1 and 2 2021, 2022 and 2023

Legend: 2021, 2022, 2023
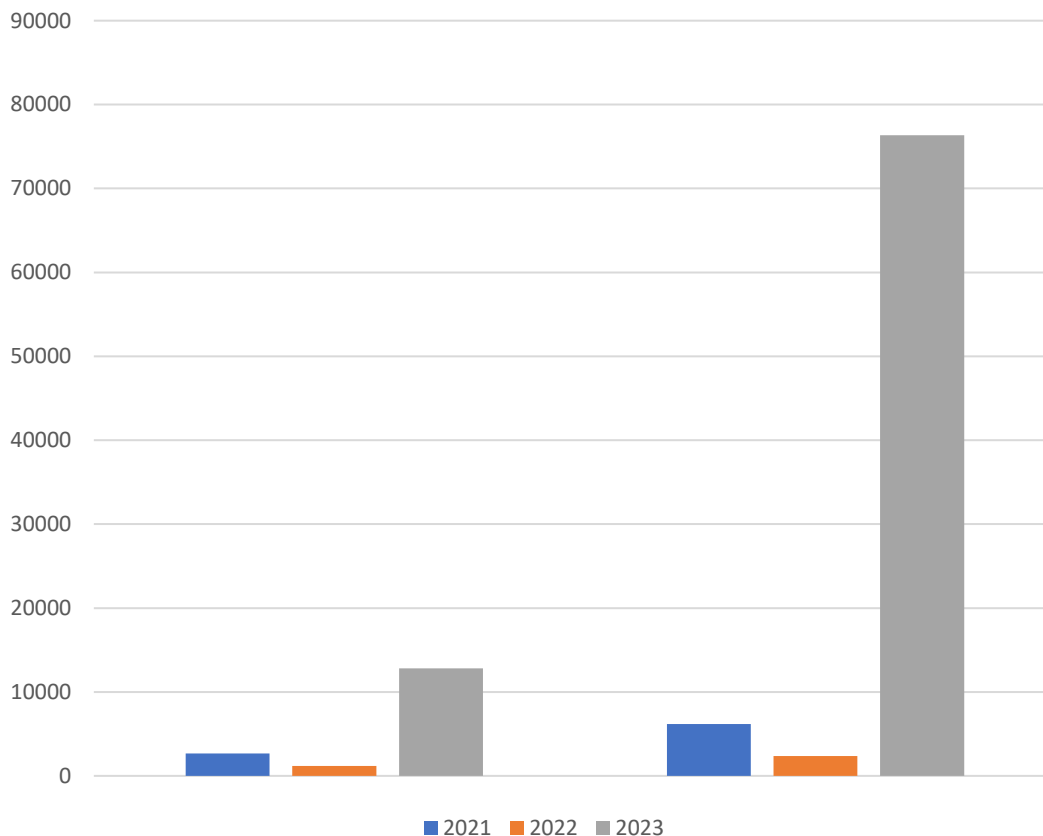
- Bands 1 and 2 cover parts of Victoria. Band 1 covers parts of southern coastal Victoria and band 2 covers parts of northern Victoria.

- Game duck abundance in bands 1 and 2 increased significantly in 2023 from the previous two years.

- The 2023 abundance index was almost 25 times higher than in bands 1 and 2 in 2022.

- This was most likely in response to improved habitat conditions throughout eastern Australia since 2020.

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Source: Porter *et al.* (2023)

EAWS game duck abundance index over time

EAAWS game duck abundance index 1983 - 2023
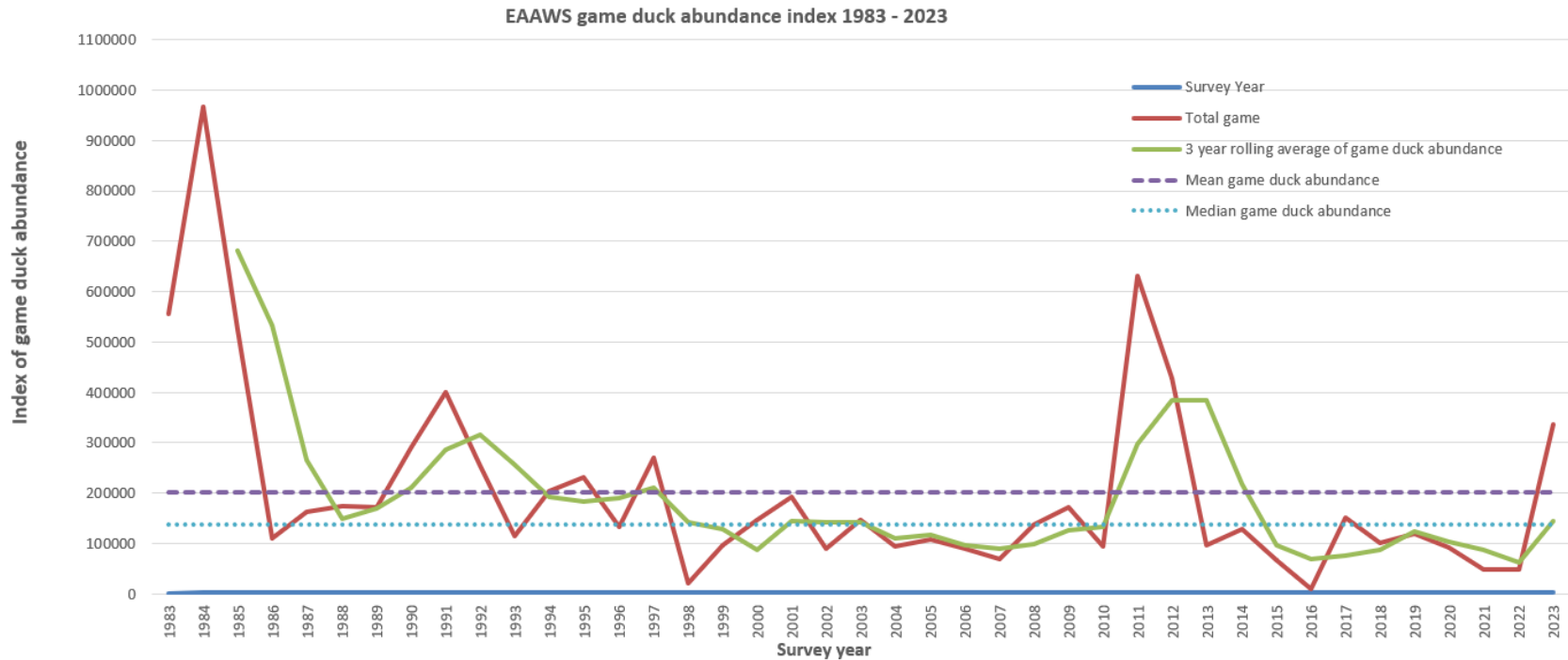
- This graph includes abundance index data (red line) and the 3-year rolling (or moving) average (green line). A rolling average is used to get an overall trend in a data set.

- The long-term average (mean) and median abundance levels are also included. The median is the mid-value and can be more suitable than the average when outliers are present.

- The 2023 EAWS game duck abundance index was above both the long-term mean and the median.

- Data must be considered in context with bird distribution, habitat availability and distribution and climatic forecasts.

EAWS relative abundance of game duck species 1983-2023

Relative abundance of game duck species 1983 -2023
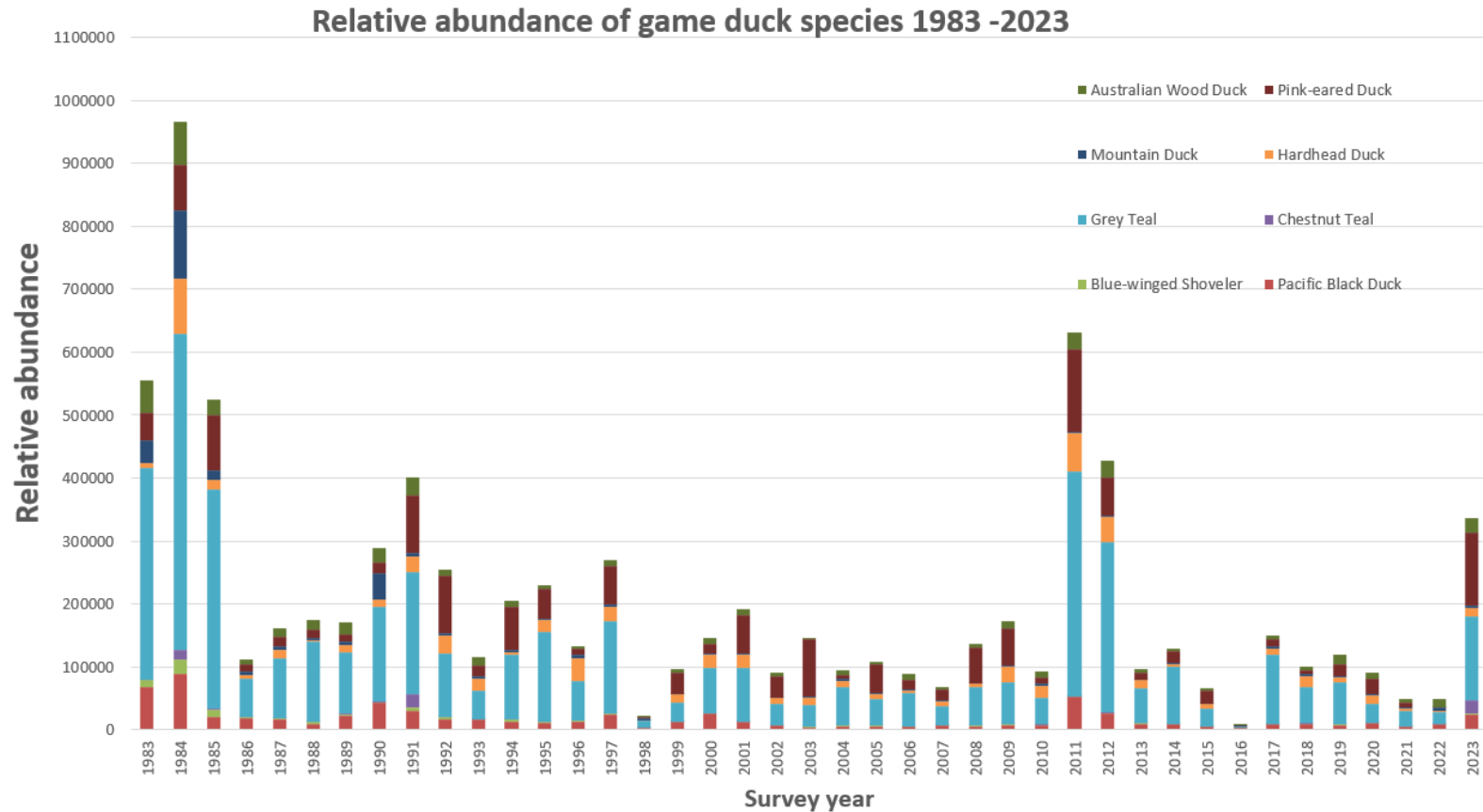
The percentage of game ducks detected in 2023 EAWS were:
- Black Duck 7% (18%), Grey Teal 40% (40%), Wood Duck 7% (26%), Pink-eared Duck 35% (2%), Hardhead 4% (4%), Mountain Duck <1% (9%), Chestnut Teal 6% (<1%) and Blue-winged Shoveler <1% (1%). Figures in parentheses are from 2022.

Victorian game duck abundance estimates

Victorian game duck abundance 2020 - 2023
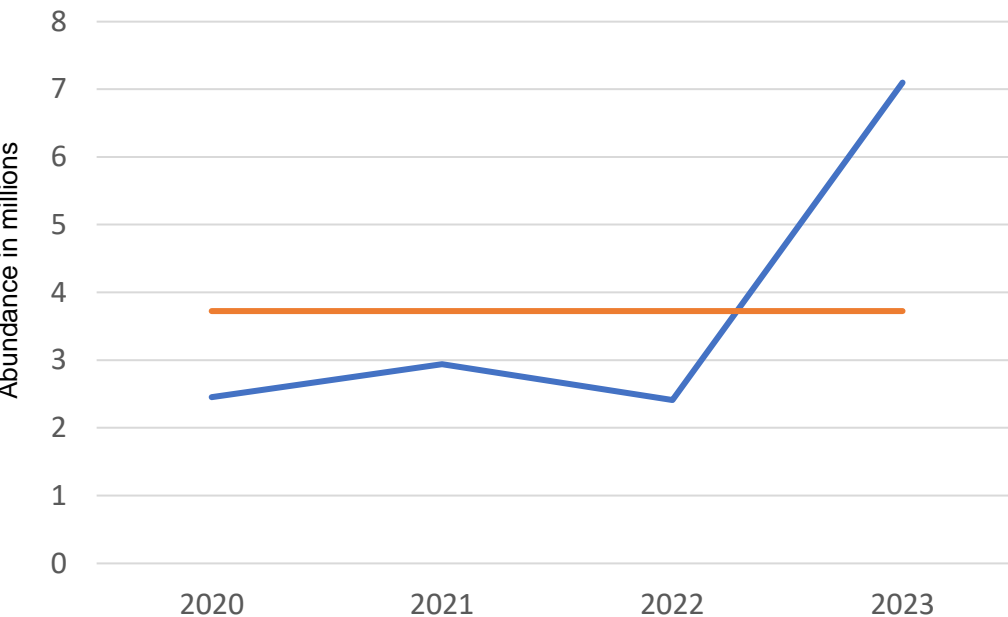
- Victoria's annual ground and aerial game duck abundance survey commenced on 16 October and concluded on 6 November 2023.

- 865 randomly selected wetlands, dams, sewerage treatment ponds, rivers and streams were surveyed.

- The total statewide absolute abundance of game ducks increased significantly from the previous year, most likely driven by the extensive flooding and presence of surface water driving breeding activity during 2022.

- The total estimated abundance of game duck species in Victoria in 2023 was 7.1 million birds, an almost three-fold increase on the previous year (2.41 million) and almost double the four-year average (3.7 million).

Source: Ramsey and Fanson (2023)

Victorian game duck abundance estimates cont...

Absolute Victorian game duck abundance by species
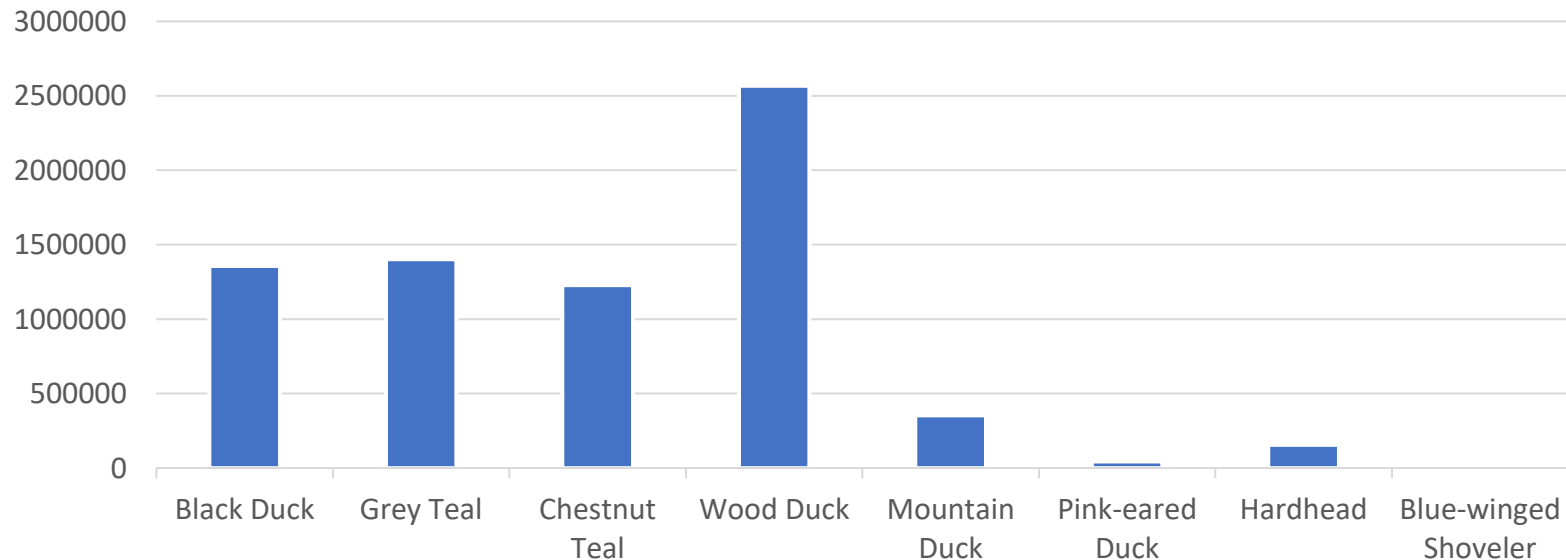
- Wood Duck were the most numerous game species in Victoria (~2.6 million), followed by Pacific Black Duck (~1.4 million) and Grey and Chestnut Teal (~1.4 and 1.2 million, respectively).

- These four species constituted approximately 92% of the total estimated Victorian game duck population.

Note: Total estimated abundance of Blue-winged Shoveler was 11,600 and Pink-eared Duck was 46,300

Source: Ramsey and Fanson (2023)

NSW Riverina waterfowl abundance surveys

- Aerial counts of randomly selected small, medium, large and extra-large dams, one wetland and channel segments were conducted throughout the NSW Riverina in May-June 2023 to determine absolute waterfowl abundance to set annual crop damage mitigation destruction quotas.

- Game duck* numbers increased significantly from the previous year by almost 4.5 times from 963,902 to 4.295 million birds.

- 2023 abundance was 3.5 times greater than the long-term average of 1.21 million.

*Includes Plumed Whistling Duck, which is not a Victorian game duck species

Estimated total game duck abundance
NSW Riverina 2015 - 2023

— Tot. abundance   — Average
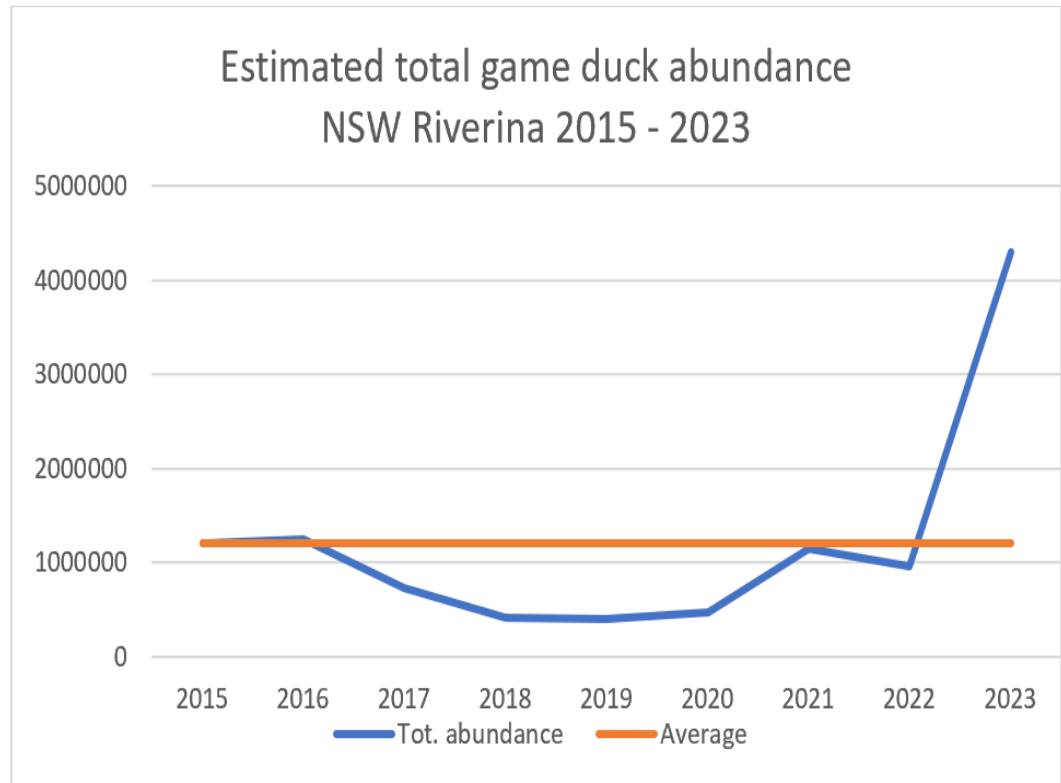
EAWS Waterbird breeding (all species)
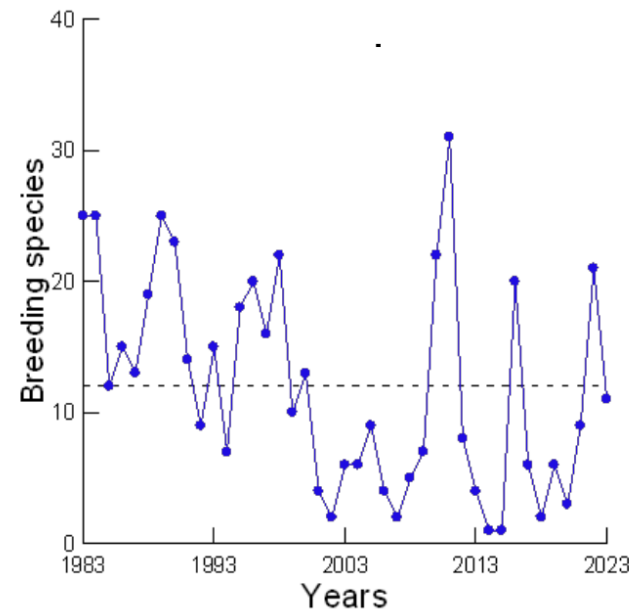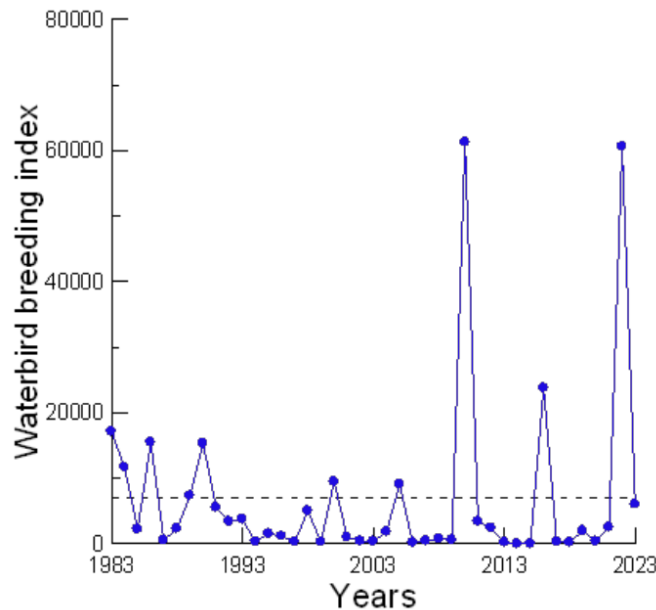
- EAWS Breeding species' richness and breeding abundance indices decreased considerably compared to the previous year (second highest recorded), with abundance falling by an order of magnitude to slightly below the long-term average.

- EAWS Breeding species' richness index also decreased to slightly below the average, with 11 species recorded breeding.

- Five species comprised 97% of the total breeding recorded (Little Black Cormorant, Darter, Nankeen Night Heron, Australian White Ibis and Pied Cormorant).

- Little game duck breeding was recorded but this is not a reliable indicator of the extent of breeding.

Source: Porter *et al.* (2023)

EAWS Waterbird breeding (all species)
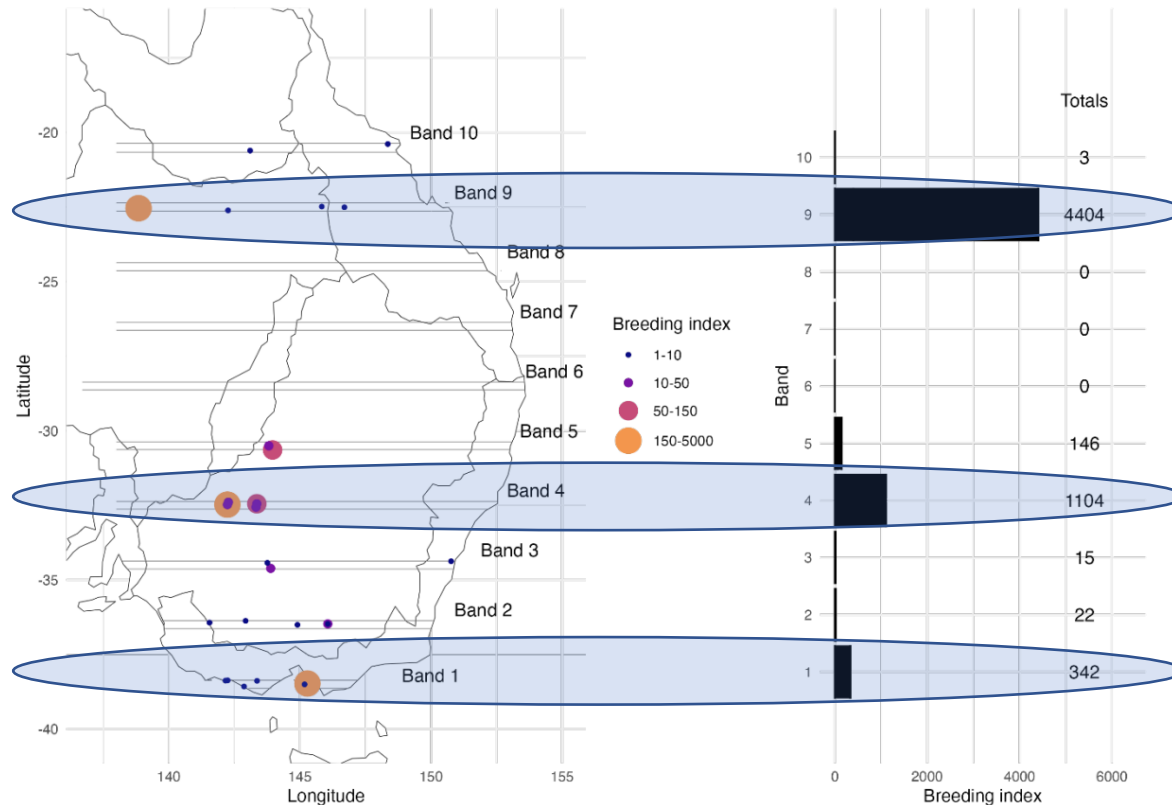
- Breeding was concentrated in one wetland (73% of total) in Survey Band 9 and comprised mostly Little Black Cormorants and Nankeen Night Herons.

- Band 4 and, to a lesser degree, Band 1 also recorded some breeding.

Source: Porter *et al.* (2023)

EAWS indices over time
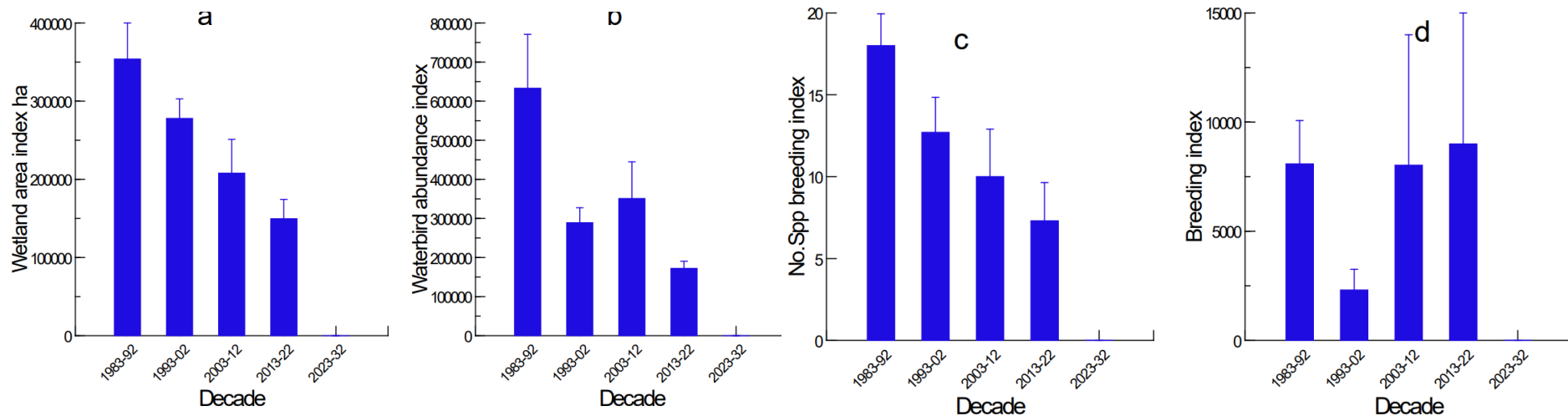
Decadal changes in indices for total abundance, wetland area, number of breeding species
and breeding in the EAWS 1983 - 2022

- Major EAWS indices for waterbirds (wetland area index, total abundance index,
  number of species breeding) continue to show significant declines over time.

EAWS indices relationship with wetland area
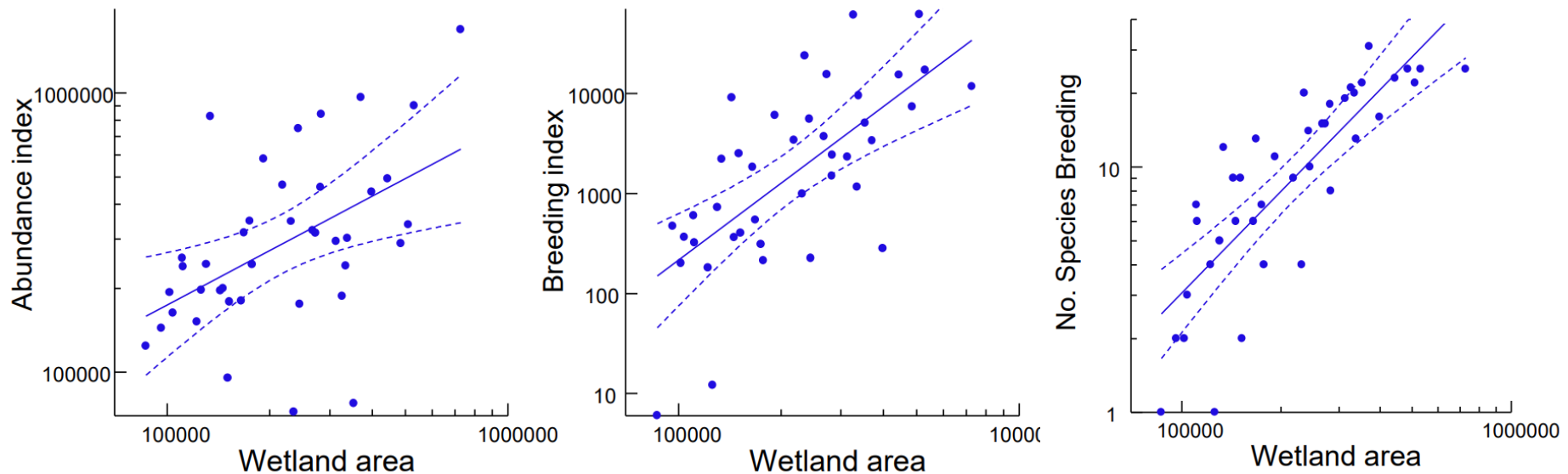
- For eastern Australia, overall waterbird abundance, breeding index and breeding species richness are positively related to habitat availability (wetland area index).

- Declines in wetland area are likely to result in declines in waterbird abundance, breeding and breeding species richness.

Source: Porter *et al.* (2023)

Climate predictions – future conditions

Current climate drivers

- Australia's climate can vary greatly from one year to the next.

- A number of drivers can influence the Australian climate. Influences will have varying levels of impact in different regions at different times of year.

- Current influences on Australia's climate include:

  - El Niño

  - Positive Indian Ocean dipole

- These influences typically result in drier than average seasons.

Source: www.bom.gov.au
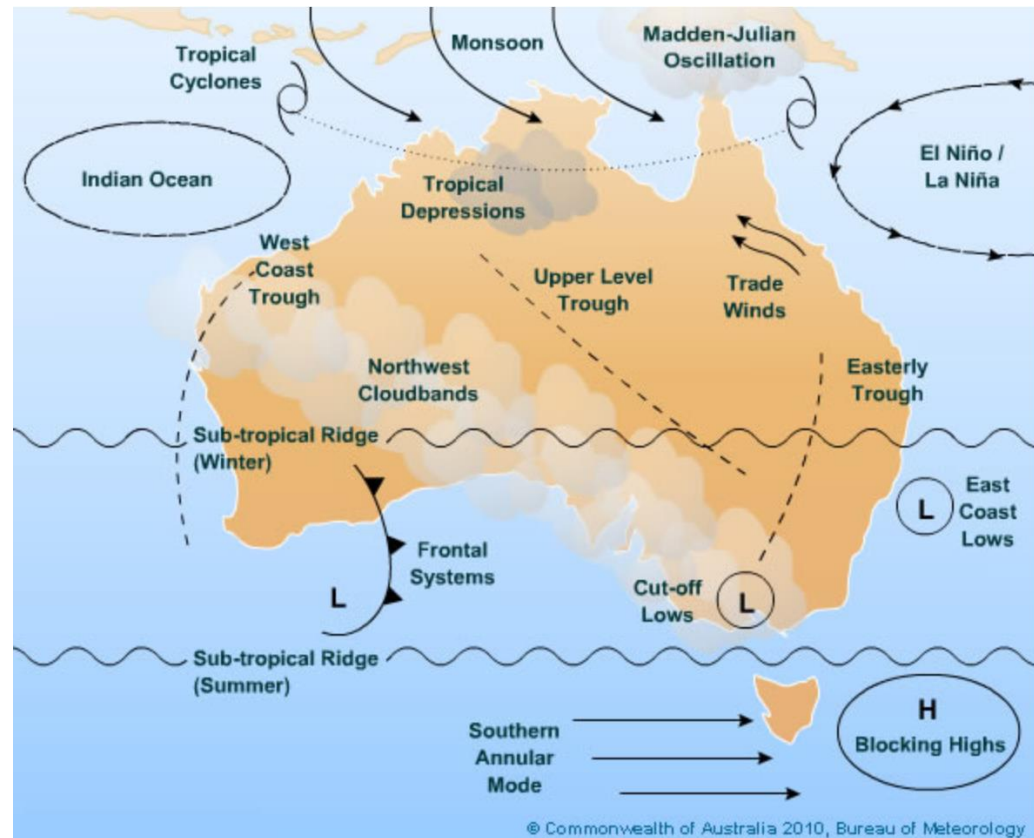
El Niño and Indian Ocean Dipole

- El Niño continues in the tropical Pacific. Indicators of the El Niño–Southern Oscillation (ENSO), including tropical Pacific sea surface temperatures (SSTs), cloud, wind, and pressure patterns are consistent with El Niño conditions. Climate model forecasts indicate some further warming of central to eastern Pacific SSTs is possible, with SSTs remaining above El Niño thresholds early into the second quarter of 2024.

- The positive Indian Ocean Dipole (IOD) event continues. IOD events typically breakdown as the monsoon trough shifts south into the southern hemisphere, typically at the end of spring. Given the current strength of this event and the active El Niño, the breakdown this year is likely to be slightly later than usual. All international climate models surveyed by BOM suggest the positive IOD event is likely to ease in December.

Monthly sea surface temperature anomalies for IOD region
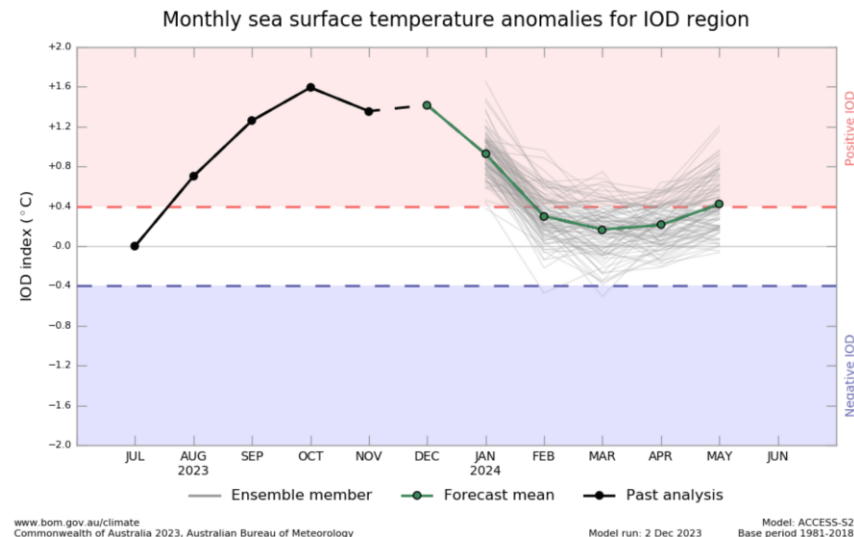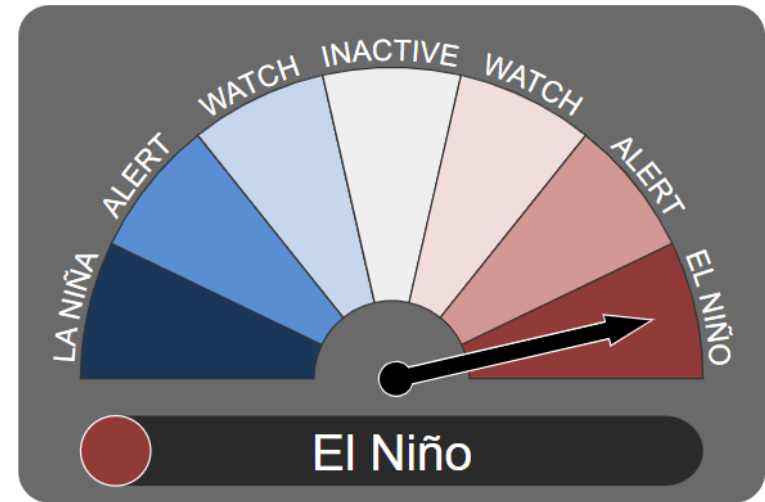
January – March 2023 predicted rainfall

January – March rainfall prediction can be used to indicate the potential impact on habitat for the forthcoming season.

- January to March rainfall is likely to be below average across much of the north, west and south-east of Australia.

- The long-range forecast is influenced by several factors, including the active El Niño and easing positive Indian Ocean Dipole events, and record warm oceans globally.

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Chance of exceeding the median rainfall for January to March 2024

Chance of exceeding median rainfall (%)

80
75
70
65
60
55
50
45
40
35
30
25
20

Model: ACCESS-S2
Base period: 1981-2018

Model run: 04/12/2023
Issued: 07/12/2023

Game Management Authority

Source: www.bom.gov.au
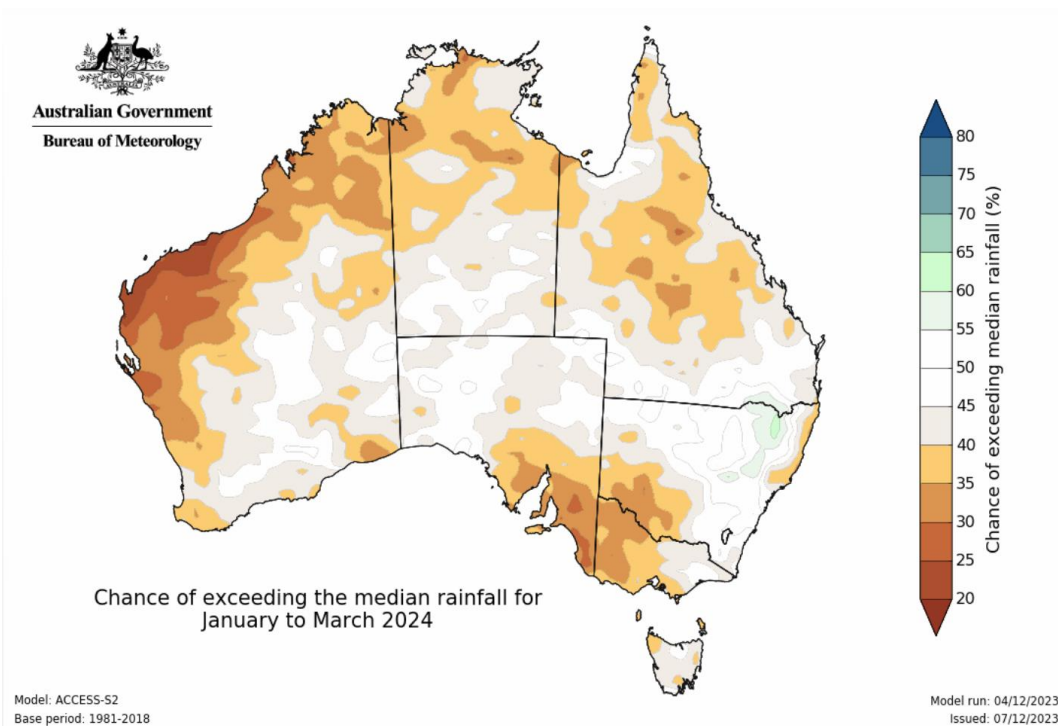
January – March 2023 temperature predictions

Chance of exceeding the median maximum temperature for January to March 2024

Model: ACCESS-S2
Base period: 1981-2018

Model run: 04/12/2023
Issued: 07/12/2023

Chance of exceeding the median minimum temperature for January to March 2024

Model: ACCESS-S2
Base period: 1981-2018

Model run: 04/12/2023
Issued: 07/12/2023

- For January to March, above median maximum temperatures are very likely (greater than 80% chance) for almost all of Australia, and likely (60 to 80% chance) across eastern Victoria.

- For January to March, above median minimum temperatures are very likely (greater than 80% chance) for much of Australia, and likely (60 to 80% chance) for southern South Australia and most of Victoria. The Gascoyne coast of Western Australia has roughly equal chances of above or below median minimum temperatures.

Game Management Authority
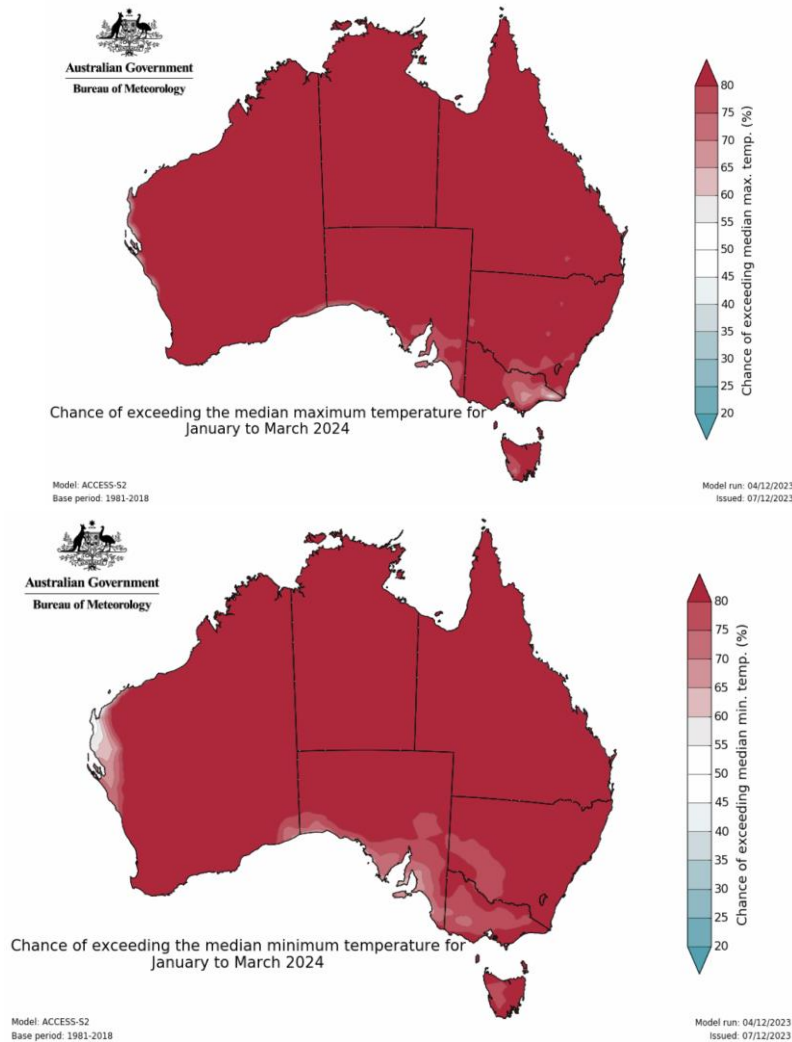
Streamflow predictions

Streamflow has a direct influence on waterbird habitat extent and population abundance. Rivers and creeks provide feeding, resting and breeding habitat and provide inputs into wetlands where they have not been diverted.

Streamflow forecast for December 2023 to February 2024

- High flow
- Near median flow
- Low flow
- Normal flow

Generated: 23:55 05/12/2023 (ver. 2.9.0)

©Commonwealth of Australia 2023, Bureau of Meteorology
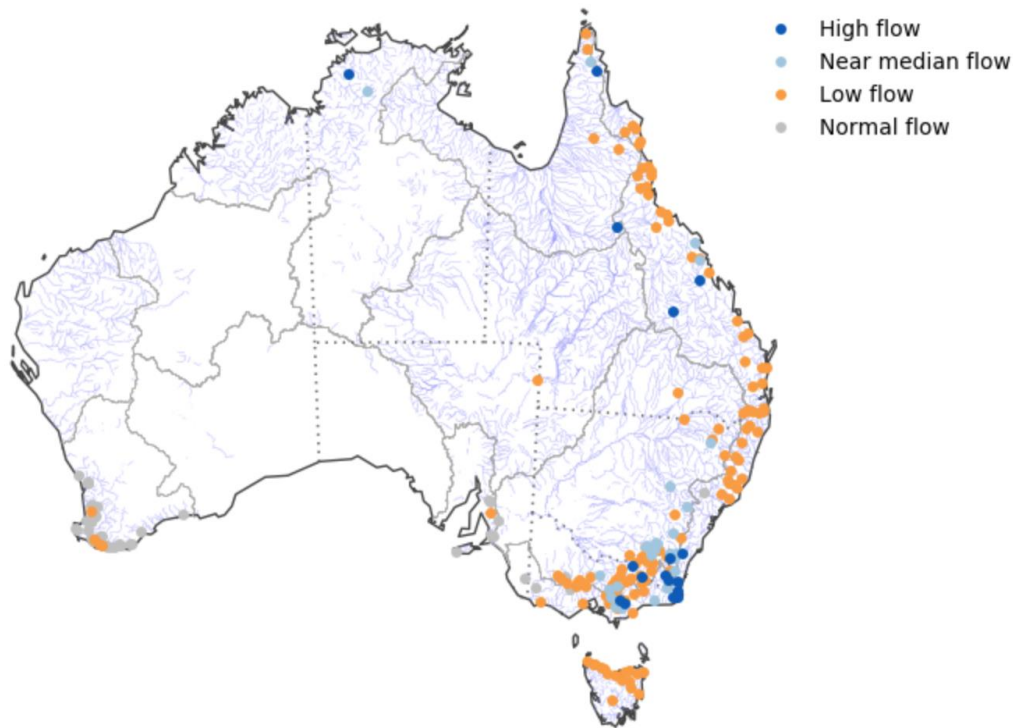
- Low streamflow is likely for most forecast locations from December to February with the exception of some in the far south-east.

Game Management Authority

Source: www.bom.gov.au

2023 harvest estimates

Harvest statistics can provide information on the health and dynamics of game duck populations, including distribution, abundance and productivity.

- The 2023 duck season was reduced from 12 to five weeks (35 days) in length. The season start was delayed from the third Saturday in March to 26 April and the end of the season brought forward from the second Monday in June to 30 May. The bag limit was reduced from 10 to four birds per day. Blue-winged Shoveler and Hardhead could not be hunted.

- There were 21,959 Game Licence holders endorsed to hunt duck in 2023. It was estimated that 65%, or 14,118, actually hunted, each taking an average seasonal harvest of 22.7 ducks.

- The average number of duck hunting days per active duck hunter was 7.1 days.

Source: Moloney and Flesch (2023)

Game
Management
Authority

2023 harvest estimates cont…

- The estimated seasonal harvest in 2023 was 319,908 consistent with the long-term average of 320,000.

- The total estimated number of duck hunting days was 99,700, 17% above the long-term average (85,000).

- The three most commonly harvested species were Pacific Black Duck (45%), Grey Teal (29%) and Australian Wood Duck (18%). Combined, these three species constituted 92% of the total seasonal harvest. The remaining ducks harvested were Chestnut Teal (4%), Pink-eared Duck (2%) and Mountain Duck (1%).

- Pacific Black Duck, Grey Teal and Wood Duck typically make up 90% of the total harvest, each with approximately 30%. Pacific Black Duck harvest was above average and Wood Duck was below average.

- The total harvest was estimated to be greatest in the North Central Catchment Management Authority (CMA) area, followed by West Gippsland CMA area and the Goulburn Broken CMA area.

- The top five towns for the total reported number of ducks harvested were (in descending order) Kerang, Sale, Horsham, Echuca and Geelong.

Source: Moloney and Flesch (2023)

Game Management Authority

Harvest per game species

Percentage (rounded) of harvest per duck species for 2023

Mountain Duck <1%

Pink-eared Duck 2%

Chestnut Teal 4%

Wood Duck 18%

Pacific Black Duck 45%

Grey Teal 29%

■ Pacific Black Duck   ■ Grey Teal   ■ Chestnut Teal   ■ Pink-eared Duck   ■ Mountain Duck   ■ Wood Duck

Source: Moloney and Flesch (2023)
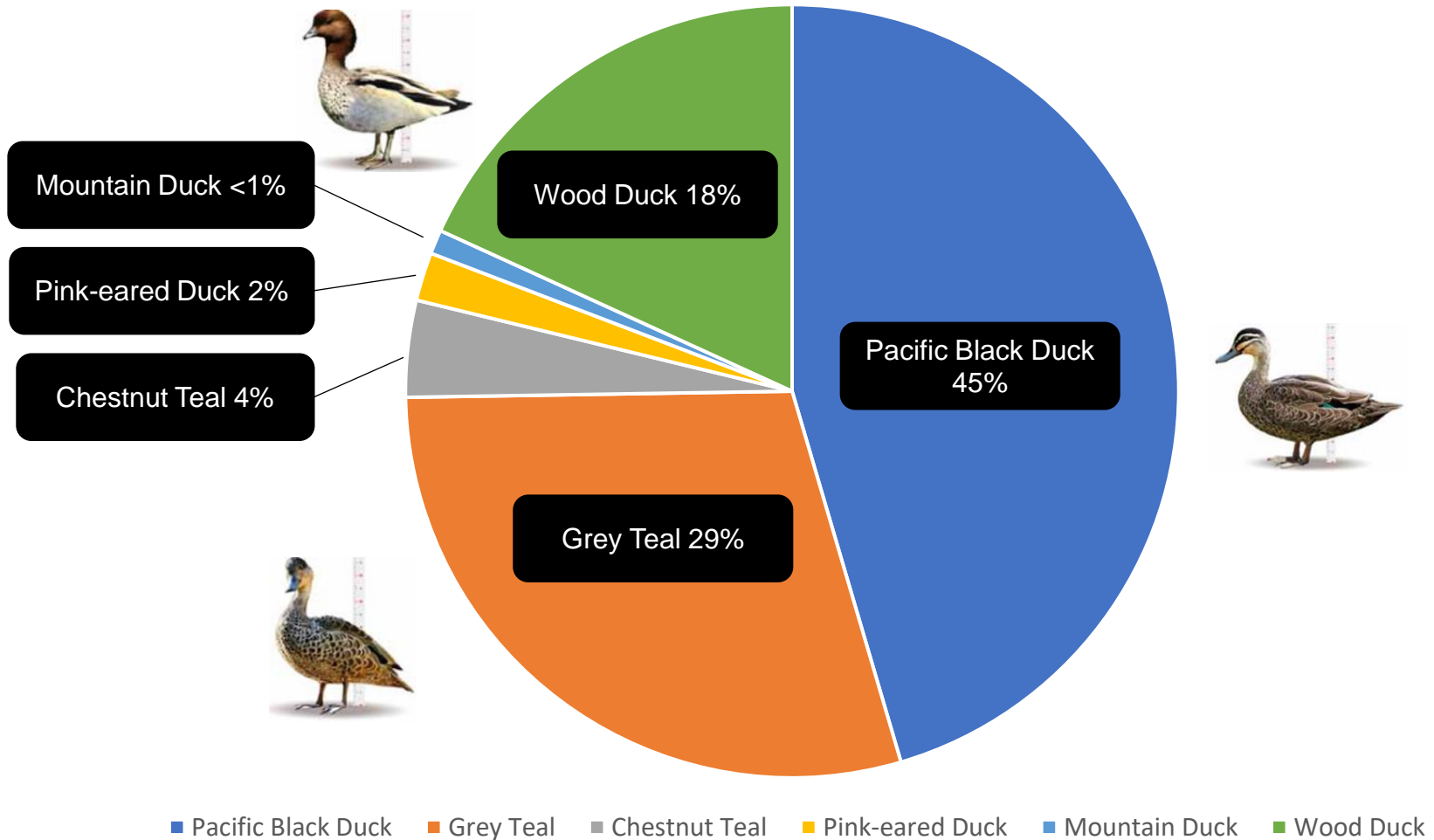
Long-term harvest statistics

Estimates	2009[1]	2010[2]	2011	2012	2013	2014	2015[3]	2016[4]	2017[5]	2018[6]	2019[7]	2020[8]	2021[9]	2022[10]	2023[11]	Avg 2009 - 2023
Licensed hunters	18,348	21,861	23,716	24,533	24,036	26,261	25,837	25,681	26,324	25,799	24,925	23,378	24,330	23,098	21,959	24,006
Total # hunter days	76,659	85,801	103,450	109,718	91,748	118,800	91,264	100,749	96,508	91,570	81,023	29,501	19,720	96,102	99,700	86,154
Total harvest	222,302	270,574	600,739	508,256	422,294	449,032	286,729	271,576	438,353	396,965	238,666	60,403	52,456	262,567	319,908	320,055
Avg # days hunted in the season per licence holder	3.98	3.98	4.48	4.6	3.75	4.57	3.59	3.98	3.83	3.62	3.27	1.3	0.8	4.2	4.6	3.64
Seasonal harvest per licence holder	11.1	12.5	26.0	21.2	17.2	17.3	11.4	10.5	17.4	15.7	9.62	2.58	2.16	11.57	14.6	13.4
Opening w/end bag per hunter	4.5	4.2	9.2	5.3	9.5	5.7	5.8	5.1	7.1	6.3	4.4	N/A	N/A	N/A	N/A	5.6*
Avg # ducks per day hunted	2.7	3.1	5.7	4.6	4.6	3.7	3.1	2.6	4.5	6.4	2.9	2.05	2.33	2.73	3.21	3.61

Does not include 2020, 2021, 2022 and 2023 following a mid-week opening

Harvest estimates are at 95% confidence intervals

Modified season arrangements
1. Two (2) birds a day with an additional three (3) Wood Duck. No Blue-winged Shoveler (BWS), Pink-eared Duck or Hardhead duck (49 day season)
2. Five (5) birds a day with an additional three (3) Wood Duck. No more than one (1) Blue-winged Shoveler (72 day season)
3. Ten (10) birds a day which included a maximum of two (2) BWS on opening day. Five (5) birds per day which includes a maximum of 1 BWS for season remainder (80 day season)
4. Eight (8) birds on opening day. Four (4) birds a day for season remainder. No BWS hunted in 2016 (87 day season)
5. Ten (10) birds a day. No BWS hunted in 2017 (87 day season)
6. Ten (10) birds a day. No BWS hunted in 2018 (87 day season)
7. Four (4) birds per day on opening weekend. Five (5) birds per day for the remainder of the season. No BWS hunted in 2019 (65 day season)
8. 3 birds per day. No BWS hunted in 2020 (38 day season). COVID-19 restrictions applied to travel, gathering size, no overnight camping
9. 5 birds per day. No BWS hunted in 2021 (20 day season). COVID-19 restrictions applied to travel and the size of social gatherings
10. 4 birds per day. No BWS and Hardhead hunted in 2022 (90 day season)
11. 4 birds per day. No BWS and Hardhead hunted in 2023 (35 day season)

Interim Harvest Model

- An expert panel recommended to develop a harvest management framework to translate waterfowl monitoring and wetland availability data into harvest recommendations while adaptive harvest management is developed simultaneously.

- An interim harvest model was developed by two members of the expert panel who are experts in waterfowl ecology.

- The model uses information from long-running duck population data sets to explore the relationship between game duck abundance, habitat availability, time and past harvest management. Condition indices are developed and awarded points.

- Using the relationship between past actual daily bag limits and retrospectively calculated point scores, the 2023 point score produces a recommended daily bag limit for the upcoming season.

- Based on 2023 data, the recommendation for the 2024 duck season is nine birds per day.

- The experts recommended to regulate the bag limit rather than season length if there was a need to restrict seasonal harvest.

Summary
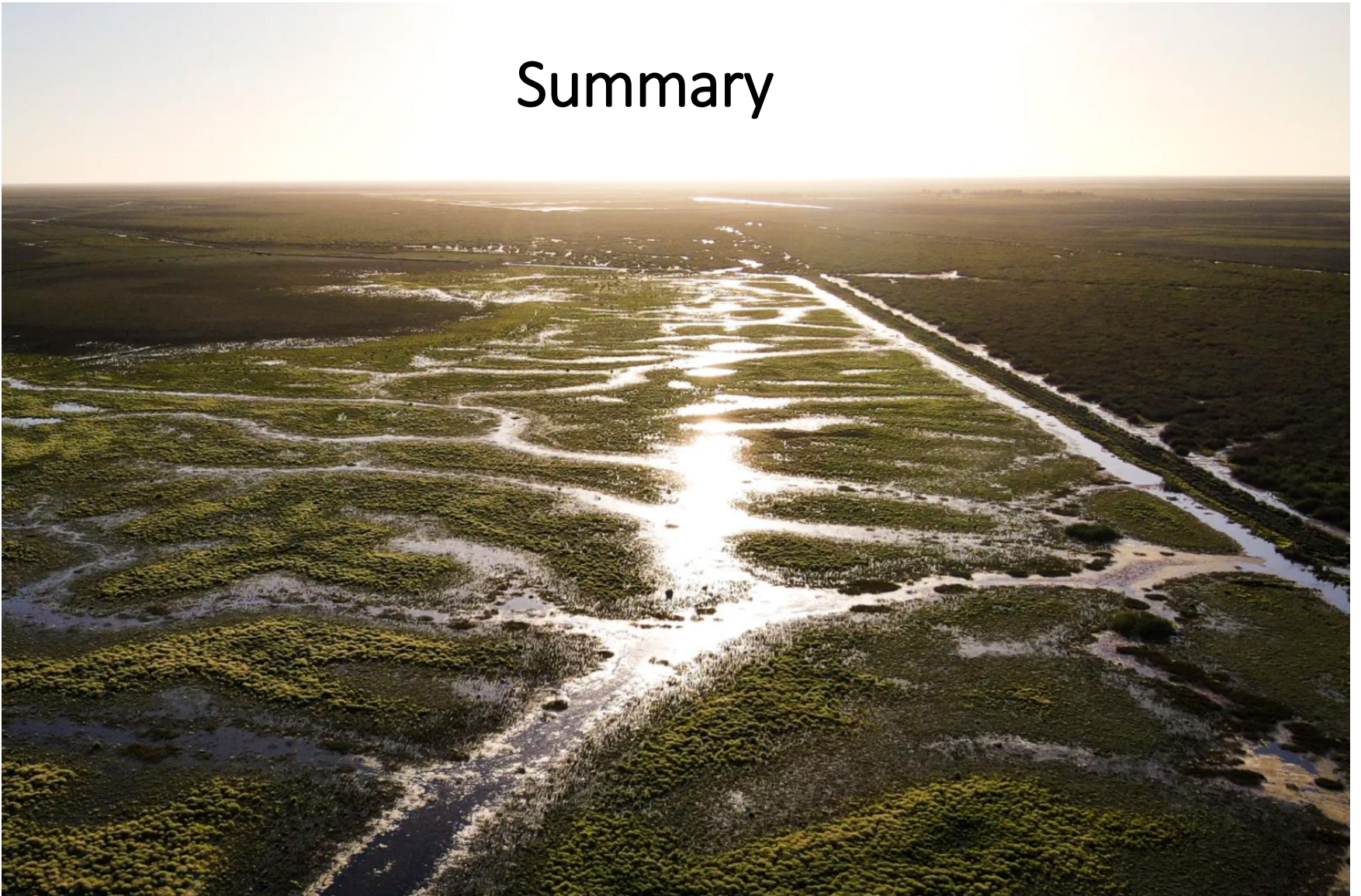
Summary

This report should be read in conjunction with source material and references cited below.

- For the previous three years, La Niña and other drivers have influenced Australia's climate resulting in significant rainfall and flooding throughout parts of eastern Australia resulting in widespread and extensive habitat for waterbirds.

- In 2023, El Niño conditions returned to Australia, as well as a positive Indian Ocean Dipole. The result was drier conditions across much of eastern Australia in 2023. In response waterbird habitat throughout eastern Australia declined from the previous year.

- The majority of wetland area occurs between northern Victoria to central New South Wales. Surface water availability in Victoria declined slightly from 2022 for both wetlands and dams, but was still higher than in 2020 and 2021.

- EAWS showed that waterbirds were more widely dispersed across the eastern Australian landscape than last year, however, the majority of birds were found in northern Victoria and central Queensland.

- In response to excellent breeding conditions from the previous year, most game duck populations increased:
  - Victoria's total population increased from 2.41 million birds in 2022 to 7.1 million in 2023
  - NSW Riverina's total population increased from 964,000 in 2022 to 4.3 million in 2023
  - the EAWS game duck index for all of eastern Australia increased by almost 7-times to the seventh highest recorded in 41 years and 60% above the long-term average. The EAWS Victorian game duck population index increased by almost 25-times from 2022.

Summary cont…

- Drier conditions in 2023 saw waterbird breeding species' richness and breeding abundance decrease from the previous year, but was still only slightly below the long-term average.

- Three major indices for waterbirds (total abundance, number of species breeding and wetland area index) continue to show significant declines over time. These declines have been attributed to water resource developments (e.g. building of dams, floodplain developments, extraction of water) which have caused widespread degradation of freshwater habitats (Kingsford *et al.* 2017).

- The persistence of El Niño conditions and the weakening positive Indian Ocean Dipole are forecast to result in below average rainfall and warmer days and nights until the end of summer. Habitat is expected to decline, however, there is much residual water in the system following three years of La Niña conditions. It is unknown whether El Nino conditions will persist beyond the summer of 2024.

- The interim harvest model considers the relationship between game duck abundance, the extent of habitat throughout eastern Australia, time and past season management. Based on current conditions, the model recommends a daily bag limit of nine ducks.

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

- Kingsford R. T. and Norman F. I. (2002) Australian waterbirds—products of the continent's ecology, *Emu - Austral Ornithology*, 102:1, 47 69, DOI: 10.1071/MU01030

- Kingsford R.T., Bino G., Porter J.L. (2017) Continental impacts of water development on waterbirds, contrasting two Australian river basins: Global implications for sustainable water use. *Glob Change Biol.* 2017; 00:1–12. https://doi.org/10.1111/gcb.13743

- Klaassen, M. (2023) *Using duck proxies and surface water to inform hunting arrangements for 2024.* Deakin University.

- Moloney, P.D. and Flesch, J.S. (2023) *Estimates of duck and Stubble Quail harvest in Victoria for 2023: results from surveys of Victorian Game Licence holders in 2023.* Unpublished Client Report for the Game Management Authority. Arthur Rylah Institute for Environmental Research, Department of Environment, Land, Water and Planning, Heidelberg, Victoria.

- NSW Department of Primary Industries (2023) *2023-2024 Annual Waterfowl Quota Report to DPI Hunting*, NSW Department of Primary Industries.

- Porter J.L., Kingsford R.T., Francis, R., and Brandis K. and Ahern, A. (2023) *Eastern Australian Waterbird Aerial Survey - October 2023 Annual Summary Report*, University of New South Wales 2023.

- Ramsey, D.S.L. and Fanson B. 2023 (2023) *Preliminary results from the 2023 survey of game ducks in Victoria.* Unpublished.

- The Long Paddock- www.longpaddock.qld.gov.au