Eastern Australian Waterbird Aerial Survey - October 2023 Annual Summary Report

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2023 Eastern Australian Waterbird Aerial Survey

Executive Summary

- The annual Eastern Australian Waterbird Aerial Survey (EAWS) began in 1983 to monitor annual continental scale changes in the distribution and abundance of waterbirds and their breeding, as well as change in the extent of wetland habitat over time. It tracks trends in more than 50 species of waterbirds.

- In 2023 (41st survey), dry conditions returned to much of eastern Australia (August-October) after record breaking rainfalls and flooding in 2022. Small areas of Queensland NSW are in drought or are drought affected.

- Wetland area decreased considerably from the previous flood year, to well below the long-term average. 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.

- After record high breeding in 2022, most game species of ducks had abundances well above long term averages, in some cases by an order of magnitude. Total abundance (all species combined) increased markedly from the previous year. Despite this, five out of eight species continued to show significant long-term declines.

- Total breeding decreased by an order of magnitude from the previous year and was 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. Long-term trends are more informative for predicting population status than year to year fluctuations.

- Availability of wetland habitat is a major driver of waterbird abundance, breeding and diversity. Reductions in habitat area and persistence due to climate change, river regulation and water extraction have resulted in ongoing long-term declines particularly in the Murray Darling basin. Purchases and timed releases of environmental water to support breeding or habitat retention have offset some the ongoing impacts of regulation.

2023 Eastern Australian Waterbird Aerial Survey Results

1. Global warming continues to influence Australian and global climates. Global sea surface temperatures were the highest on record for their respective months from April to October. Australia's climate has warmed by around 1.48°C since 1910 (BOM 2023[a]). There has also been an increase in extreme heat and fire weather events, as well as a trend towards a greater proportion of rainfall from high intensity short duration rainfall events, especially across northern Australia (BOM 2023[a]).

2. Drier conditions have returned to much of Australia after record breaking rainfalls and flooding in 2022. For Australia as a whole, October rainfall was 65% below the 1961–1990 average, the fifth-driest October on record (since 1900) and the driest since 2002 (BOM 2023[b]). Much of south-eastern Queensland had very low August–October rainfall and large areas of 3-monthly rainfall deficiencies have developed in South Australia and eastern Australia (BOM 2023[b]).

3. In 2023 low streamflows were recorded in parts of eastern New South Wales, southern and south-east Queensland, and parts of South Australia and western Victoria (BOM 2023[b]). Storage levels remain low in some parts of southern and central Queensland and eastern parts of New South Wales (BOM 2023[b]). The combined storages in the Murray–Darling Basin were 92% full. This is down from 101% at the end of October last year. Menindee Lakes storages are around 76% full (Water NSW 2023).

4. A small proportion (9.7%) of Queensland was in drought or drought affected (as of November 2023); in NSW 12.6% of the state was in drought or drought affected (DPI 2023). South Australian and Victorian drought maps are not currently available.

5. Despite two successive La Niňa years three major indices for waterbirds (total abundance, number of species breeding and wetland area index) continued to show significant declines over time. If 1983 & 1984 peak years are omitted then 3 of the 4 major indices still showed significant decline (OLS regression at p=0.05; variables 4th root or log transformed where appropriate and autocorrelation plots examined for serial autocorrelation; Fig. 1; Table 1). Long-term trends are more informative for predicting population status than year to year fluctuations.

6. Total waterbird abundance in 2023 (n=579,641) increased significantly from 2022 to well above the long-term average: the 7th highest in 41 years. Waterbirds were most abundant in Survey Bands 8 and 2 (Figs 2 & 5). Temporary desert wetlands - Lakes Mumbleberry & Torquinnie in Band 8 supported more than 180,000 waterbirds (31% of total abundance). In Band 2, a group of eight wetlands near the southern Coorong held more than 71,500 waterbirds.

7. Breeding species' richness and breeding abundance, decreased considerably compared to the previous year, with abundance falling by an order of magnitude to slightly below the long-term average. Breeding was concentrated in one wetland (73% of total) in Survey Band 9 (Fig. 6) and comprised mostly Little Black Cormorants and Nankeen Night Herons.

8. Most species functional response groups (feeding guilds) showed significant long-term declines (OLS regression at p=0.05; variables 4th root or log transformed where appropriate and autocorrelation plots examined for serial autocorrelation. Fig. 3; Table 2). Long-term changes were also observed in decadal averages of total abundance, wetland area index, breeding index and breeding species' richness (Fig. 4).

2023 Eastern Australian Waterbird Aerial Survey Results (continued)

10. Wetland area index (192,083 ha), decreased considerably from the previous flood year, to well below the long-term average. 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 (Fig.7). Bands 2, 3 & 4 contained the largest areas of habitat – comprising 64% of the inundated wetland area sampled (Fig.2). Important habitat areas included Macquarie Marshes, Lowbidgee wetlands, Paroo Overflow lakes, Talyawalka Creek, Menindee Lakes and Proserpine Dam and Lakes Galilee and Moondarra in the north (Fig. 5).

11. The Macquarie Marshes had less extensive flooding than the previous year and supported relatively low numbers of waterbirds; no breeding colonies were active. The Lowbidgee wetlands also had intermediate inundation extent and supported moderate numbers of waterbirds and very low breeding. Most wetlands in the regulated Menindee Lakes system were full, including outside the survey band to the north - Copi Hollow and Lakes Wetherell, Pamamaroo, Bijiji and Balaka. Overall, there were moderate waterbird numbers and little breeding activity on these wetlands. The Talywalka Lakes systems also held considerable water and moderate to high numbers of waterbirds (Fig. 7).

12. Waterbirds had 72% of their total abundance distributed across thirty wetlands, making them less spatially concentrated and more evenly spread than the previous year. Nevertheless, two Band 8 wetlands (Lakes Torquinnie and Mumbleberry) supported more than 180,000 waterbirds representing 31% of the total abundance (Fig. 5). These wetlands together with the Talywalka Lakes and Proserpine Dam generally supported large numbers of waterbirds and high species diversity (Figs 2 & 6). Conversely around 40% of surveyed wetlands supported no waterbirds (includes wetlands that were dry).

13. Total breeding index (nests + broods) was 6,036 (all species combined), an order of magnitude decrease from the previous year (60,580) and below the long-term average (Figs. 1 & 6). Breeding species' richness also decreased considerably with 11 species recorded breeding. Five species comprised 97% of the total breeding recorded, primarily numbers of nests (Little Black Cormorants, 4,400; Darter 959; Nankeen Night Heron 400; Australian White Ibis 355, and Pied Cormorants 161).

14. Most game species of ducks had abundances well above long term averages, in some cases by an order of magnitude. Despite this, five out of eight species continued to show significant long term declines (OLS regression at $p=0.05$; variables 4th root or log transformed where appropriate Table 3). Chestnut Teal increased sharply from the previous year to their highest abundance since 1991. One species (Australian Shelduck) declined in abundance compared to 2022.

15. Waterbird indices (abundance, breeding species richness), across river basins responded to widespread dryer conditions than the previous flood year with declines in wetland area and breeding. Overall abundance increased, after high levels of breeding in the previous year. Wetland areas decreased in the Murray-Darling Basin compared to the previous year (Fig. 8). Species relative abundances were less even compared to previous years – with 10 species comprising 79% of total abundance. These species were, in order of decreasing abundance: Grey Teal, Pink-eared Duck, Eurasian Coot, Great Cormorants, Pacific Black Duck, Australian Wood Duck, Pelicans, Chestnut Teal, Black Swans and Banded Stilts.

2023 Eastern Australian Waterbird Aerial Survey Results (continued)

16. Selected species distribution and abundances are shown in Figures 10-20; Freckled Duck, Plumed Whistling Duck and Pelicans were included for comparison with game species. Map plots in these figures show 2023 distribution and trend plots show changes in abundance over time (1983-2023). Horizontal lines in trend plots indicate the long-term average.

17. Across Eastern Australia overall abundance, breeding index and breeding species richness were positively related to available habitat (wetland area index). Conversely, declines in wetland area were likely to result in declines in waterbird abundance, breeding and breeding species richness (Fig. 9).

Methods

Methods are described in detail in Braithwaite et al. (1985) and Kingsford et al. (2020) – a short description follows here. All waterbirds (including nests and broods) were counted from high-winged aircraft (e.g. Cessna 206 or 208) at 167–204 km hr^{-1} and a height of 30–46 m, within 150 m of the wetland's shoreline where waterbirds concentrated. A front-right observer (navigator) and a back-left observer independently record counts on audio recorders, with their combined counts making up a completed count. Counts are attributed on the recorder to a unique number for each wetland, and a geolocation (longitude, latitude), as well as the exact time of day the count commenced. All timing is synchronised to GPS time – this enables audio counts to be linked to location via a GPS track log of the flight path. The percent fullness (inundated area) of each wetland is also estimated, relative to the mapped high-water mark. Inundated areas (ha) are also estimated for wetlands which are not mapped.

An area of 2,697,000 km^2 is systematically sampled with ten survey bands 30 km in width, spaced every 2° of latitude from 38°30'S to 20°30'S. Waterbirds are counted on all waterbodies (rivers and wetlands) larger than 1 ha within survey bands; additional counts are made on an ad-hoc basis of wetlands smaller than 1 ha. This ensures information is collected across a representative sample of waterbodies (wetlands, dams, lakes, estuaries and rivers).

All waterbirds are identified to species, except those few that cannot be consistently identified to species' level from the air and were grouped: small grebes (Australasian Little Grebe, Hoary Headed Grebe), small egrets (Cattle Egret, Little Egret and Intermediate Egret), terns and small and large migratory wading birds (Charadriformes). Counts of no birds are also recorded, as are dry wetlands. Waterbirds are counted singly and in groups, progressively increasing up to 1,000 individuals. Waterbird nomenclature and classification follows the IOC World Bird List (Gill et al. 2023).

Three counting techniques are used: total counts, proportion counts and transect counts. For total counts, all birds are counted during a circumnavigation of the wetland, the preferred method for wetlands with large concentrations of waterbirds. For proportion counts, a proportion (usually >50%) of a large wetland with few waterbirds (e.g. large dam) is surveyed, with counts extrapolated to give total counts. For the final transect method, waterbirds are counted within 200 m-wide transects (100 m on each side of the aircraft, delineated by tape markers on each aircraft wing strut), a technique only used for braided complex large wetlands. Total estimates are formed from the relative area of the transects, compared to total area flooded. Most counts are total counts or proportion counts greater than 50%.

Acknowledgements

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We thank Sharon Ryall for help with logistics, along with staff from our collaborative agencies. We also thank Thomas Clarke, for piloting the aircraft and Paul Wainwright (SA Landscapes), Heath Dunstan (VIC GMA), Shannon Dundas (NSW DPI) and Jody O'Connor (DEW SA) for acting as aerial observers. Trainees were Chris Henderson (QLD DSE) Simon Toop, Scott Henshall and Kurt Murphy (VIC GMA), Karl Hillyard and Allira Taylor-Wilkins (SA NPWS) and Ashwyn Rudder
We also thank Daniel Simpson, Yannick Tidou, Sophie Hewitt, Matt Davis, Jana Stewart, Ada Sanchez-Mercado, Zoe Ford, Julie Hall, Fred Dadzie, Brendan Alting, Emily Gardener-Brandis, Annabel Murray, Nicole Malinconico and Nathali Machado de Lima for support, data entry and management, graphics and quality assurance. Cover Picture: Lake Torquinnie John Porter.

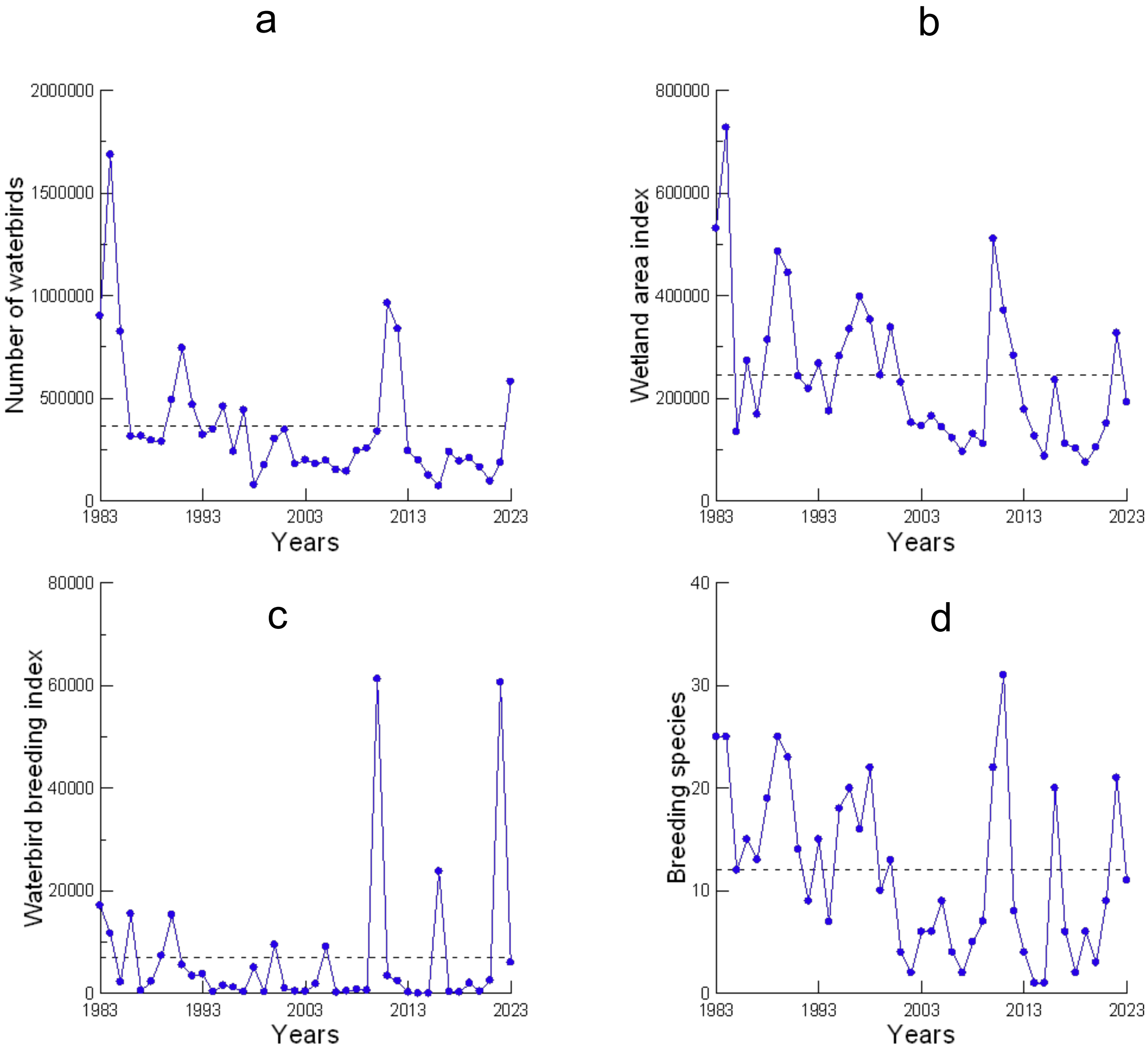


Figure 1. Changes over time in a) total abundance, b) wetland area, c) breeding and d) number of breeding species in the Eastern Australian Waterbird Aerial Survey transects (1983-2023); horizontal lines show long-term averages.

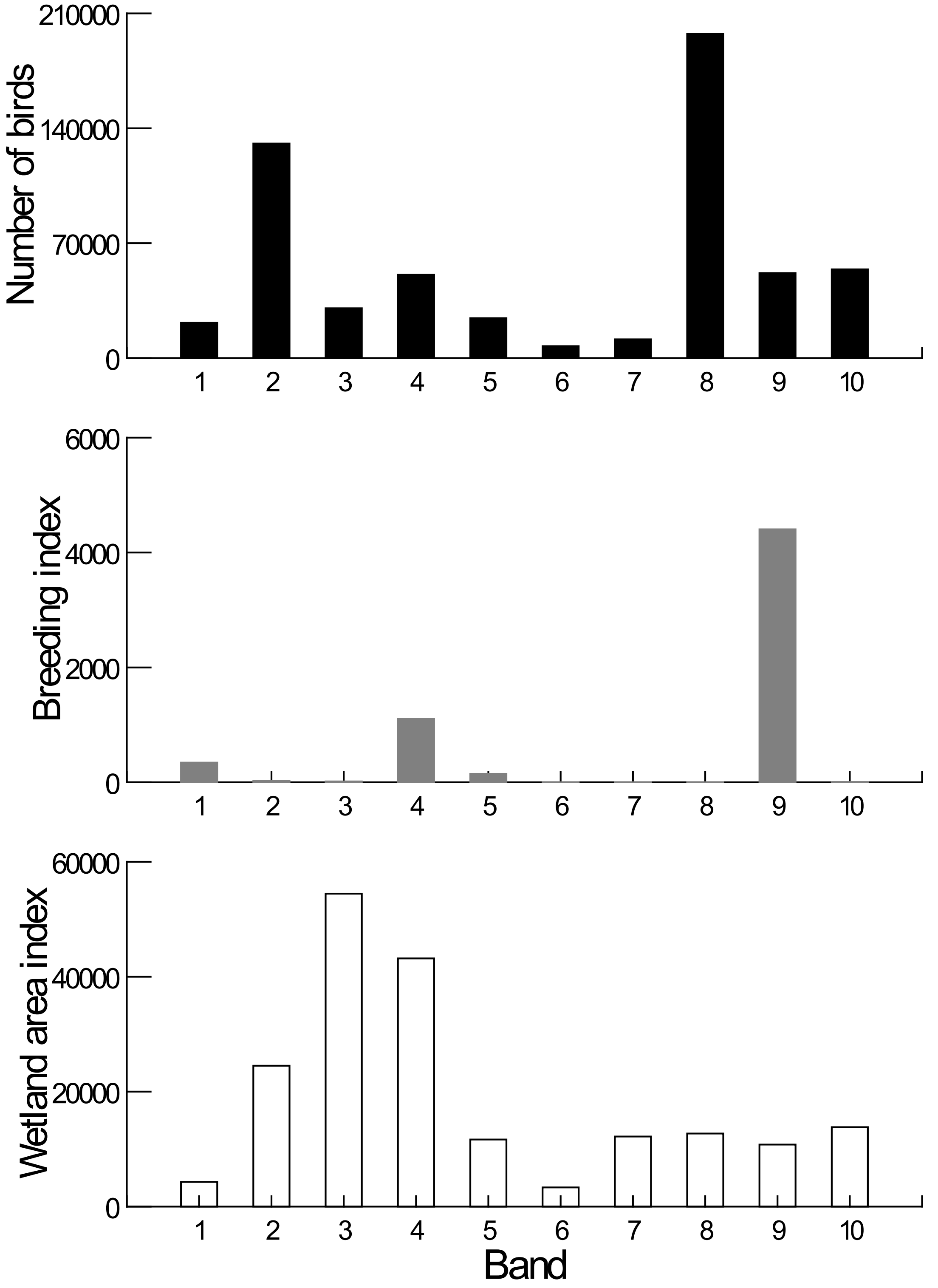


Figure 2. Distribution of waterbird abundance, breeding index and wetland area index in survey bands 1-10 (south to north respectively) of the Eastern Australian Waterbird Aerial Survey in 2023.

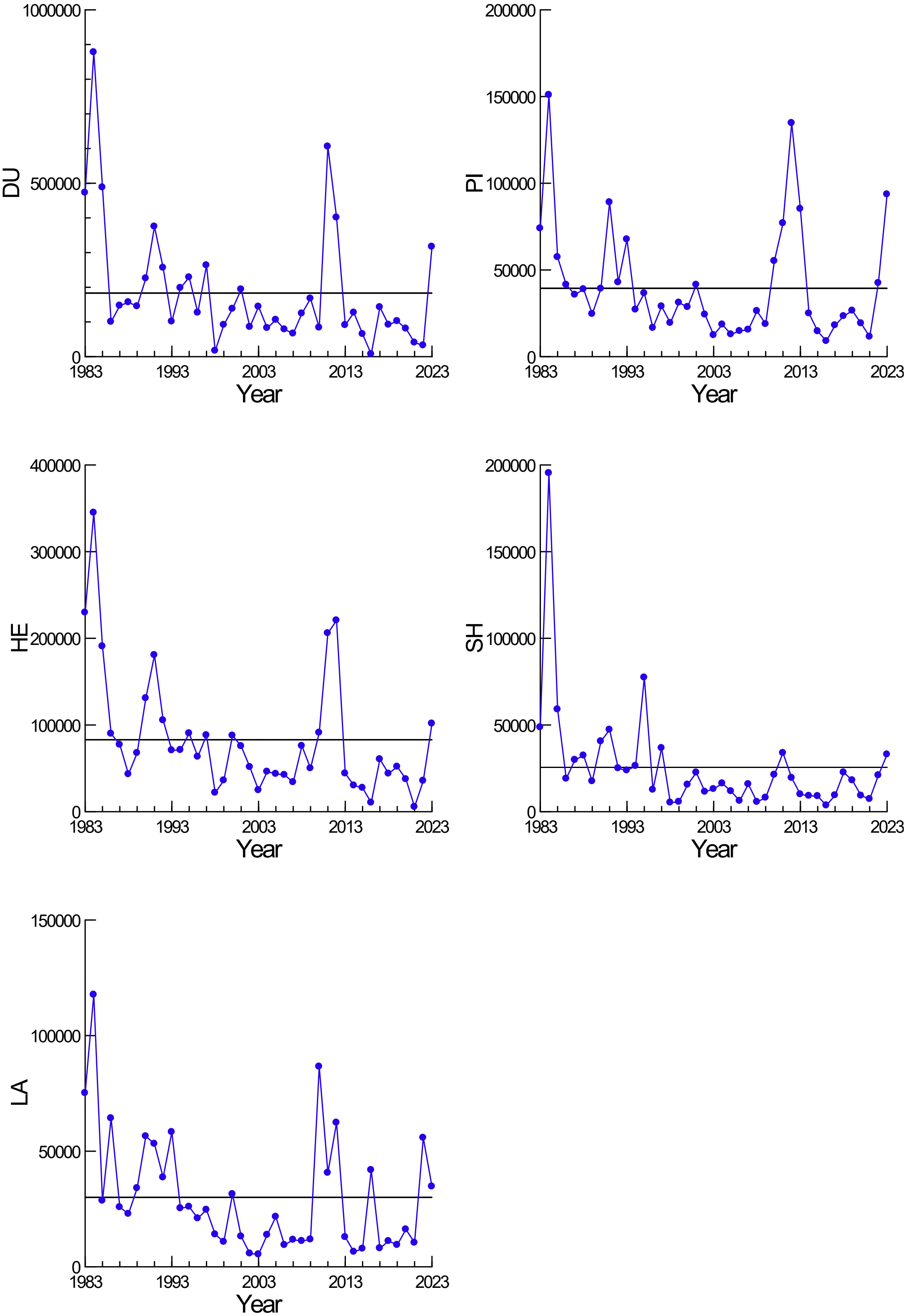


Figure 3. Changes in abundances of waterbird functional response groups (Du=ducks; Pi=piscivores; He=herbivores; Sh=shorebirds; La=large wading birds) over time in the Eastern Australian Waterbird Aerial Survey bands (1983-2023).

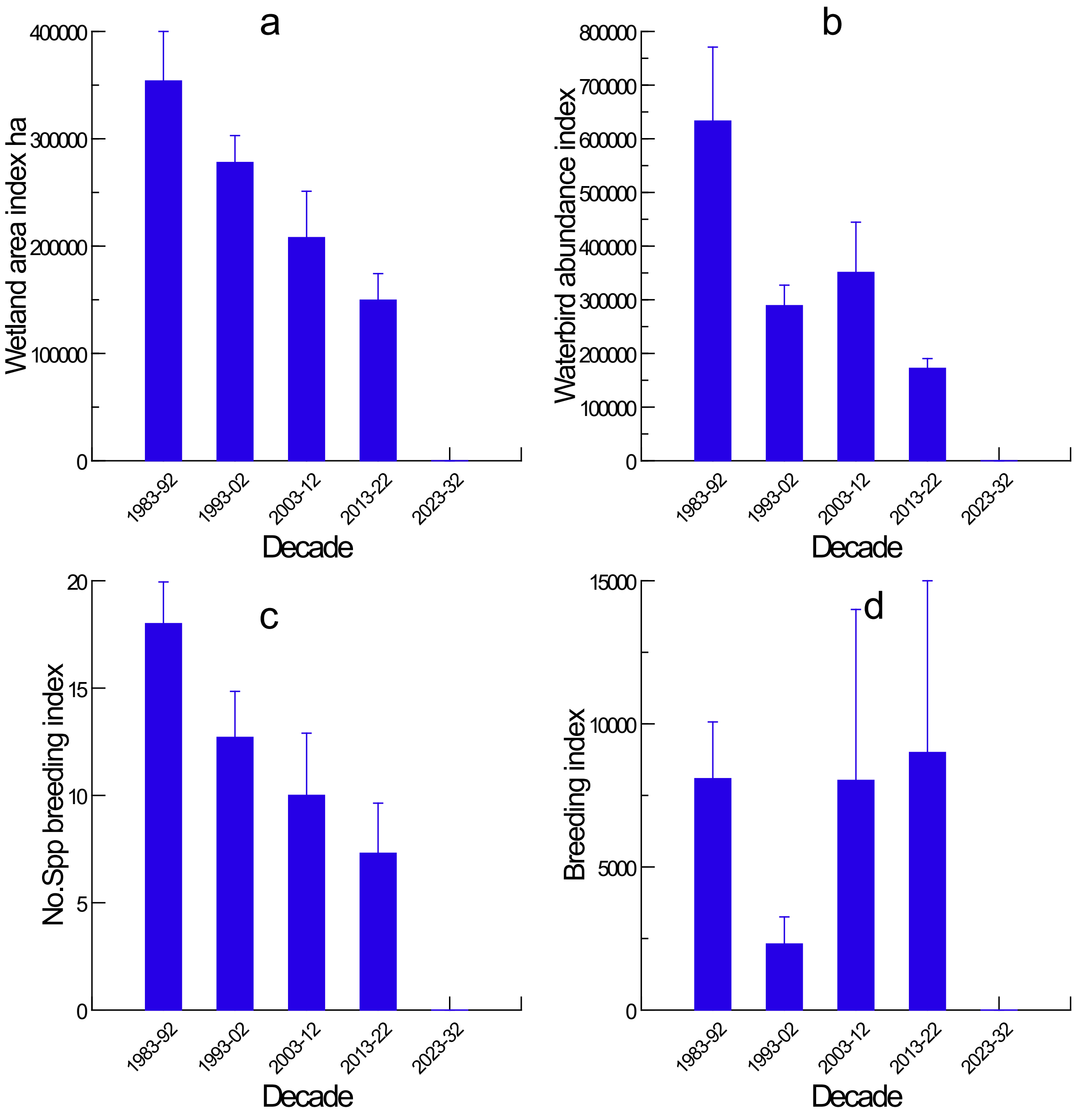


Figure 4. Decadal means of a) wetland area index, b) total abundance index, c) number of breeding species and d) breeding index in the Eastern Australian Waterbird Aerial Survey (1983-2023). Error bars are SE. The most recent decade with only a single years data (2023) is not shown.

Table 1. Trends in total waterbird abundance index, wetland area index, breeding index and breeding species richness in the Eastern Australian Waterbird Aerial Survey (1983-2023).

Variable	Trend	Regression all years	Trend	Regression 1983-84 omitted
Total waterbird abundance	decline	r^2=0.30, p<0.001	decline	r^2=0.20, p=0.004
Wetland area index	decline	r^2=0.27, p<0.001	decline	r^2=0.18, p=0.007
Breeding index	no trend	r^2=0.02, p=0.363	no trend	r^2=0.003, p=0.759
Breeding species richness	decline	r^2=0.19, p=0.004	decline	r^2=0.12, p=0.030

Table 2. Trends in abundances of functional response (Fx) groups, in the Eastern Australian Waterbird Aerial Survey (1983-2023).

Fx group code	name	Trend	Regression all years	Trend	Regression 1983-84 omitted
Du	Ducks	decline	r^2=0.22, p=0.002	decline	r^2=0.14, p=0.017
He	Herbivores	decline	r^2=0.25, p=0.001	decline	r^2=0.15, p=0.017
La	Large wading birds	decline	r^2=0.18, p=0.006	no trend	r^2=0.09, p=0.060
Pi	Piscivores	no trend	r^2=0.08, p=0.071	no trend	r^2=0.02, p=0.355
Sh	Shorebirds	decline	r^2=0.29, p<0.001	decline	r^2=0.21, p=0.002

Table 3. Trends in abundances of game species from the Eastern Australian Waterbird Aerial Survey (1983-2023).

Species	Trend	Regression all years	Trend	Regression 1983-84 omitted
Pacific black duck	decline	r^2=0.32, p<0.001	decline	r^2=0.21, p=0.004
Australasian shoveler	decline	r^2=0.45, p<0.001	decline	r^2=0.38, p<0.001
Chestnut teal	no trend	r^2=0.02, p=0.337	no trend	r^2=0.01, p=0.628
Grey teal	decline	r^2=0.27, p=0.001	decline	r^2=0.18, p=0.008
Hardhead	no trend	r^2=0.06, p=0.140	no trend	r^2=0.03, p=0.321
Mountain duck	decline	r^2=0.34, p<0.001	decline	r^2=0.26, p=0.001
Pink-eared duck	no trend	r^2=0.07, p=0.092	no trend	r^2=0.08, p=0.092
Australian Wood duck	decline	r^2=0.13, p=0.019	no trend	r^2=0.04, p=0.235

2023 Total abundance index 579,641

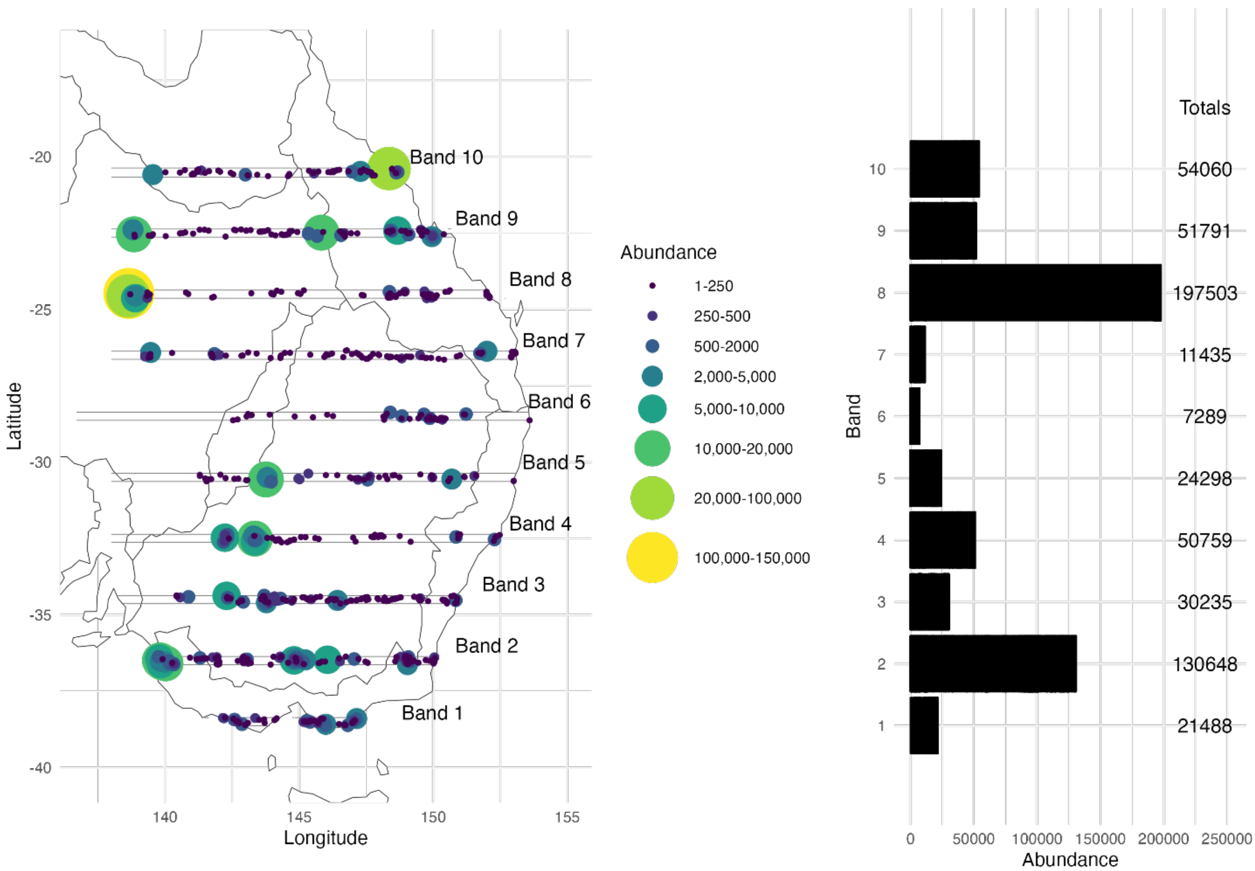


Figure 5. Distribution and abundance of waterbirds in the 2023 Eastern Australian Waterbird Aerial Survey bands. Dry wetlands and those with zero waterbirds not plotted.

2023 Breeding index – 6,036

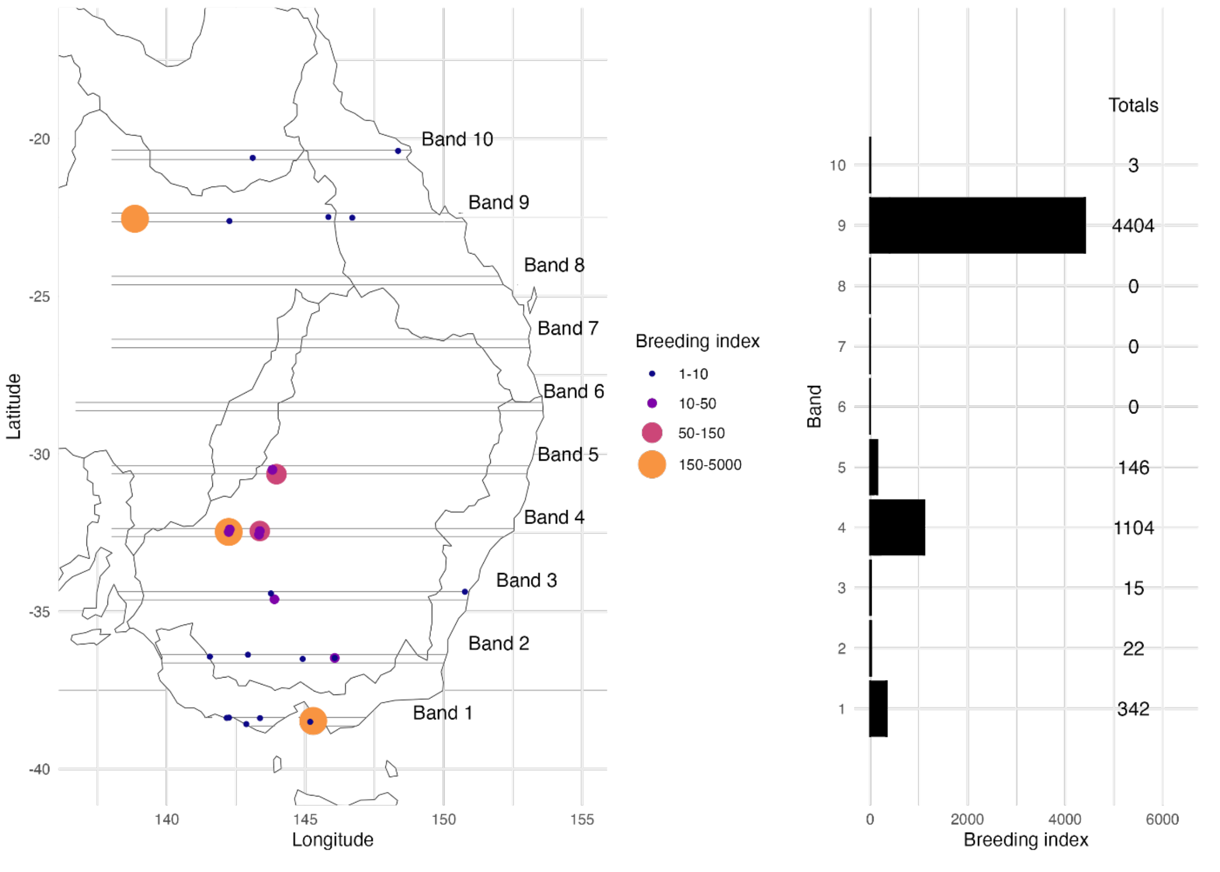


Figure 6. Distribution of waterbird breeding in the 2023 Eastern Australian Waterbird Aerial Survey bands. Only wetlands with breeding recorded are plotted.

2023 Wetland area index – 192,083 ha

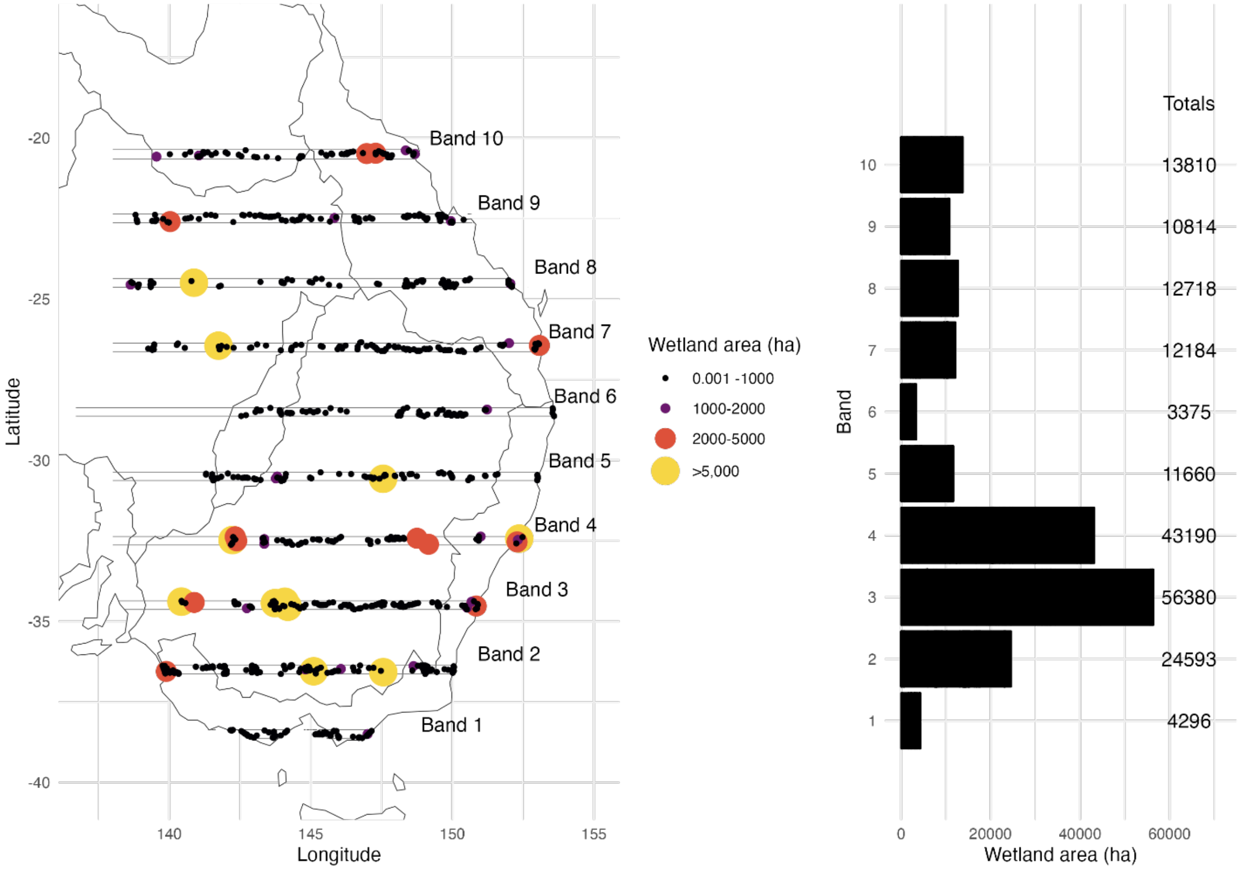


Figure 7. Distribution of wetland area in the 2023 Eastern Australian Waterbird Aerial Survey bands. All surveyed wetlands with surface water present are plotted; dry wetlands are not plotted.

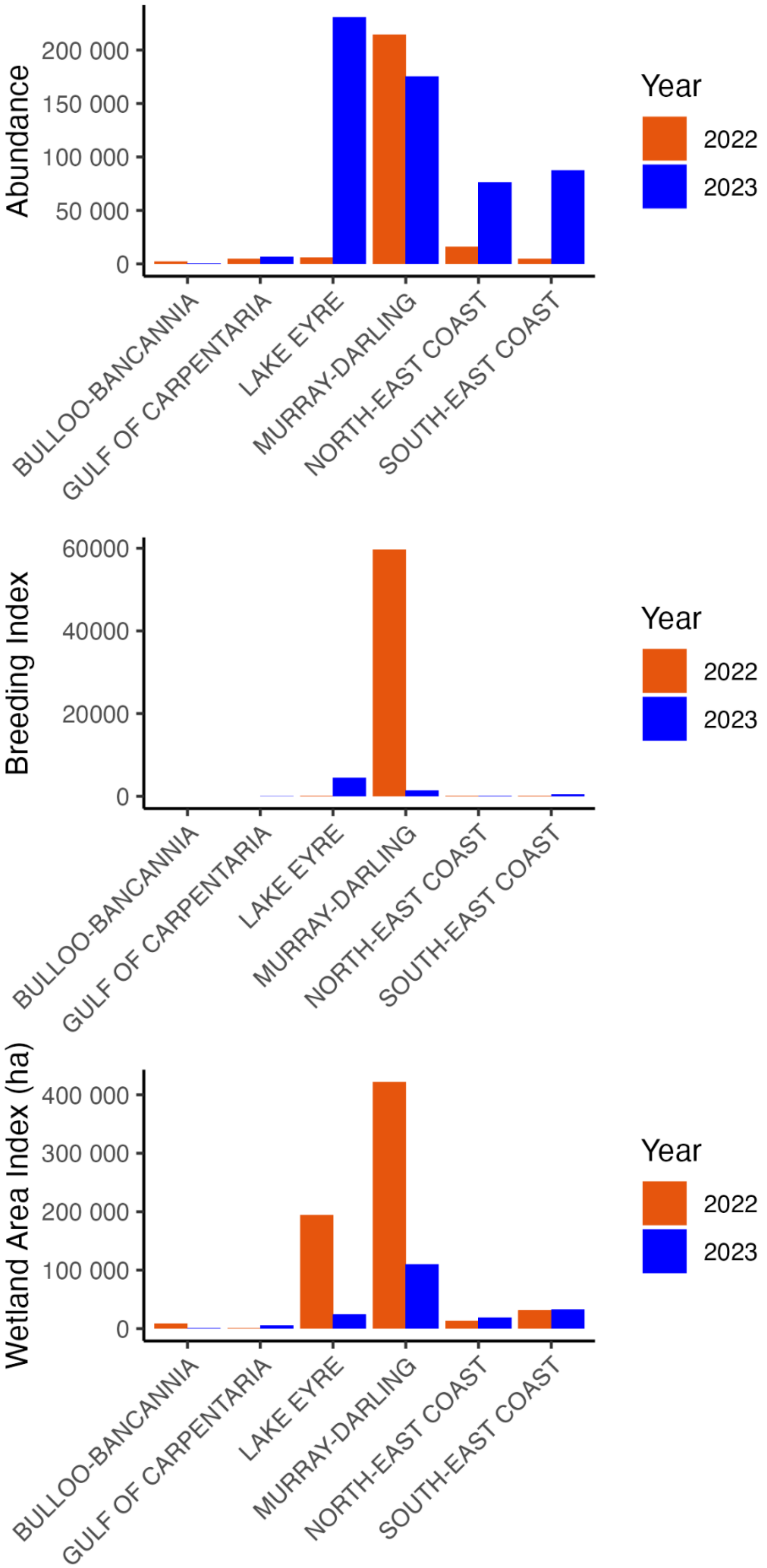


Figure 8. Comparison of waterbird abundance, breeding and wetland area indices in major river basins 2022-2023.

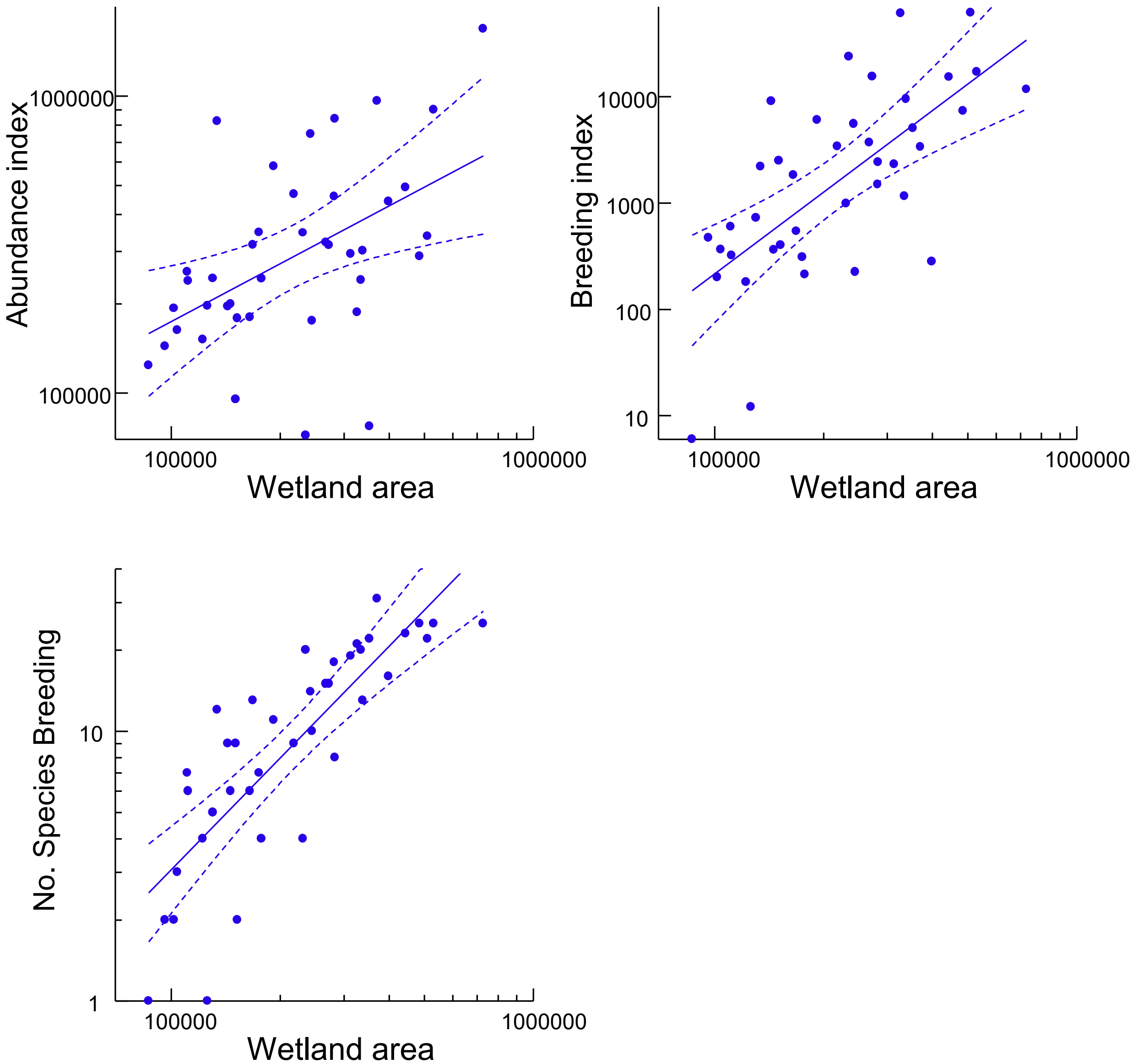


Figure 9. Significant positive interactions between abundance index, breeding index and number of breeding species with wetland area index (ha) for the Eastern Australian Waterbird Aerial Survey (1983-2023). Dashed lines are 95% confidence limits.

Pacific Black Duck

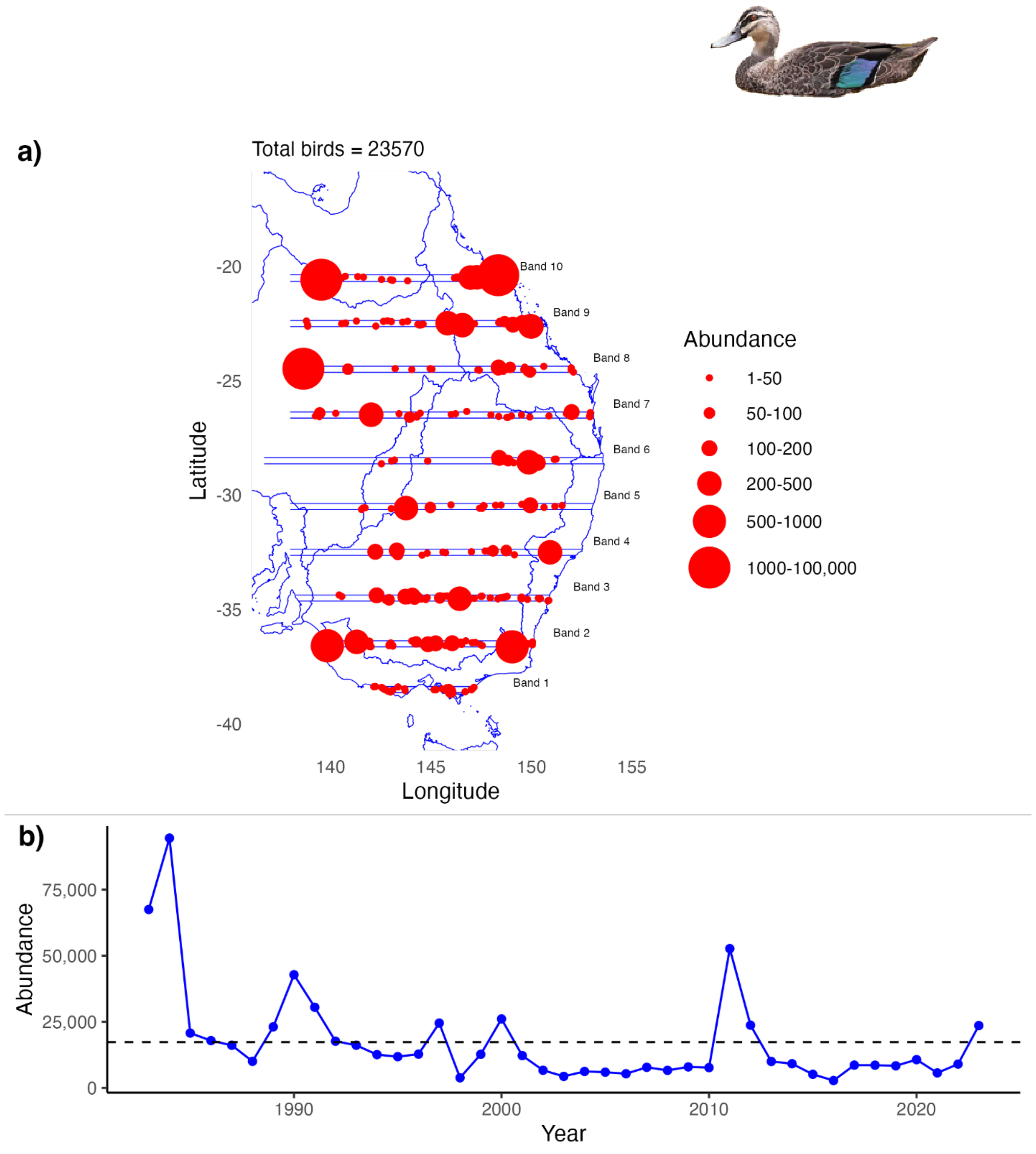


Figure 10. a) Distribution and abundance of Pacific Black Duck during the 2023 Eastern Australian Waterbird Aerial Survey. B) Changes in abundance (1983-2023).

Australasian Shoveler

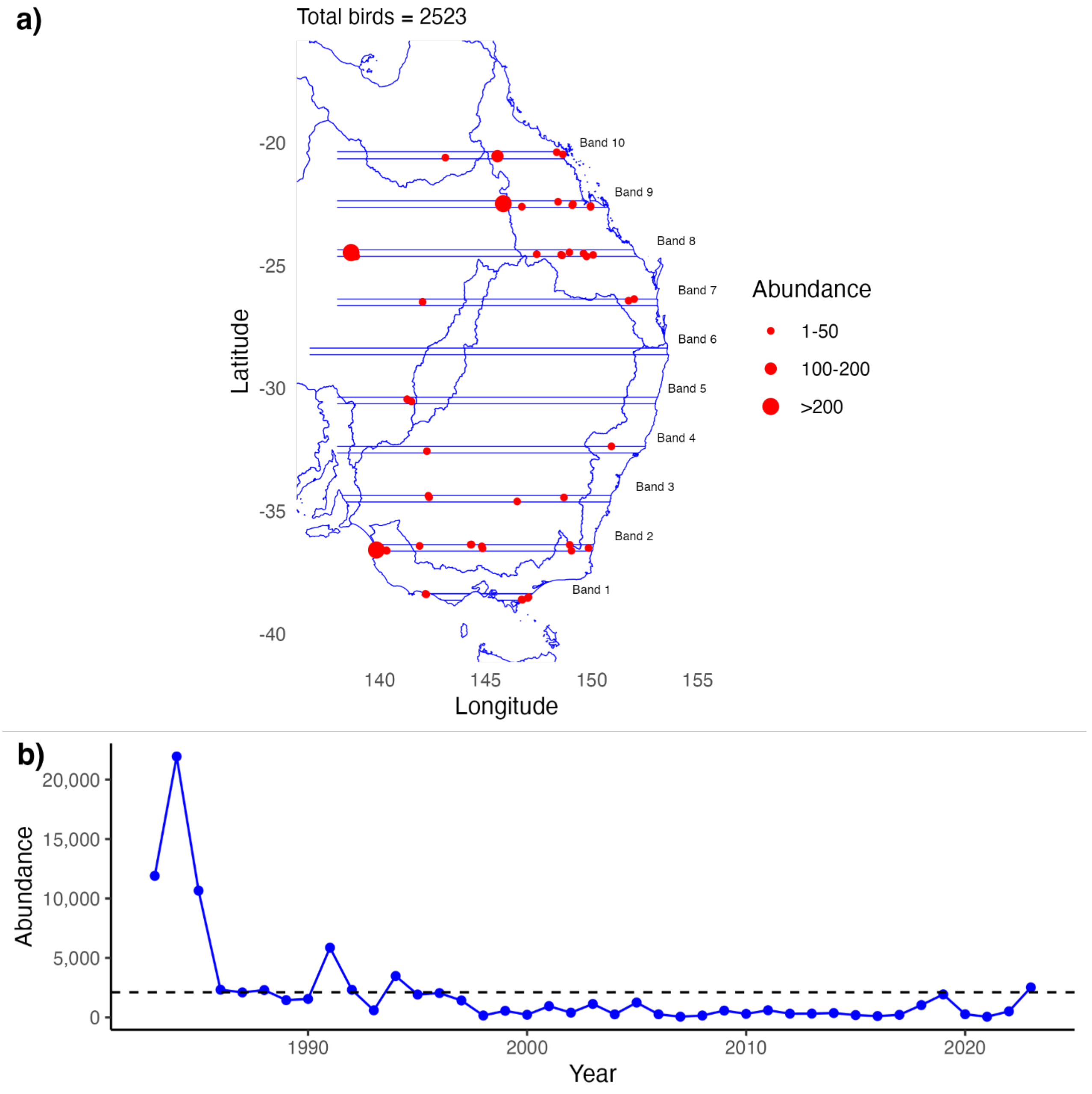
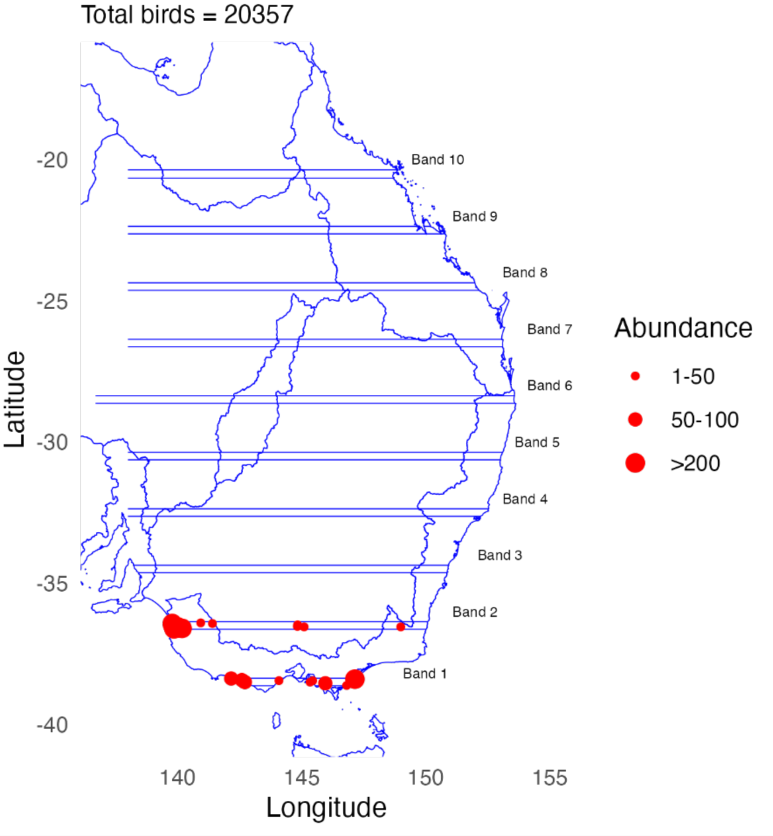


Figure 11. a) Distribution and abundance of Australasian Shoveler during the 2023 Eastern Australian Waterbird Aerial Survey. b) Changes in abundance index (1983-2023).

Chestnut Teal

a)



b)

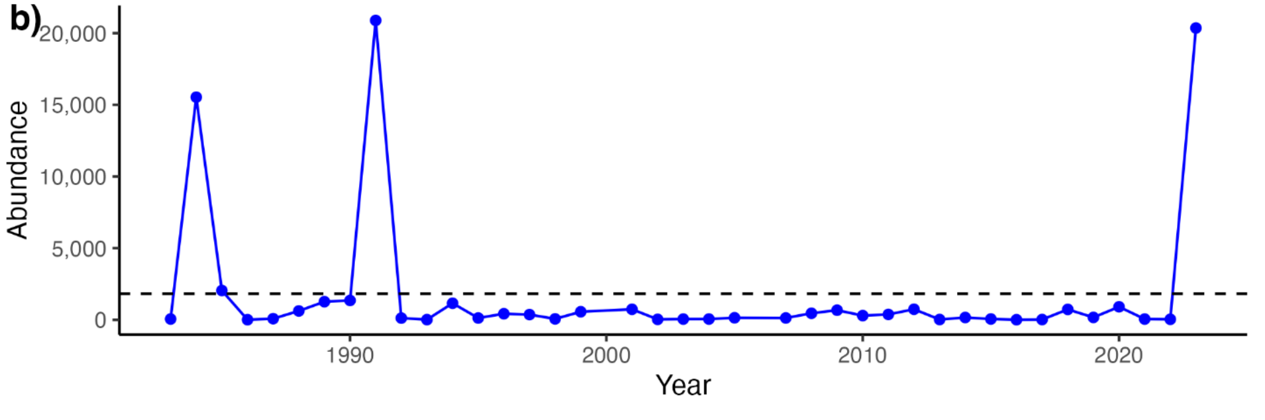
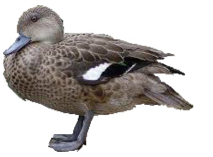


Figure 12. a) Distribution and abundance of Chestnut Teal during the 2023 Eastern Australian Waterbird Aerial Survey. b) Changes in abundance index (1983-2023).

Grey Teal



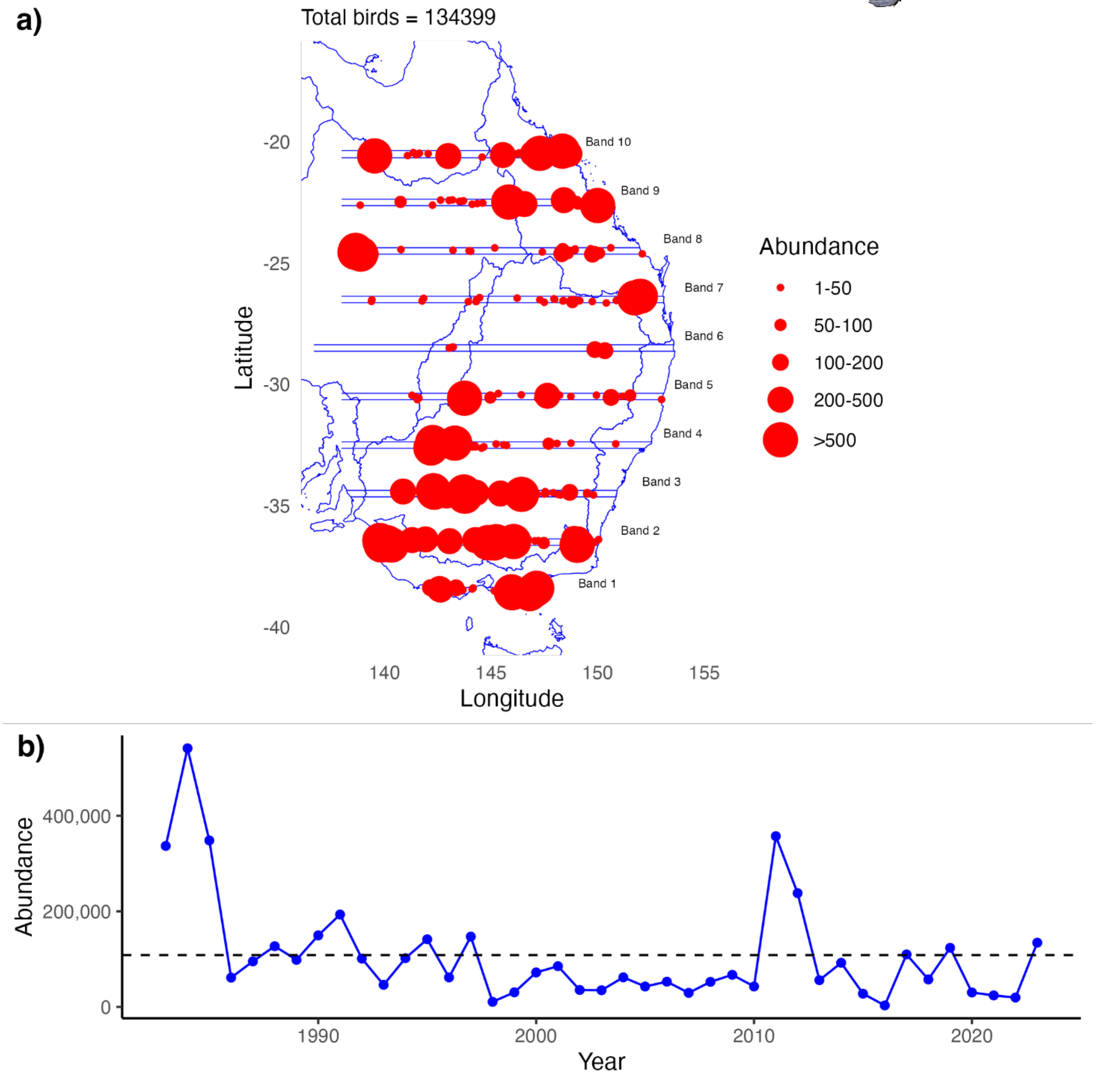


Figure 13. a) Distribution and abundance of Grey Teal during the 2023 Eastern Australian Waterbird Aerial Survey. b) Changes in abundance index (1983-2023).

Hardhead

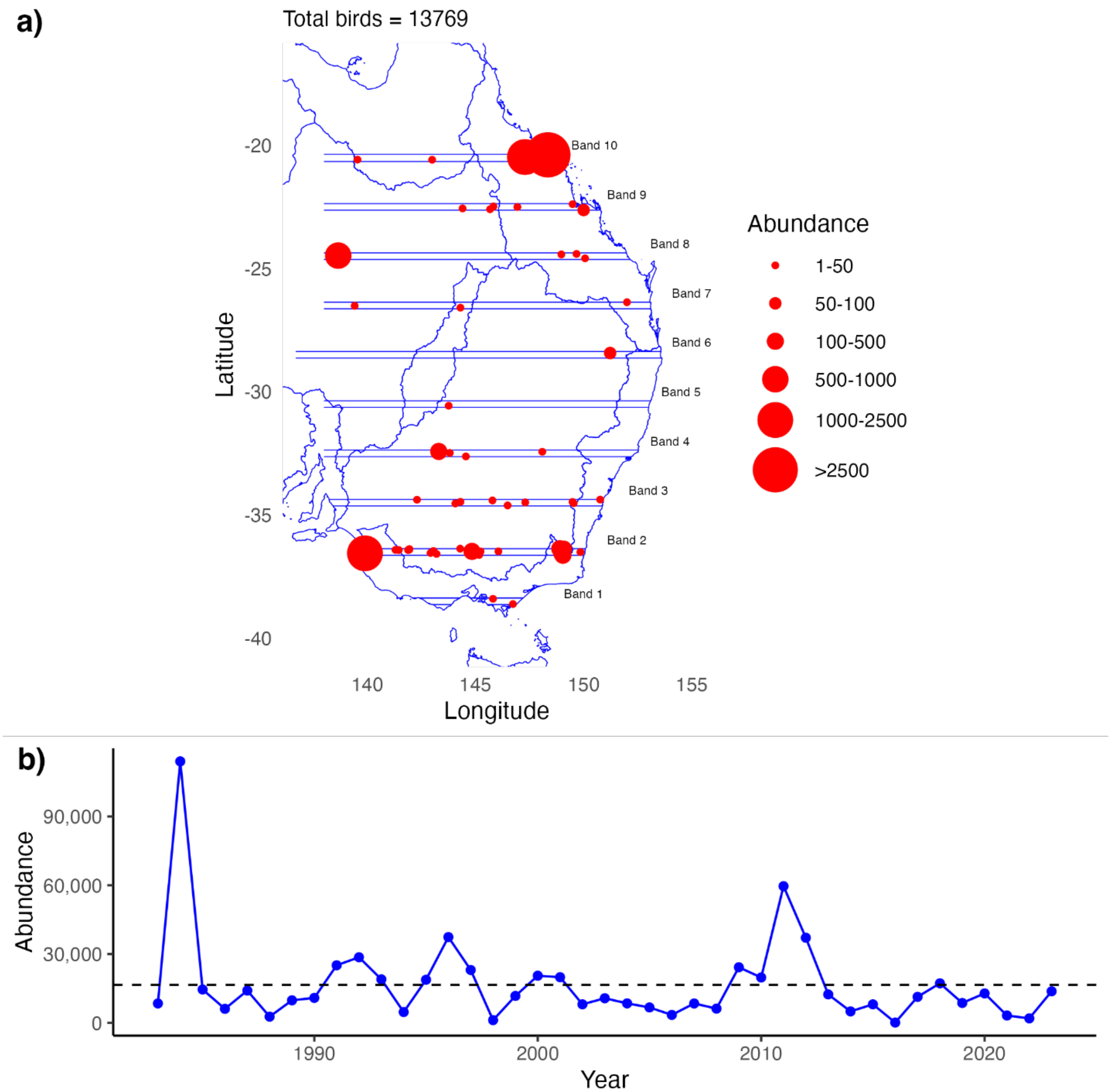
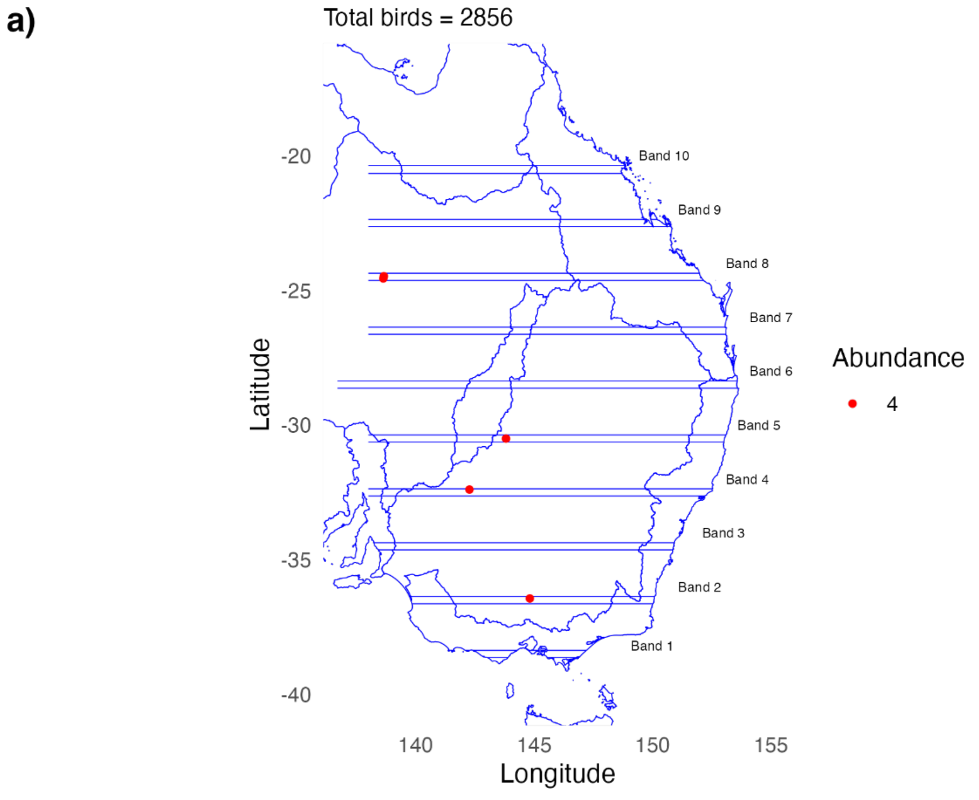


Figure 14. a) Distribution and abundance of Hardhead during the 2023 Eastern Australian Waterbird Aerial Survey. b) Changes in abundance index (1983-2023).

Freckled Duck



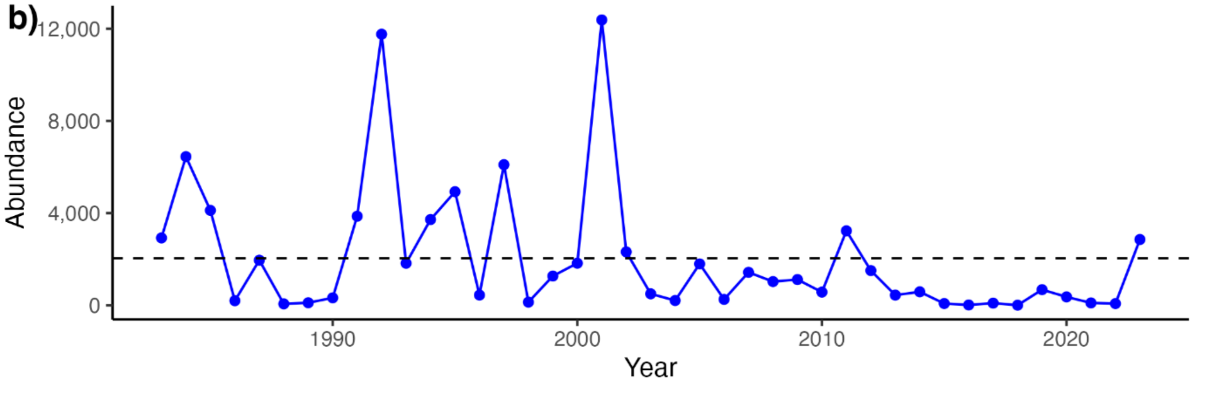
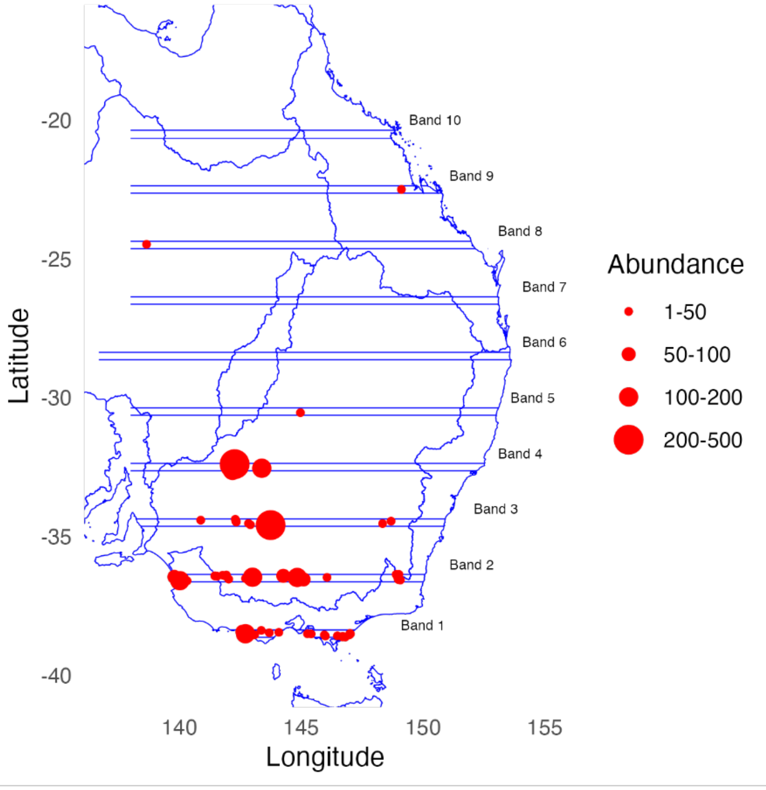


Figure 15. a) Distribution and abundance of Freckled Duck during the 2023 Eastern Australian Waterbird Aerial Survey. b) Changes in abundance index (1983-2023).

Australian Shelduck

a)



b)

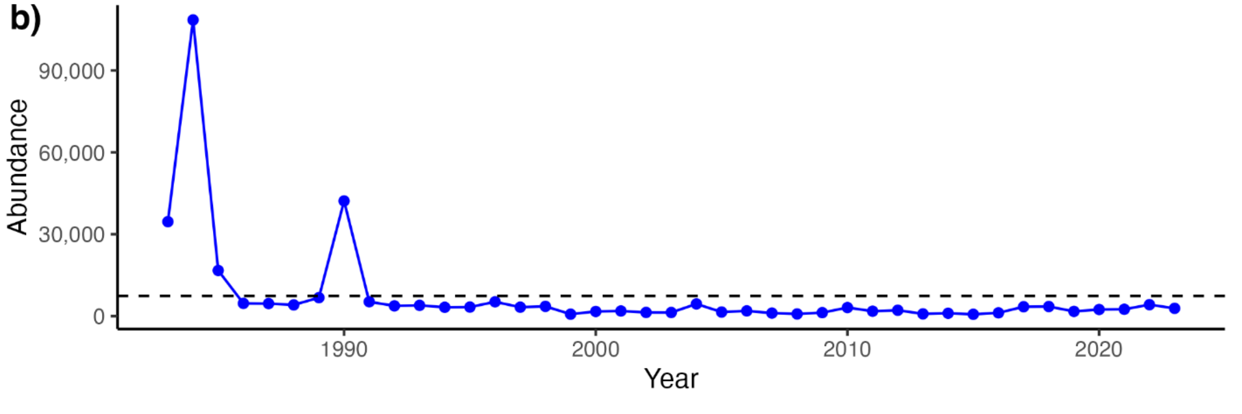


Figure 16. a) Distribution and abundance of Australian Shelduck during the 2023 Eastern Australian Waterbird Aerial Survey. b) Changes in abundance index (1983-2023).

Pink-eared Duck

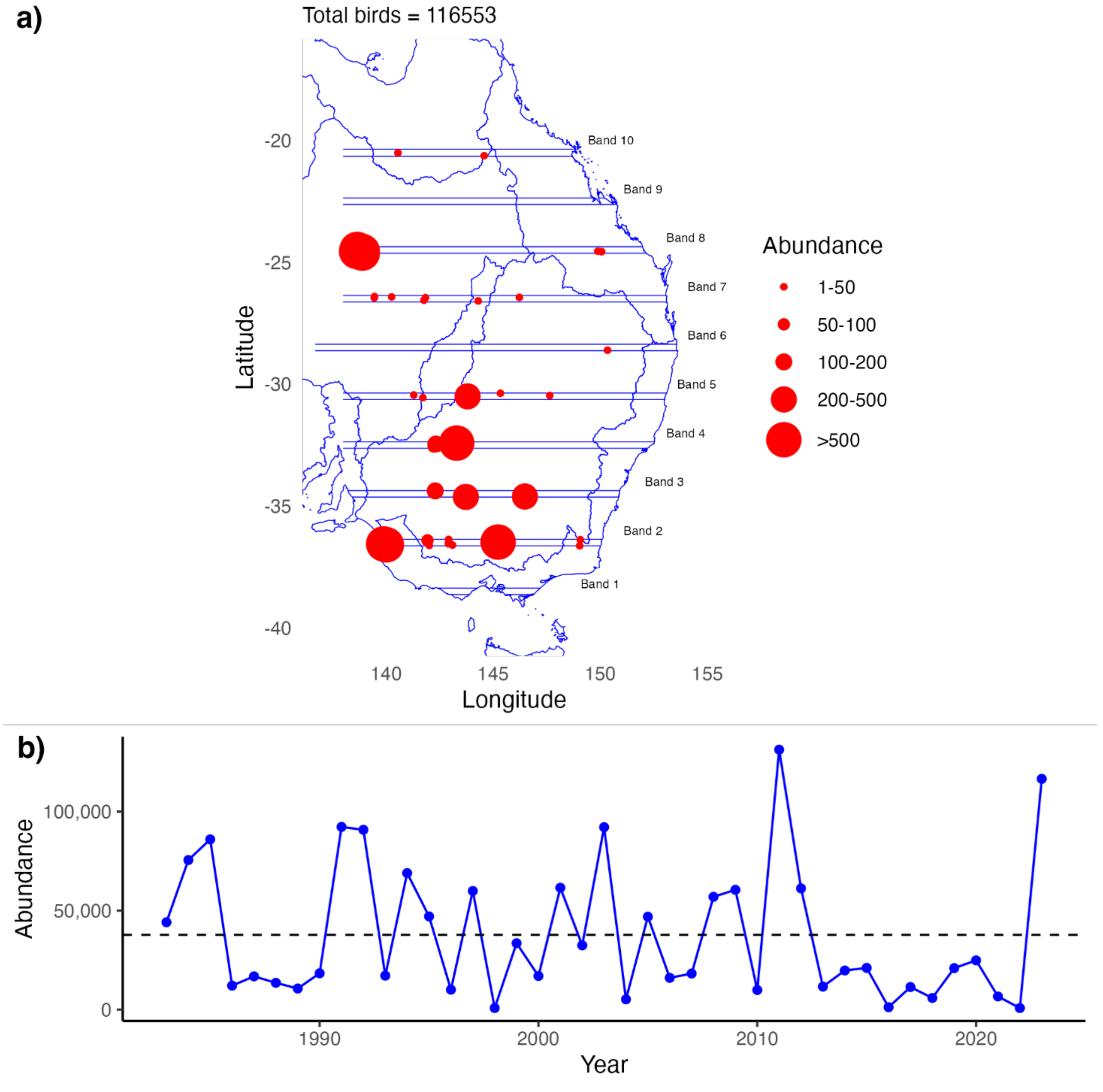


Figure 17. a) Distribution and abundance of Pink-eared Duck during the 2023 Eastern Australian Waterbird Aerial Survey. b) Changes in abundance index (1983-2023).

Plumed whistling- duck

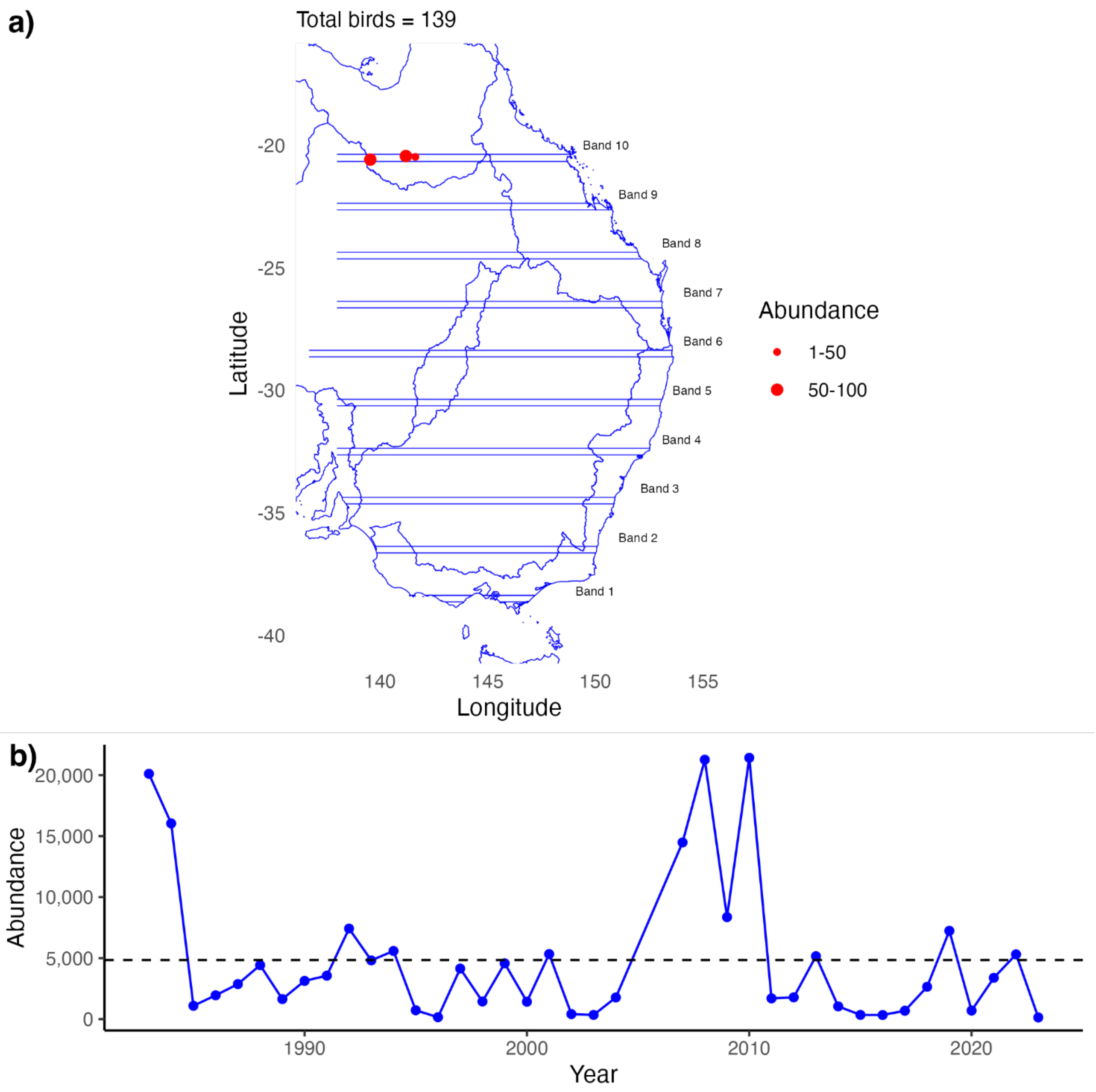


Figure 18. a) Distribution and abundance of Plumed Whistling Duck during the 2023 Eastern Australian Waterbird Aerial Survey. b) Changes in abundance index (1983-2023).

Australian Wood Duck

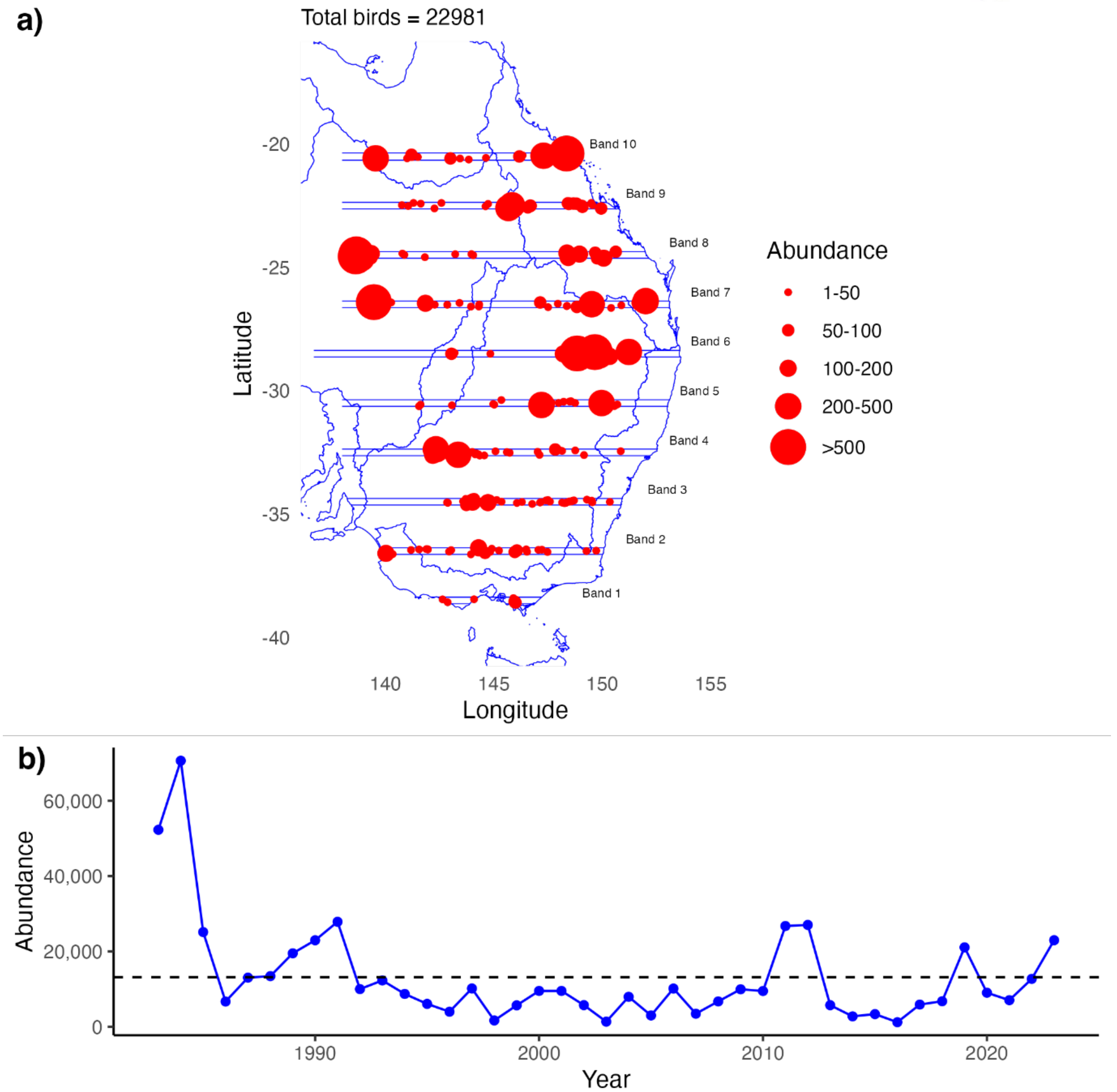


Figure 19. a) Distribution and abundance of Australian Wood Duck during the 2023 Eastern Australian Waterbird Survey. b) Changes in abundance index (1983-2023).

Australian Pelican

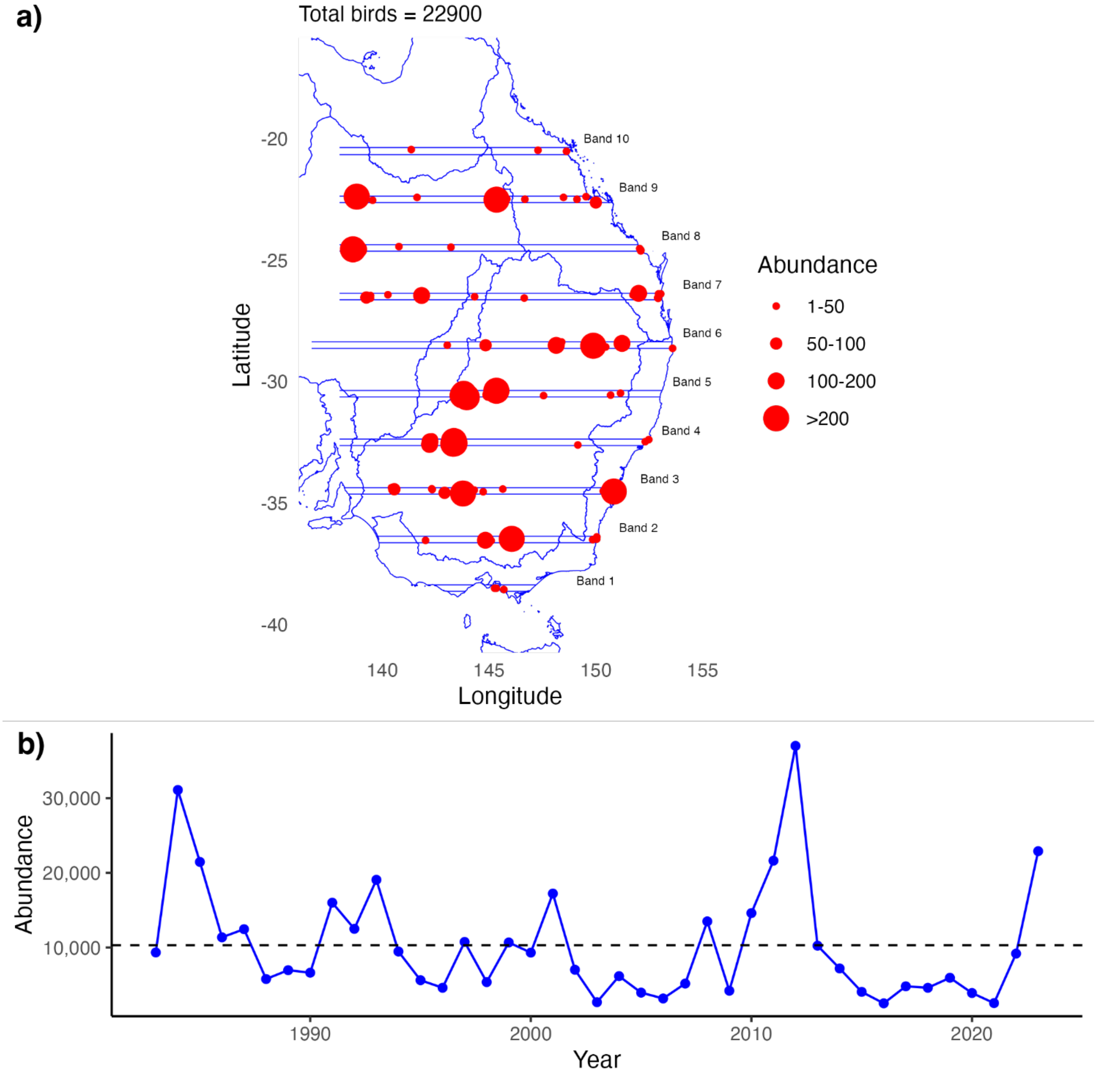


Figure 20. a) Distribution and abundance of Australian Pelican during the 2023 Eastern Australian Waterbird Survey. b) Changes in abundance index (1983-2023).

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