Aerial Survey of Magpie Goose in the Top End of the Northern Territory 2025

Moyle River to Arnhem Land Floodplains

NORTHERN TERRITORY GOVERNMENT

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The Department thanks the Traditional Owners, pastoralists and park management agencies who allowed the surveys to be undertaken across their land.

Tony Griffiths provided critical review that greatly improved this report.

Contents

Summary

A fixed-wing aerial survey of Top End floodplains of the Northern Territory was undertaken from 7 April to 1 May 2025, to estimate population size and nesting activity of Magpie Goose. A total of 7,343 km of fixed-width survey transects were flown using the standard methodology applied since 2011. The survey incorporated key floodplain habitats from Moyle River in the west to the Blue Mud Bay region of Arnhem Land in the east and covered 20,398 square kilometres (over 2 million ha) of potential habitat at a sampling intensity of 14.4%. All Magpie Goose and Magpie Goose nests sighted were recorded and corrected for a combined perception and visibility bias using established correction factors.

The 2025 population estimate for Magpie Goose was 1,222,984 ± 134,674 (total ± standard error) with a precision of 11.01%. This population estimate represents a slight decrease of 8.1% compared to the 2024 estimate. The 2025 population estimate continues a trend over recent years of being well below the most recent peak 2,900,000 recorded in 2012 but above the historical low of 724,500 recorded in 2017. The population remains relatively steady but well below apparent carrying capacity, despite there being relatively good rainfall over the past three wet seasons.

The number of Magpie Goose nests was estimated to be 71,235 ± 7,703 for the surveyed area with a precision of 10.8%. This was very close to 2024 nesting levels and would be considered a moderate nesting season in the context of long-term data. The rainfall preceding the survey period was average across much of the survey region, with some areas being slightly above average for the wet season. In addition to rainfall, weeds and damage caused by introduced buffalo and feral pigs are known factors impacting nesting habitat and key food resources for Magpie Goose.

1. Introduction

The Wildlife Management Program for the Magpie Goose (*Anseranas semipalmata*) in the Northern Territory of Australia 2020-2030 (WMP MG) (Clancy 2020) sets out the management protocols to ensure the long-term conservation of wild populations of the Magpie Goose and its habitats in the Northern Territory, in the context of continuing sustainable harvest. A key management activity is to undertake an annual aerial survey monitoring program across the key floodplain habitat in the Top End (Northern Territory north of 15°S latitude), immediately following the end of the annual Wet Season. Surveys are timed to coincide with the period when birds are nesting and when the population is at its most geographically concentrated, in order to optimise sampling.

The survey methods have been standardised to ensure continuity with previous surveys, as set out in the WMP MG. This report presents the results of the 2025 aerial survey of the Top End floodplains (Figure 1).Three regions have been surveyed since population monitoring commenced in 1983, with all regions surveyed annually since 2017. From 2011 to 2016, Area 2 was surveyed annually and Area 1 on a biannual or more frequent basis. Area 3 was historically surveyed less regularly (see Clancy 2020 for further details).

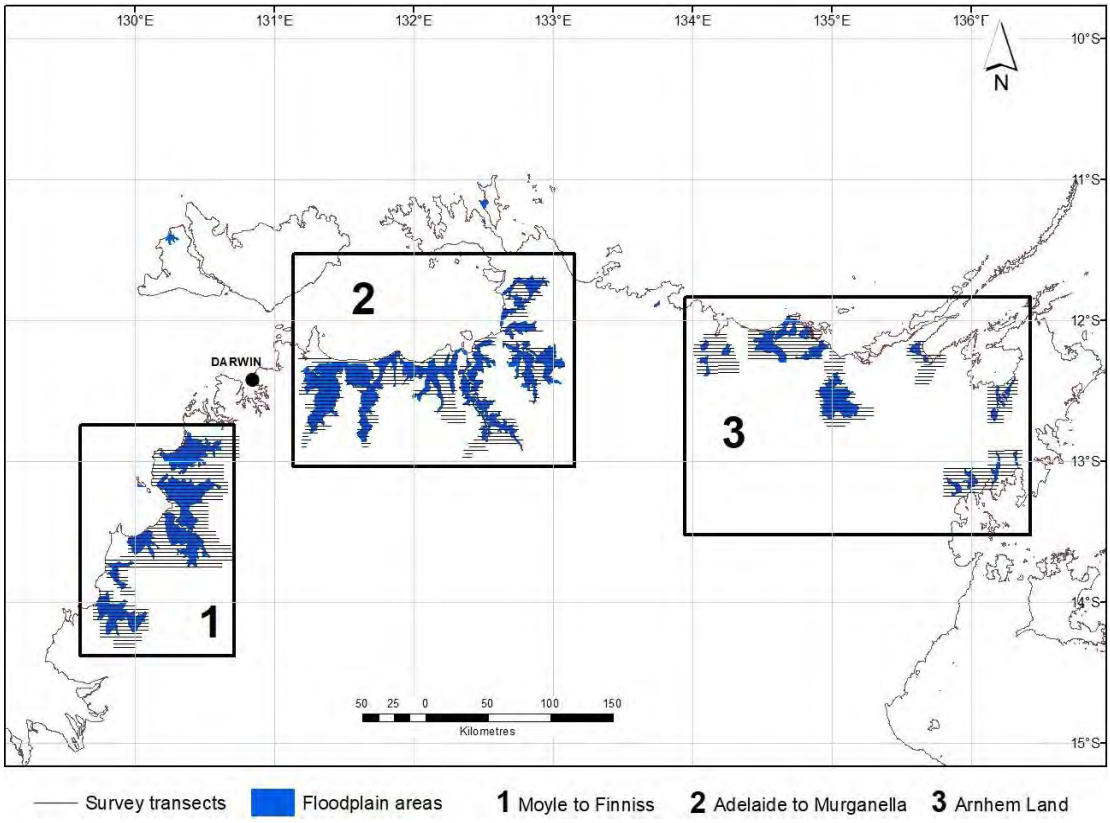


Figure 1. Map of the Top End of the Northern Territory showing the regions surveyed for Magpie Goose.

Overall population estimates from previous aerial surveys from 2015 to 2024 are detailed in Table 1. Note that in 2015 and 2016, when some survey regions were not surveyed, the figures have been adjusted to give an estimated total in a pro rata manner, relative to their contribution to the total counts in other years (e.g. Arnhem Land is estimated to comprise 10% of total population in years when it was not surveyed).

It is assumed that the surveyed area encompasses 90-95% of the total area of the Northern Territory occupied by the Magpie Goose population at the time of the survey, due to their use of the floodplains as breeding habitat and the reliance of birds on the lower floodplains for food during this time of year.

Table 1. Population and nest estimates (total ± standard error) for Magpie Geese from 2015 to 2024 derived from aerial surveys.

Year	Number of geese	Standard error	Number of nests	Standard error
2015*	1,200,000	200,000	105,000	13,000
2016*	1,350,000	136,000	40,000	6,000
2017	724,500	78,750	84,840	14,625
2018	918,200	117,000	77,840	14,250
2019	1,542,943	215,317	10,484	3,185
2020	1,432,793	211,784	39,723	7,743
2021	982,156	283,717	44,010	9,086
2022	1,856,935	250,620	62,674	17,895
2023	1,260,454	148,626	45,900	5,932
2024	1,330,246	138,163	70,244	8,077

*adjusted

2. Methods

2.1. Survey Area and Design

The cumulative amount of rainfall during a given wet season is a key determinant of the commencement Magpie Goose congregations for their annual nesting (Whitehead and Saalfeld 2000). To assist in confirming optimal timing for the survey, current season-to-date rainfall records were reviewed and stakeholder contacts (e.g. Aboriginal ranger groups, crocodile egg harvesters) were approached in early March, regarding observations of magpie geese (and any nesting) activity on the floodplains. Observations were reported of high levels of geese activity in the Moyle to Finniss River region, indicating that nesting should be well underway by early to mid-April. As per previous years, surveys were scheduled to commence from early April in the Moyle Finniss area and progress from the western to eastern Top End.

The Moyle River to Finniss River floodplains survey region (Area 1 in Figure 1) includes all major floodplain habitat within that region and was surveyed between the 7th and 11th April, 2025. This area comprises six major survey blocks (Figure 2).

The Adelaide River to Murgenella Creek floodplains survey region (Area 2 in Figure 1) includes all major floodplain habitat within that region and was surveyed between the 14th and 23rd April, 2025. This area comprises nine major survey blocks (Figure 3).

The Arnhem Land floodplains survey region (Area 3 in Figure 1) includes all major floodplain habitat within that region and was surveyed between the 28th April and 1st May, 2025. This area was divided into six

major survey blocks (Figure 4). Survey blocks were completed from east (based from Nhulunbuy) to west (based from Maningrida).

The survey was conducted using a Cessna 206H high-wing aircraft flown at a ground speed of 185 km/h (100 knots) and an altitude of 61 m (200 ft) above ground level. Where the transect had to traverse open water, aircraft height was adjusted to maintain safe gliding range but in practice this did not impact on survey areas, as such occasions were rare and did not occur in areas of significant Magpie Goose habitat. Transect width was demarcated by marker rods attached to the aircraft wing struts and calibrated (Marsh & Sinclair 1989) to give a transect width of 200 m on each side of the aircraft at survey altitude.

Transect lines flown on the survey were aligned east-west, perpendicular to the general north-south orientation of the major river systems, ridges and escarpments of the area (Figures 2-4). Transects were spaced at an interval of 1.5' of latitude (2.778 km) to give a survey intensity of 14.4% from the combined port and starboard transect width of 400 m. Navigation of transects was by Global Positioning System pre-programmed with all transect waypoints on Samsung Galaxy Tab 2 (7.0) using the OziExplorer Android GPS mapping software.

For all surveys, two observers (Mike Welch and either Anna Belford, Brydie Hill or Tony Griffiths) were used unless otherwise indicated. All surveys included at least one observer with over 200 hours experience in aerial surveying for Magpie Goose and checks were done to ensure adequacy of less experienced observers via dual observations with more experienced observers. On some survey flights, an additional observer was present (generally a local Aboriginal Ranger group representative).

2.2. Counting Procedure

The survey crew comprised a pilot/navigator, a starboard front seat observer and a port mid-seat observer. The pilot and observers could communicate via aircraft intercom, and the pilot indicated the start and finish of each transect by calling either 'start transect' or 'finish transect'.

All data entry was via an iPhone run in "flight" mode (to prevent mobile data connection during surveys and also to reduce power use and extend battery life) using the device's internal GPS receiver, which is considered adequate for the purposes of the survey.

Data were entered by observers using a purpose-built program developed in-house (Zeng et al. 2022) and based on the previously used Basic program written by K. Saalfeld. Species recorded in 2025 were : Magpie Goose, Magpie Goose Nest, Black-necked Stork (*Ephippiorhynchus asiaticus*), Brolga (*Grus rubicunda*), Feral Pig (*Sus scrofa*), Horse (*Equus caballus*, generally only feral animals counted), Buffalo (*Bubalus bubalis*) and Saltwater Crocodile (*Crocodylus porosus*)], with the additional inclusion of wild cattle and Banteng in the Arnhem Land survey areas where they were unlikely to be managed stock. Number sighted and species code were entered by the observer upon sighting with each record automatically geo-coded on entry. This report only covers the Magpie Goose and Magpie Goose nests observations but data collected for other species can be accessed via the NT Government's NR Maps online platform.

2.3. Post Survey Data Handling and Analysis

Data were downloaded daily from each observer's mobile device to a laptop computer and opened in Excel. Data were immediately checked for logged errors (signified by code 999 entered by the observer) as well as any apparent major errors in recording (e.g. transects wrongly coded by the observers). Files for each observer were merged on a survey block basis and converted from .csv format and uploaded to the RStudio desktop application (RStudio Team 2020) for analyses in R (R Core team 2020). Data files were run through a simple validation process via package "pointblank" (Iannone and Vargas 2020) to check for duplicated observations, missing values, non-conforming variable types and other anomalies.

Because transects were variable in length and therefore area, the Ratio Method (Jolly 1969, Caughley and Grigg 1981, Marsh and Sinclair 1989, Caughley and Sinclair 1994) was used to estimate density, population size and their associated standard errors for the survey area. Input data were the observed numbers of each species for the port mid- seat and starboard front-seat observers. Estimates were corrected for perception and visibility bias using the wet season correction factors of Bayliss and Yeomans (1990a, b); 3.28 for Magpie Geese and 2.23 for Magpie Goose nests. All analyses were performed in RStudio (RStudio 2022.07.1+554 “Spotted Wakerobin” Release for Windows; RStudio Team 2020) using R version 4.2.2 (R Core team 2020) and attached packages.

Population estimates are accompanied by a ‘standard error’ statistic, which provides an indication of how accurately the sample data represents the whole population. The higher the standard error, the lower the confidence that can be placed in the estimated population. The ‘precision’ of the population estimate, also known as the ‘co-efficient of variation’, is the proportion of the standard error compared to the population estimate. This is expressed as a percentage and the lower it is, the more precise the population estimate is. Wildlife management often centres on identifying trends in abundance over time, which requires a reasonable level of precision, and most wildlife surveys aim for a precision of less than 20% (Harris et al. 2013).

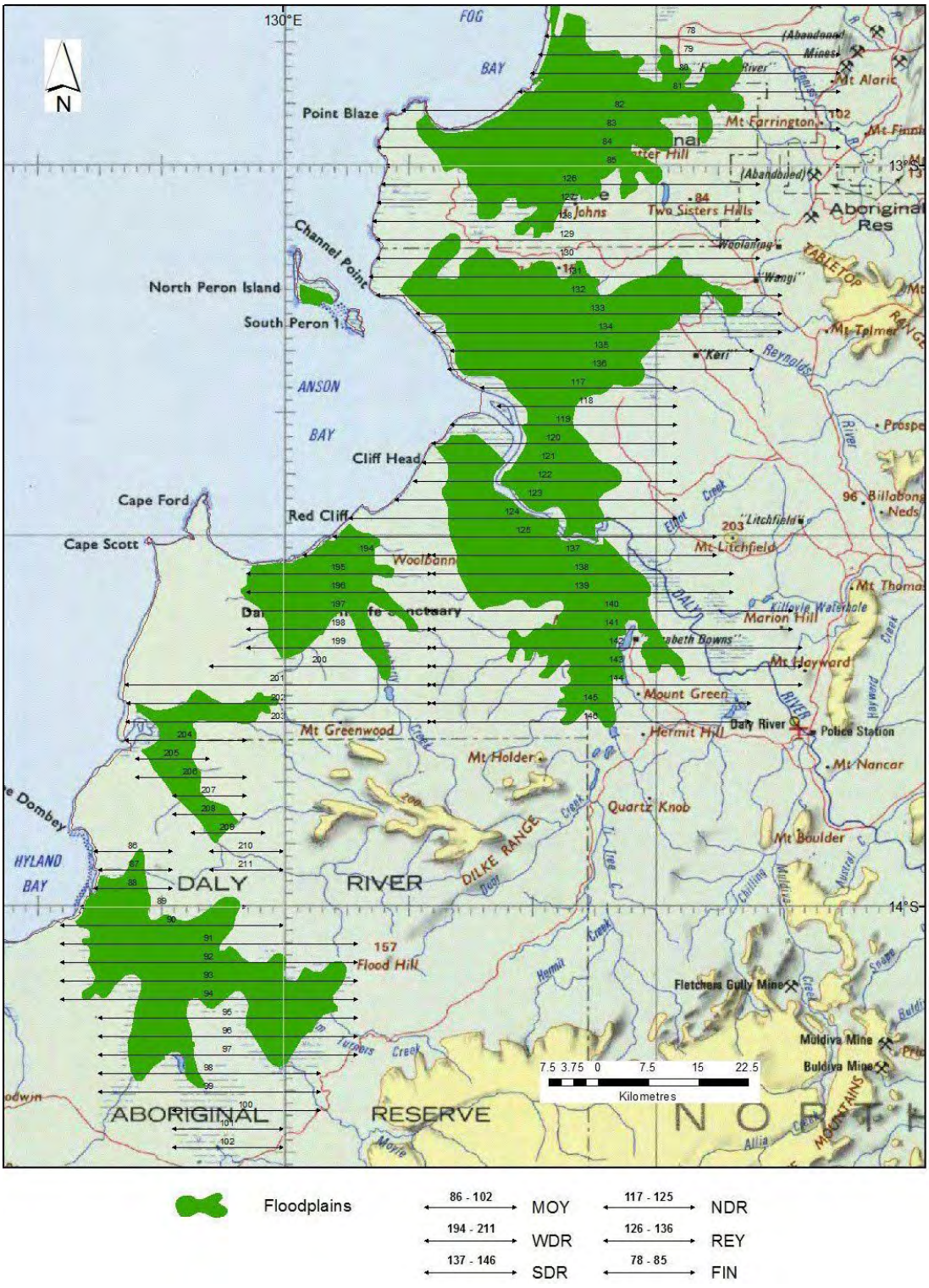


Figure 2. Survey blocks and survey transects flown in the Moyle River floodplain to Finniss River floodplain survey region

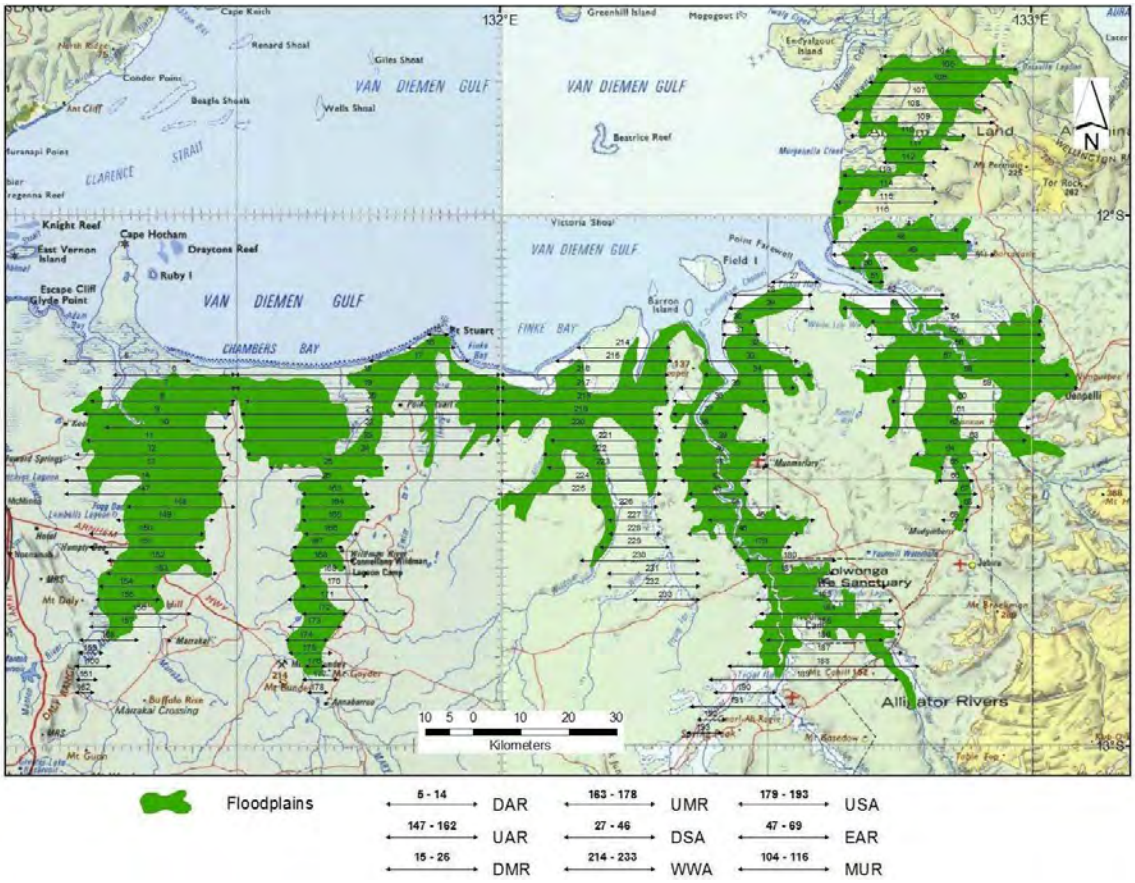


Figure 3. Survey blocks and survey transects flown in the Adelaide River floodplain to Murgenella Creek floodplain survey region.

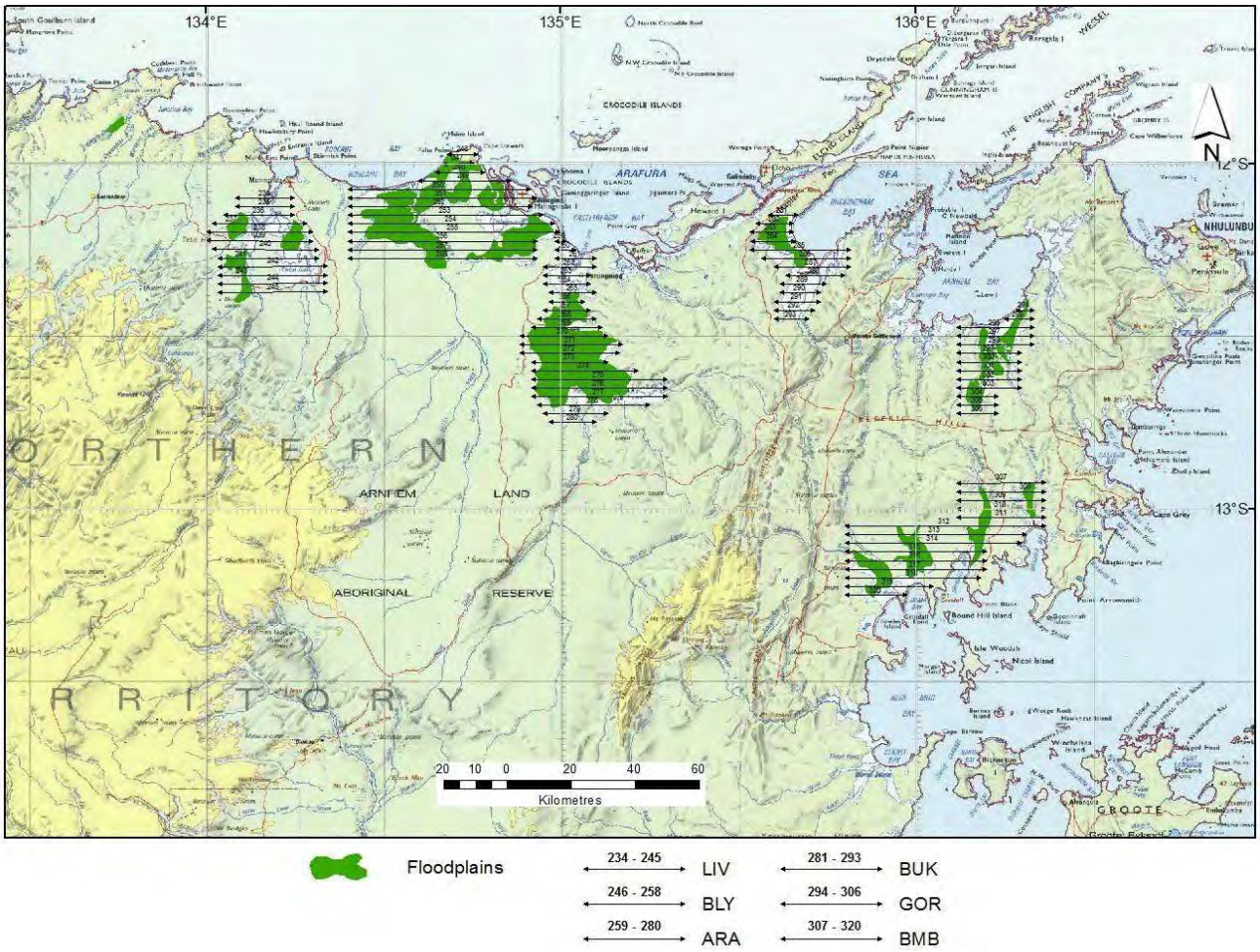


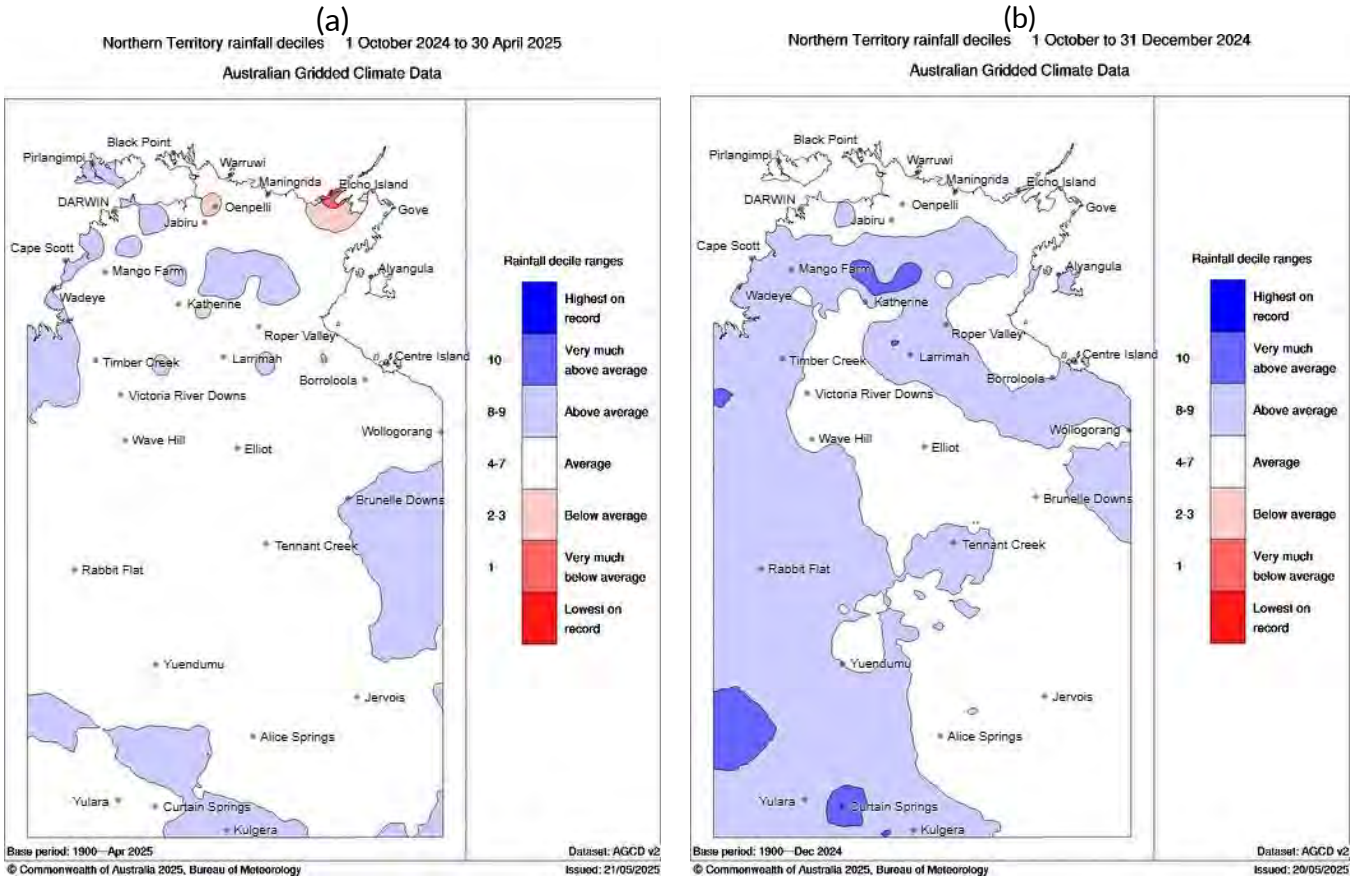
Figure 4. Survey blocks and survey transects flown in the Arnhem Land floodplains survey region.

3. Results and Discussion

3.1. Environmental conditions

Rainfall recorded across the Top End in the 2024/25 wet season was generally average for most of the floodplain areas and their catchments, with some areas of above average rainfall in the Moyle River floodplain to Finniss River floodplain survey region and western section of the Adelaide River floodplain to Murgenella Creek floodplain survey region (Figure 5). Below average rainfall was observed in the East Alligator River catchment (eastern section of Adelaide River floodplain to Murgenella Creek floodplain survey region) and Buckingham Bay/Gurrumuru catchments of the eastern Arnhem Land region (Figure 5a).

Above-average early wet season (i.e. October to December) is generally linked to high levels of Magpie Goose nesting (Whitehead and Saalfeld 2000). During the early 2024/25 wet season, above average rainfall was observed over most of the Moyle to Finniss River survey region and some of the Mary River floodplain within the Adelaide to Murganella survey region, with the remainder being average (Figure 5b).



Source: bom.gov.au

Figure 5. Map of the NT showing rainfall deciles for a) the entire 2024/25 wet season and b) early 2024/25 wet season.

3.2. Total Population and Nesting Estimates

The population estimates for each survey block within the three survey regions are presented in Table 2, along with the density and precision values for all estimates. The precision of individual block estimates ranged from around 23% to as high as 93% (Table 2). However, as with previous years the high sampling intensity means that at a whole of survey region scale, the estimate is generally satisfactory (precisions of 13.0, 15.1, 37.6 % for the Moyle-Finniss, Adelaide-Murgenella and Arnhem Land regions respectively). The overall population estimate has a precision value of 11.01%. For both the goose population estimate and the nest estimate, the precision values are at acceptable levels, indicating that the overall population estimates are robust.

The total population of Magpie Goose in the Top End in 2025 was estimated to be 1,222,984 ± 134,674 (total ± standard error) geese with a density of 60 per km^2 and reflecting a small decrease from that estimated in 2024 (1,330,246 ± 138,163). The precision of the overall population estimate was considered to be very good (11.01%) and in line with typical values from previous surveys, which have been in the range of 8-18%.

The total estimated number of Magpie Goose nests was 71,235 ± 7,703, with an overall density of 3.49 nests per km^2, at a precision of 10.8%. The ratio of nests to total population of Magpie Goose (expressed as a percentage) gives an indication of the nesting rate for the season, which ranged from 3% to 13%for 2011 to 2024. The nesting proportion for 2025 was 5.8%, which signifies a moderate nesting season. Only moderate levels of nesting have been observed since 2021, despite there being three average and two above-average wet seasons over the past four years. High levels of nesting (10% or greater) have not been observed since 2018. Similar to 2022, 2023 and 2024, it is possible that the overall level of nesting was underestimated due to a general lack of nesting synchrony compared to historical observations, meaning in some areas nesting may have occurred later than the survey. Field observations during the 2025 survey indicated that in many survey areas (particularly in the Adelaide River to Murgenella region), geese were starting to aggregate into small breeding groups of 2-3 birds that had were only just commencing nest-building. In the Arnhem Land region, large late wet season rainfall occurred, with many floodplain areas being completely inundated by high water levels at the time of survey and having very limited nesting activity.

3.3. Population and Nesting Patterns

3.3.1. Population Dispersion

As in previous years, the total population estimate may represent a conservative estimate of the species population in the NT, recognising that some birds may occur outside the surveyed area at the time of survey. Despite the lack of a substantial population increase following several consecutive average or above average rainfall years, it is not considered likely that there had been large scale migration outside the survey region over recent years. One possibility could be large numbers of birds congregating in the Ord River agricultural region in Western Australia, but consultation with both government and agriculture industry representatives based in Kununurra indicated that geese usually leave the region at the start of the wet season. There is no evidence from other data sources of unusual movements of birds from within to outside the survey area (e.g. Magpie Goose sightings reported in eBird (www.ebird.org)). The survey results are also consistent with the prevailing rainfall conditions and there is no need to assume any emigration to explain the year-to-year trend.

Table 2. Estimated population, density and precision (expressed as %) for Magpie Goose and nests in each survey region.

Survey Region	Survey Block	Survey Area (km^2)	No. Geese	Density Geese per km^2	Precision Geese (%)	No. Nests	Density Nests per km^2	Precision Nests (%)
Moyle to Finniss	FIN	1,025	24,144	23.5	54.2	2,261	2.2	42.9
	MOY	1,149	119,219	103.8	23.0	22,300	19.4	22.3
	NDR	958	68,311	71.3	29.1	2,849	3.0	35.4
	REY	1,385	42,184	30.5	32.1	4,197	3.0	36.2
	SDR	1,207	54,029	44.8	26.1	6,597	5.5	33.4
	WDR	821	33,506	40.8	47.5	4,057	4.9	44.5
Adelaide to Murgenella	DAR	756	115,438	152.7	48.9	6,984	9.2	44.0
	DMR	1,234	145,823	118.1	37.1	6,349	5.1	35.5
	DSA	850	70,771	83.3	27.2	3,252	3.8	27.3
	EAR	1,311	116,850	89.1	32.8	4,770	3.6	34.6
	MUR	786	97,853	124.4	40.9	155	0.2	74.1
	UAR	670	63,914	95.4	41.5	2,323	3.5	44.1
	UMR	446	10,045	22.5	69.5	1,301	2.9	85.5
	USA	949	17,152	18.1	36.7	1,115	1.2	32.5
	WWA	1,211	45,601	37.7	36.0	2,044	1.7	63.2
Arnhem Land	ARA	1,295	61,477	47.5	31.4	170	0.1	58.4
	BMB	1,213	729	0.6	62.8	46	0.04	68.7
	BUK	562	4,556	8.1	93.1	0	0	0
	GOR	584	14,965	25.6	45.2	341	0.6	46.7
	LIV	707	17,379	24.6	90.8	0	0	0
	BLY	1,281	99,038	77.3	70.5	124	0.1	69.6

The average size of observed groups of Magpie Goose for each of the three survey regions compared with those recorded in previous years is presented in Figure 6. The mean group size was similar to the past several years, with observed group sizes in the Arnhem Land region having decreased compared to the particularly high numbers observed in 2024. It appears that in very dry years (e.g. 2016 and 2019), birds tend to become much less dispersed and occur in very large flocks, rather than spread out across the nesting areas (Figure 6).

The block densities ranged from 0.6 per km^2 within the Blue Mud Bay floodplain block (BMB) in the Arnhem Land region to 153 per km^2 within the Downstream Adelaide River flood plain survey block (DAR) in the Adelaide River to Murgenella Creek region. The majority (55.9%) of the total population occurred in the survey region from west of Adelaide River to Murgenella Creek which was slightly lower than the 2024 survey and still less than historical levels, when around two thirds of the total population generally were counted there (Clancy 2018, Clancy 2019). The Downstream Mary River (DMR) survey block had the largest number of birds with 145,823. Sixteen percent of the total population was recorded in the Arnhem Land region, which was the same as 2024 and substantially higher than for any previous years that surveys have been undertaken in this region. Recent trends in population size for the three survey regions are presented in Figure 7.

Maps showing 2025 Magpie Goose observations compared to historical data, are provided in Appendix A. Some key observations are made below:

- Little Moyle River –low numbers observed historically and none in 2025 (Figure A1)
- Finniss River – relatively low numbers and extent in 2025 compared to historical data (Figure A3)
- Adelaide and Mary River - relatively low numbers and extent in 2025 compared to historical data (Figure A5)
- Central Arnhem Region – relatively low numbers and extent in Liverpool and Blythe floodplains in 2025 compared to historical data (Figure A9)
- East Arnhem Region – Only low numbers have ever been observed in Buckingham Bay (only one group in 2025), and very low numbers in Blue Mud Bay in 2025 (Figure A11).

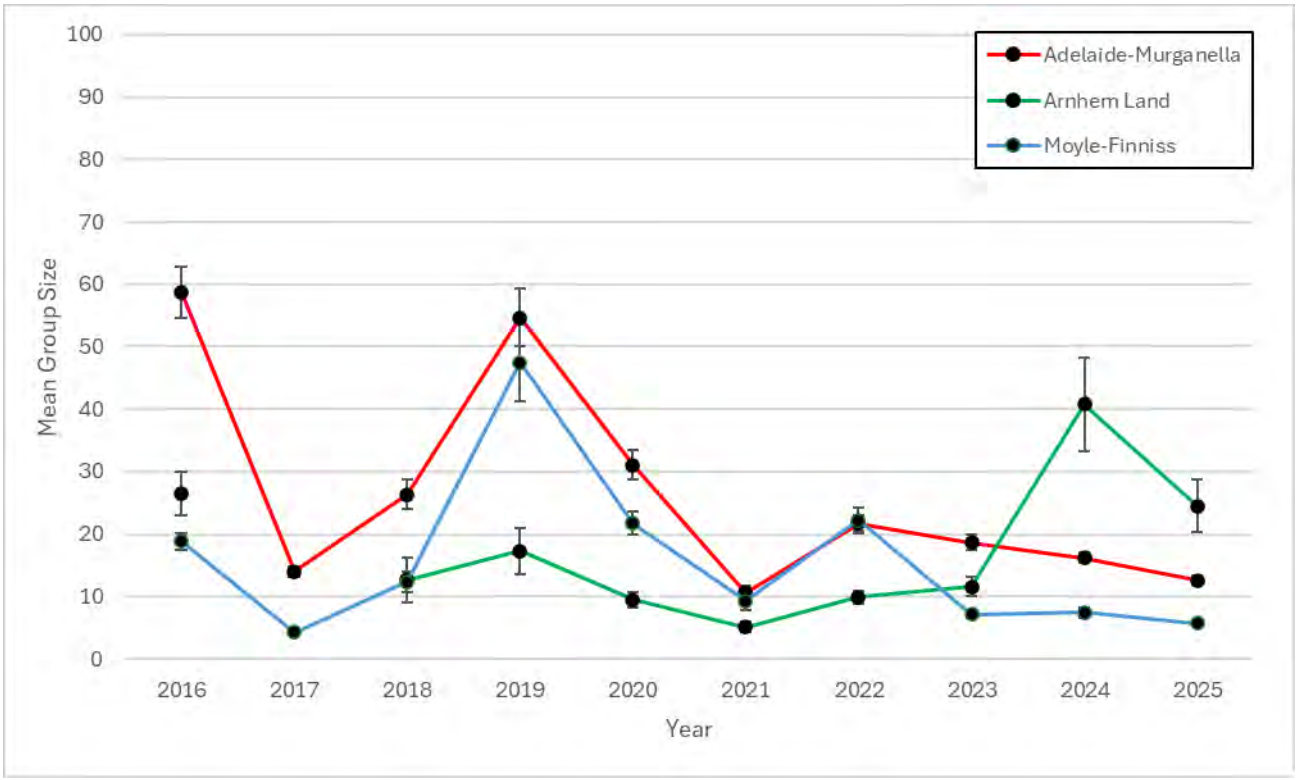


Figure 6. Mean (+/− standard error) recorded group size of Magpie Goose 2016 to 2025 (End of Wet Season Surveys)

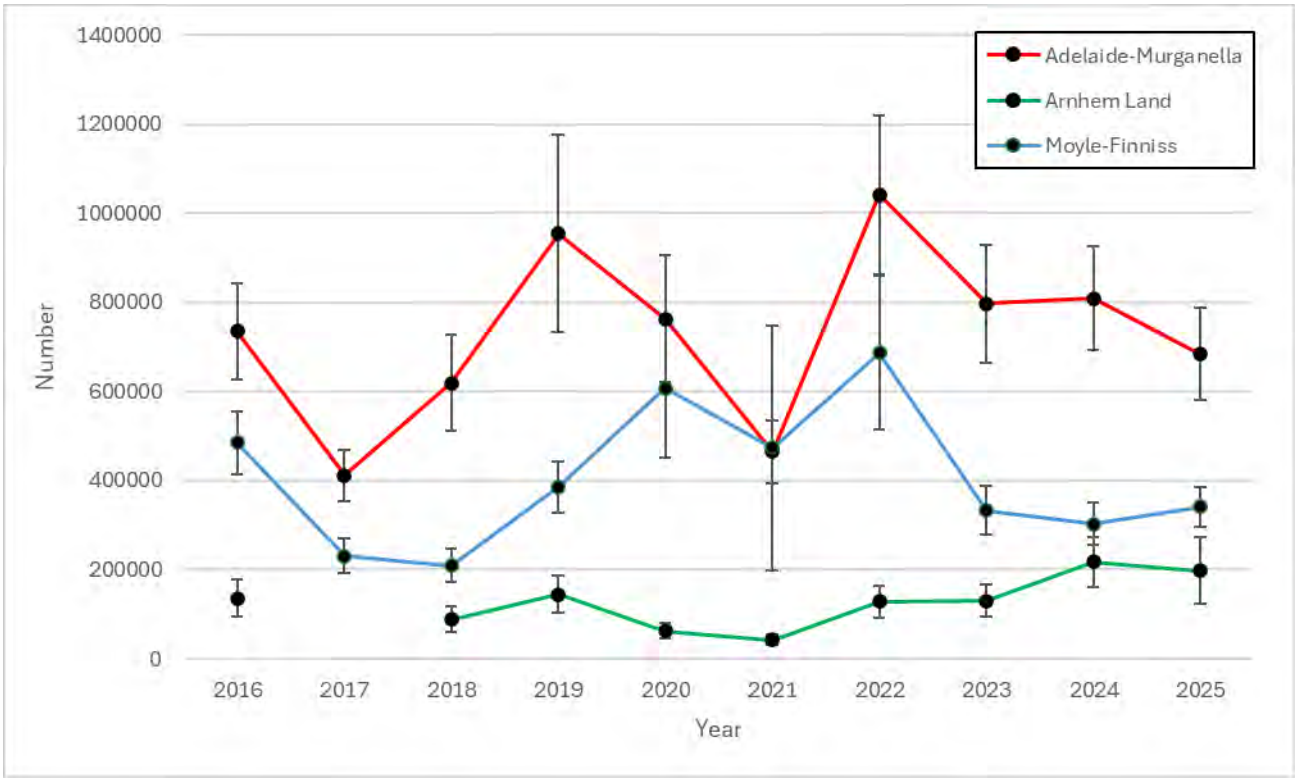


Figure 7. Population size (+/- standard error) of Magpie Goose 2016 to 2025 in each survey region (End of Wet Season Surveys)

3.3.2. Nesting Areas

Historically, the most important nesting areas for Magpie Goose have been in the Moyle-Daly-Reynolds and Adelaide-Mary-South/East Alligator Rivers floodplains.

Maps showing 2025 nesting observations compared to historical data, are provided in Appendix A. Some key observations are made below in relation to nesting areas:

- Little Moyle River – No nesting in 2025 and very little historically (Figure A2)
- Murganella Floodplain – Low levels of nesting in 2025compared to historical data (Figure A8)
- Central Arnhem Region – No nesting has ever been observed in the Liverpool River floodplain; very little (both in 2025 and historically) in the Blyth River floodplain; and was relatively low in 2025 in Arafura Swamp (Figure A10)
- East Arnhem Region – No nesting has ever been observed in Buckingham Bay; and very little historically in the Goromuru or Blue Mud Bay floodplains (Figure A12)

3.3.3. Long Term Trends

Long term trends in the Magpie Goose population and nesting activity from 1983 to 2024 are shown in Figure 8 and Figure 9, respectively. The 2025 result is consistent with a population below apparent carrying capacity, following a reasonable 2024 breeding season with moderate survival across the 2024 dry season. The population level has remained relatively static over the past five years, following recovery from the recent historical low in 2018 (Figure 8). The population is considered to be in a “moderate” phase, being below the most recent peak 2,500,000 recorded in 2012 (Clancy 2020) but above the historical low

population estimate recorded in 2017 (Table 1). Rainfall-driven variability in both population size and nesting index are a feature of Magpie Goose population dynamics in the Top End (Bayliss 1989, Bayliss & Yeomans 1990a, Whitehead & Saalfeld 2000, Delaney et al. 2009, Groom & Saalfeld 2017, Clancy 2020).

As a result of the apparent pattern of lower synchrony of nesting across the survey area over recent years, it is difficult to predict what the population trend may be over the coming year. However, the monitoring results generally indicate a relatively healthy population that whilst well below historical highs, is above the most severe recorded population troughs. In addition to the influence of rainfall, factors such as weeds and introduced buffalo and feral pig damage are likely to be impacting nesting habitat and key food resources.

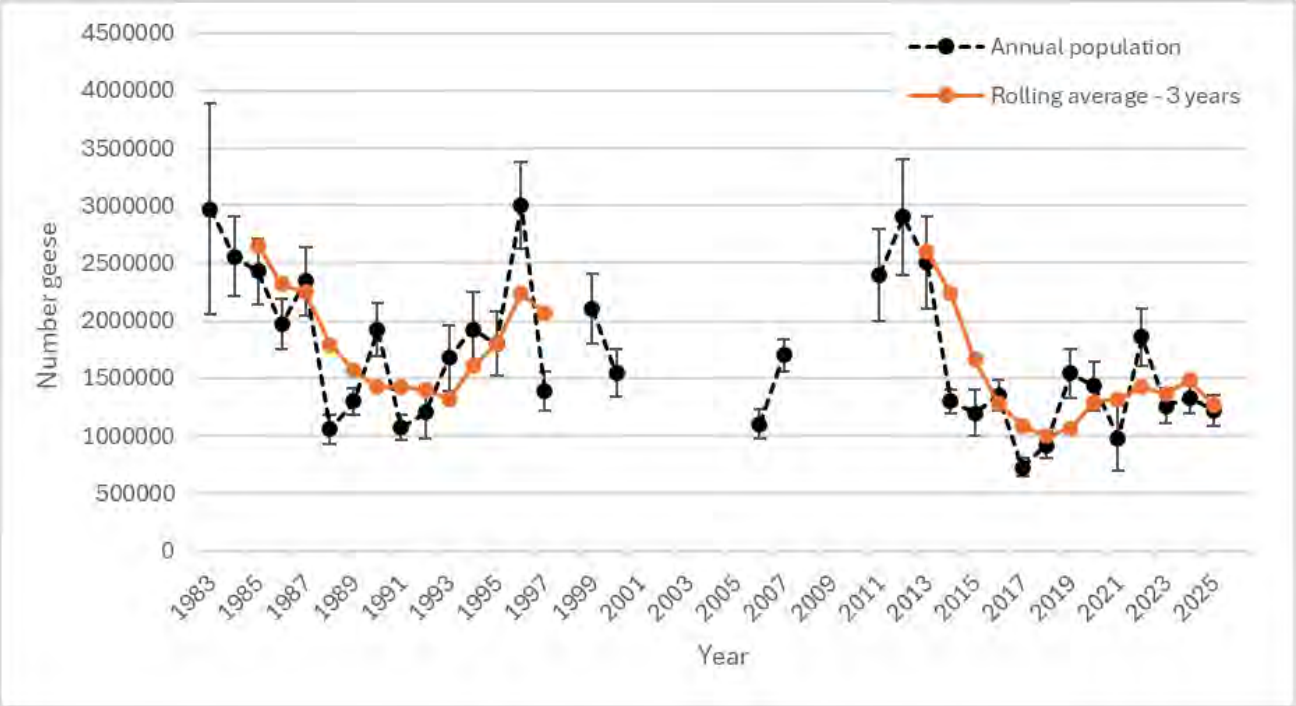


Figure 8. Long term population trend of Magpie Goose 1983 – 2025 (end of Wet Season surveys)

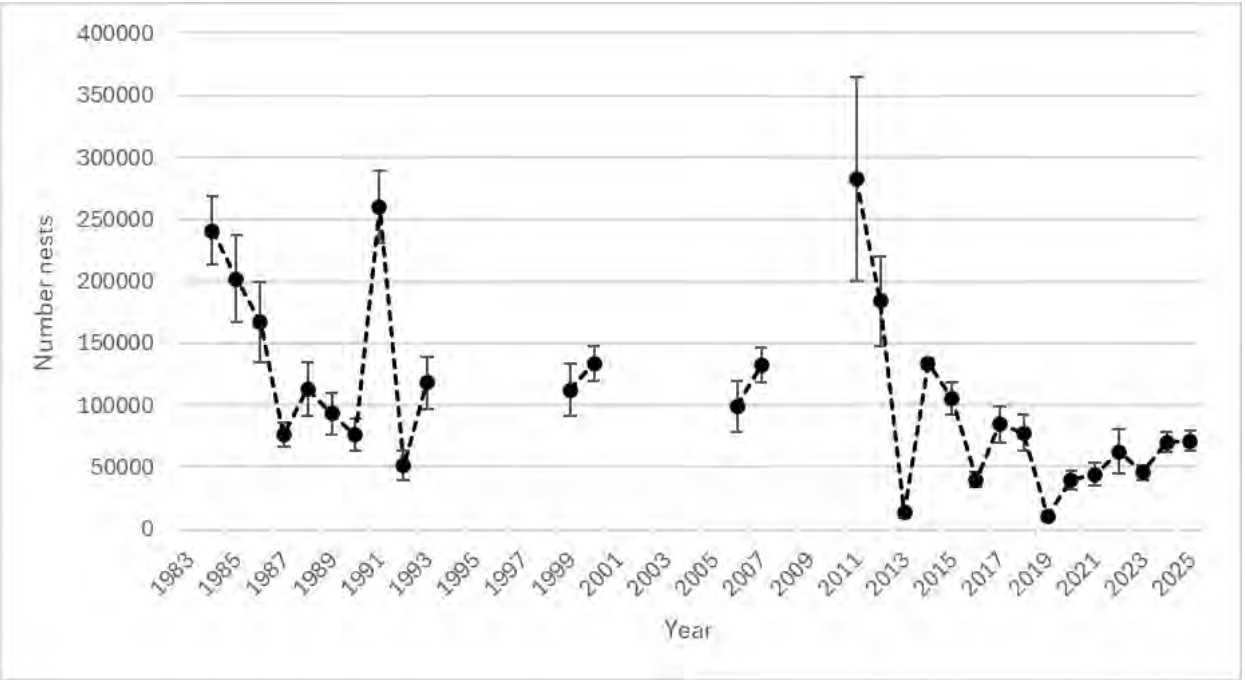


Figure 9. Long term trend of Magpie Goose nesting 1983 – 2025 (end of Wet Season surveys)

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Appendix A: Maps showing occurrence of Magpie Geese and nesting in 2025, compared to historical data

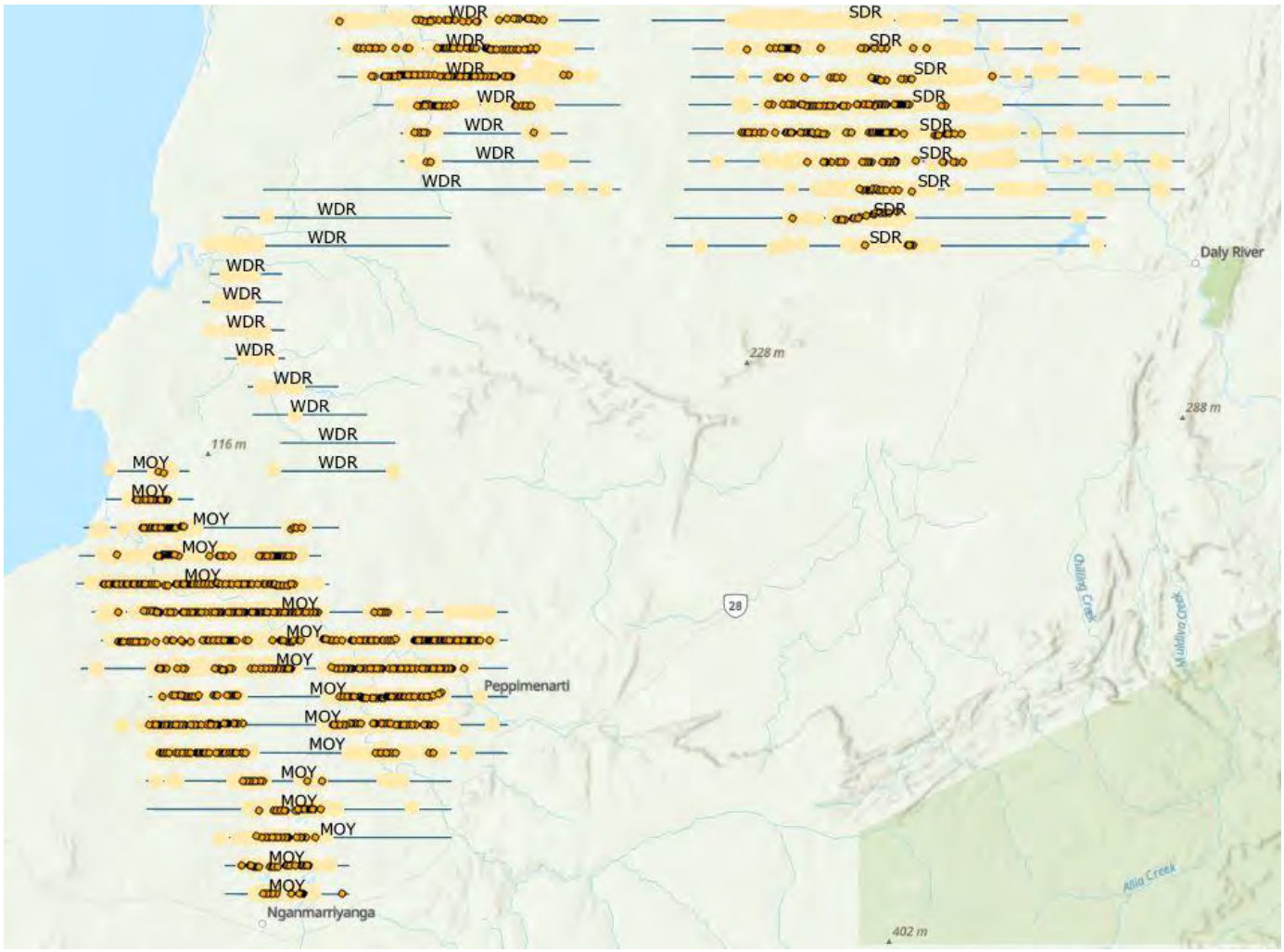

Figure A1. Magpie Goose observations in 2025 (dark orange points) compared to historical data (light orange shading) in the Moyle to southern Daly River region

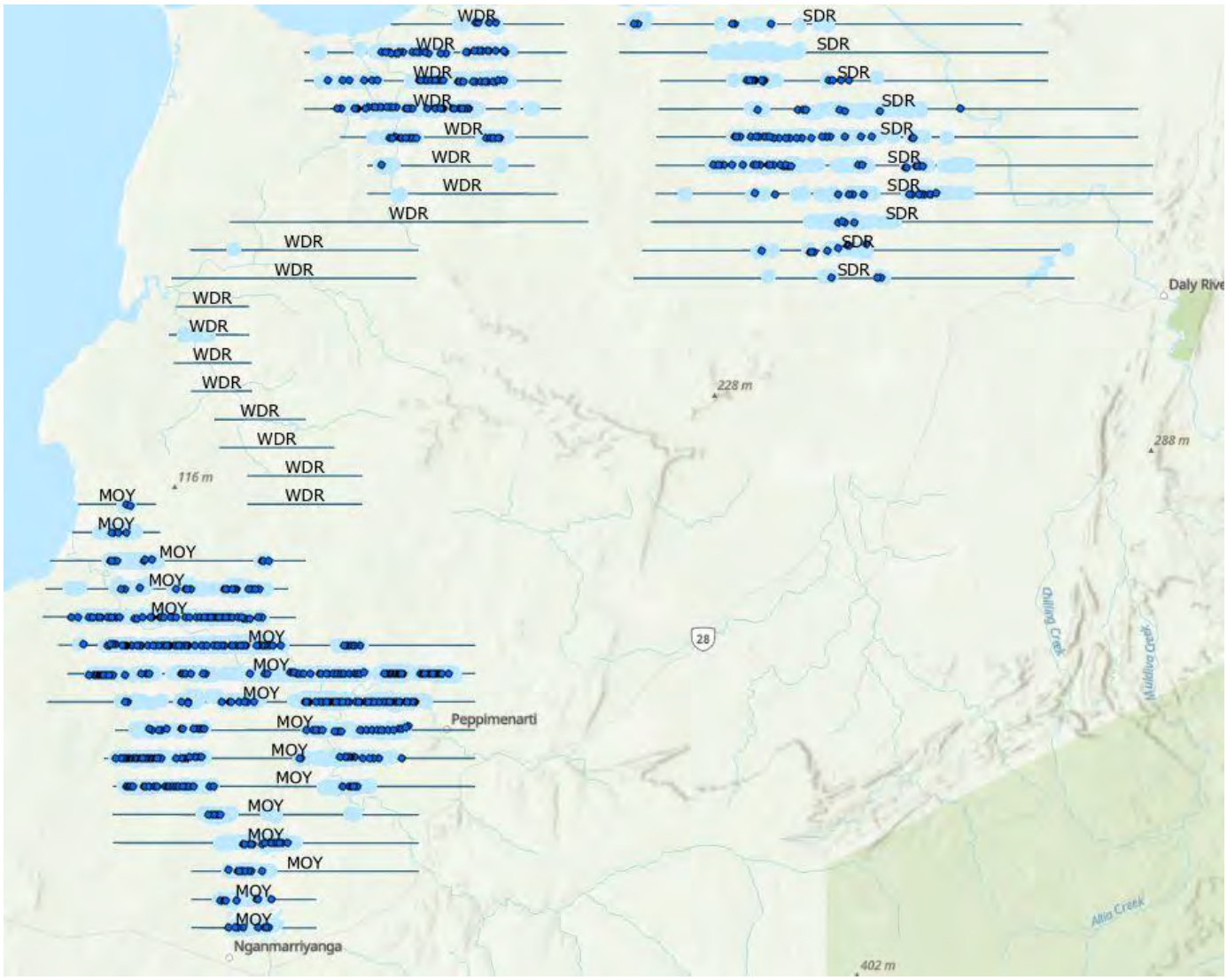

Figure A2. Magpie Goose nest observations in 2025 (dark blue points) compared to historical data (light blue shading) in the Moyle to southern Daly River region

Figure A3. Magpie Goose observations in 2025 (dark orange points) compared to historical data (light orange shading) in the northern Daly-Finniss River region

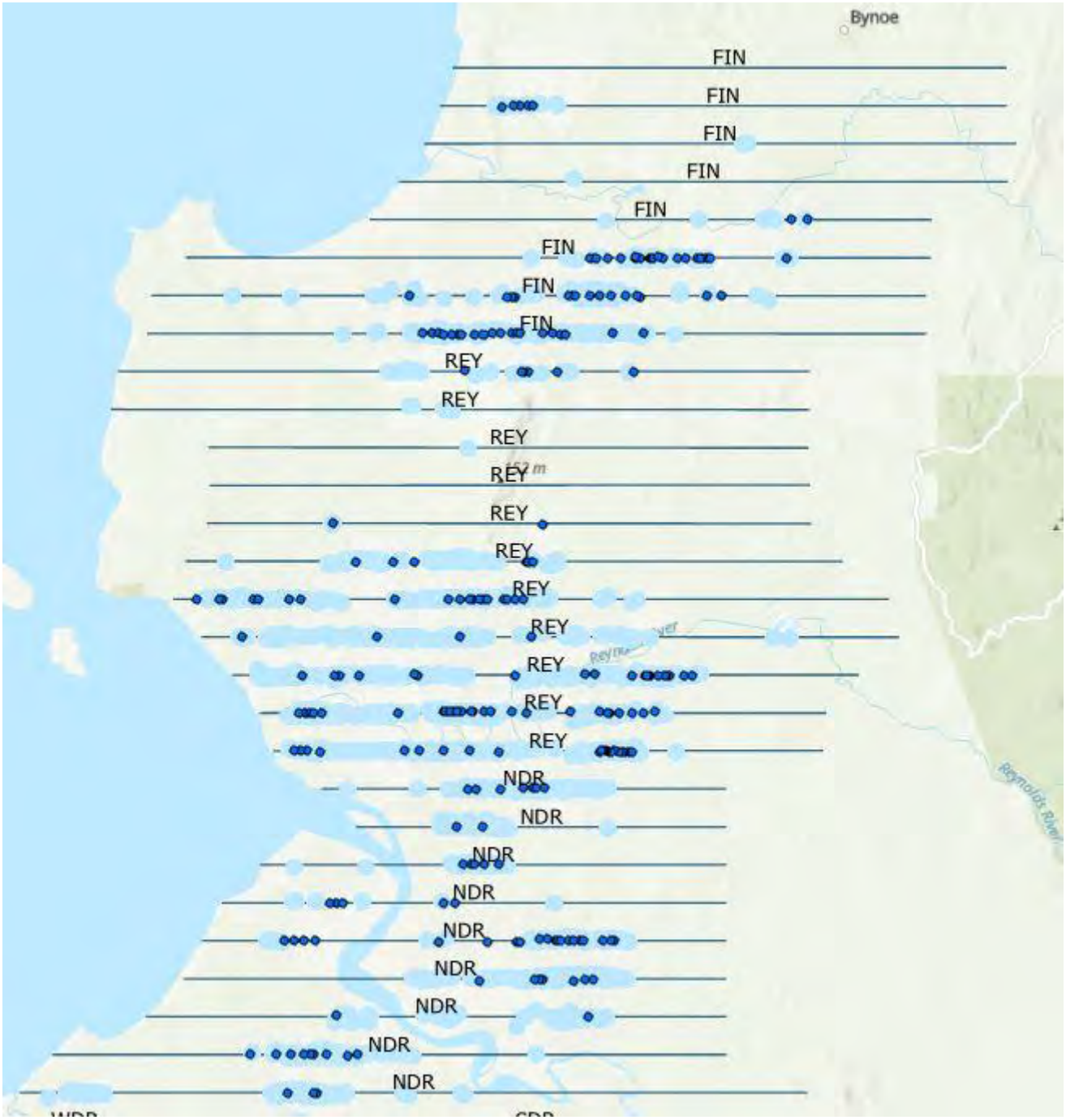

Figure A4. Magpie Goose nest observations in 2025 (dark blue points) compared to historical data (light blue shading) in the northern Daly-Finniss River region

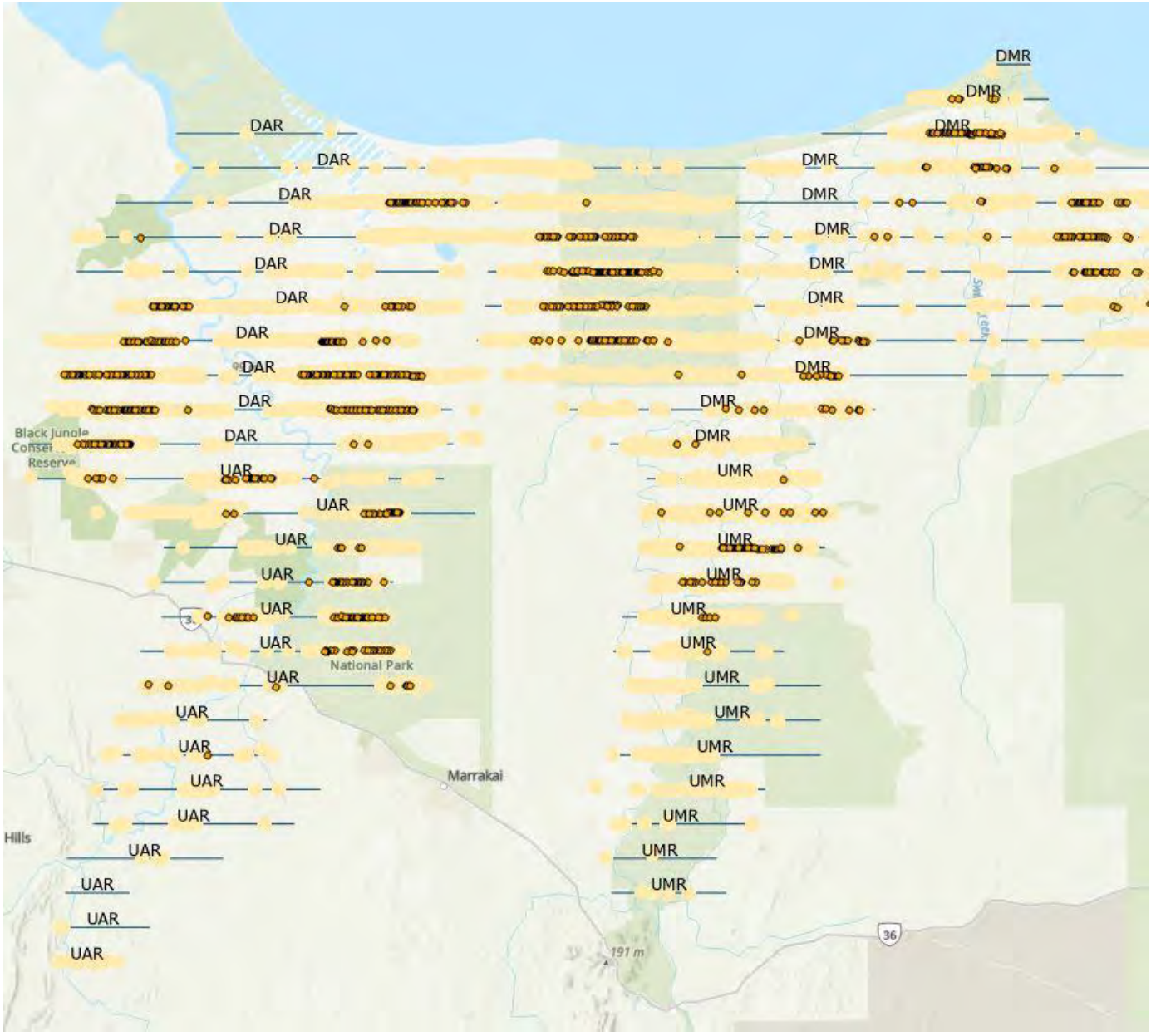

Figure A5. Magpie Goose observations in 2025 (dark orange points) compared to historical data (light orange shading) in the Adelaide- Mary River region

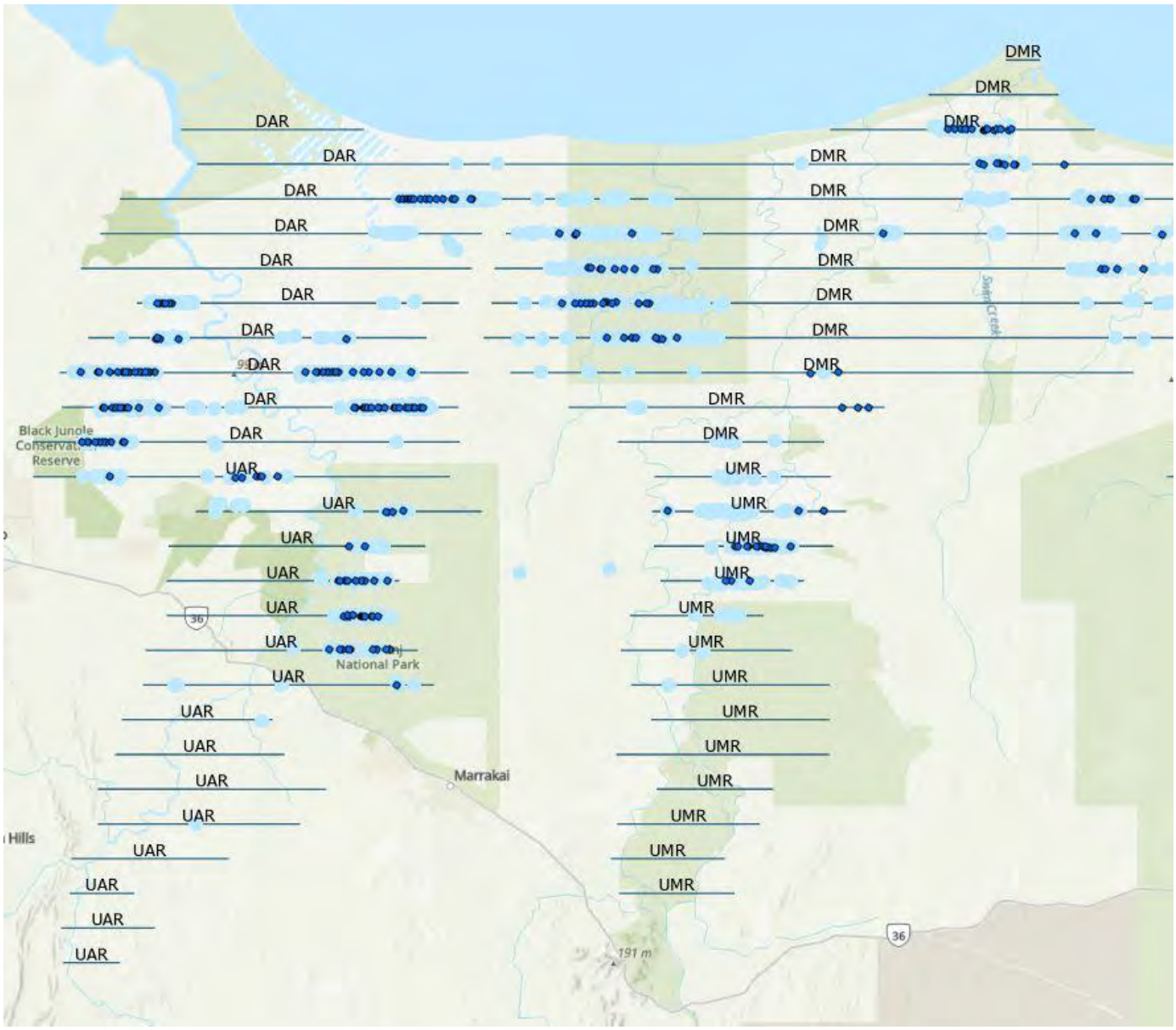

Figure A6. Magpie Goose nest observations in 2025 (dark blue points) compared to historical data (light blue shading) in the Adelaide-Mary River region

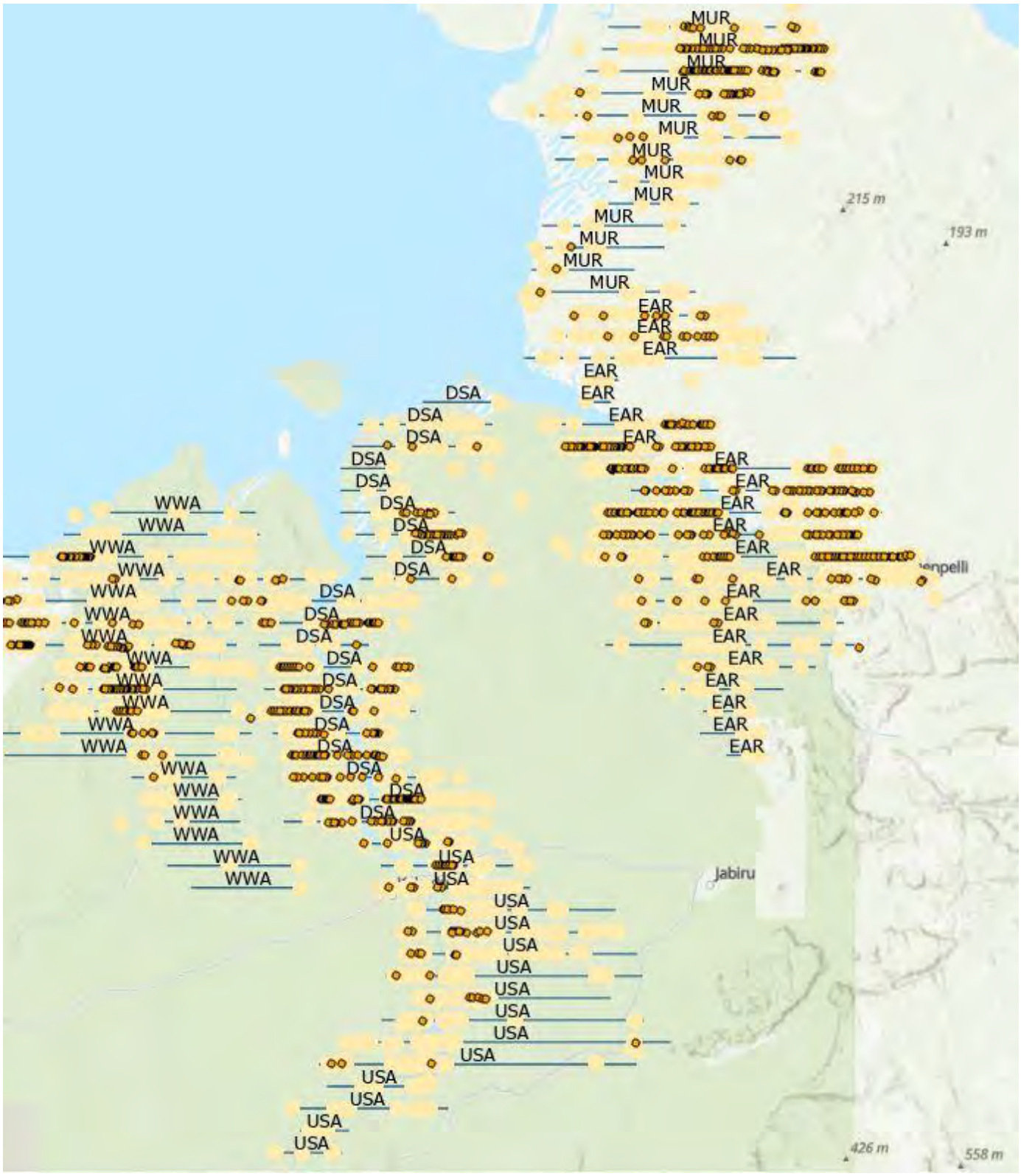

Figure A7. Magpie Goose observations in 2025 (dark orange points) compared to historical data (light orange shading) in the Kakadu-West Arnhem region

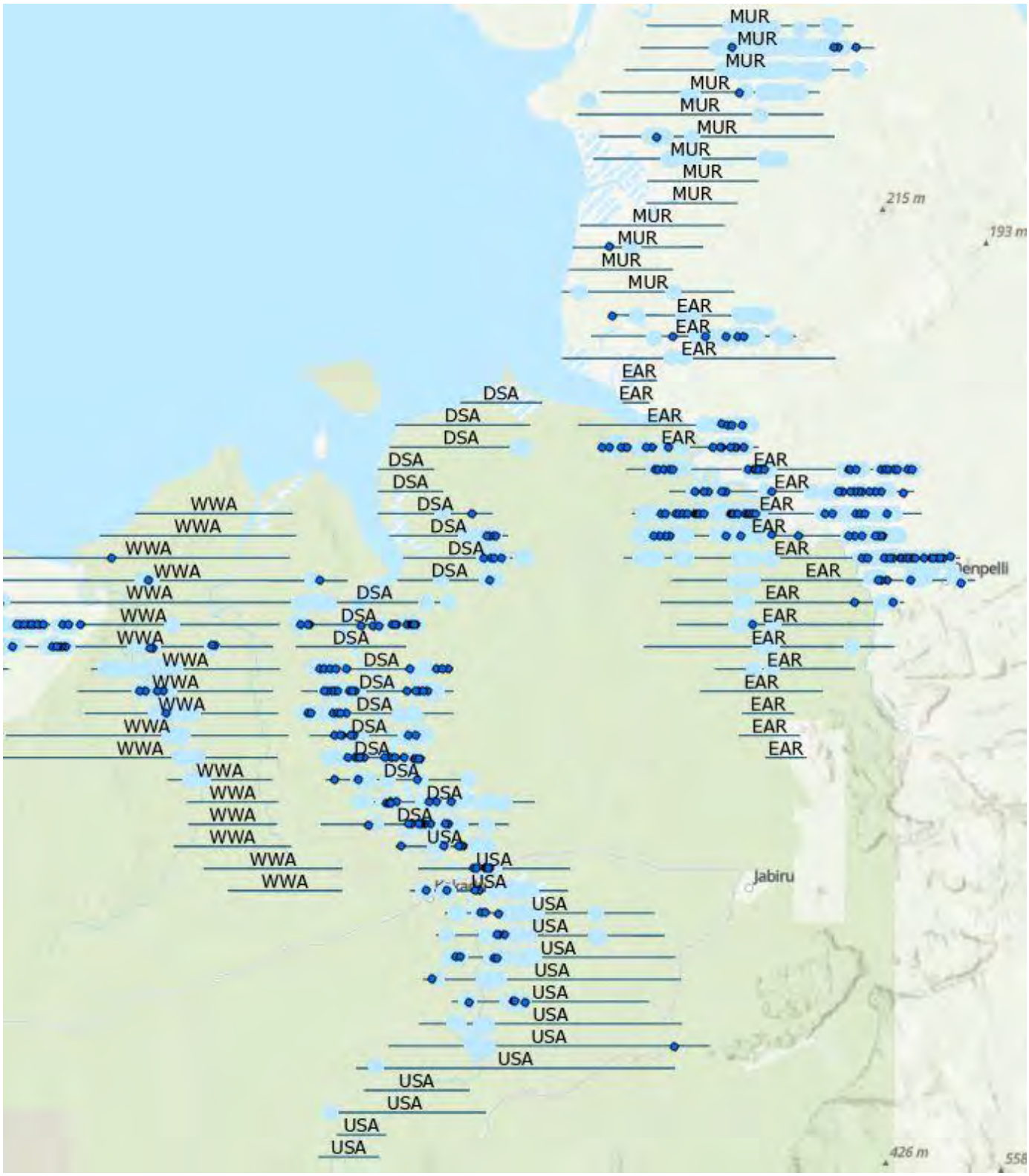

Figure A8. Magpie Goose nest observations in 2025 (dark blue points) compared to historical data (light blue shading) in the Kakadu-West Arnhem region

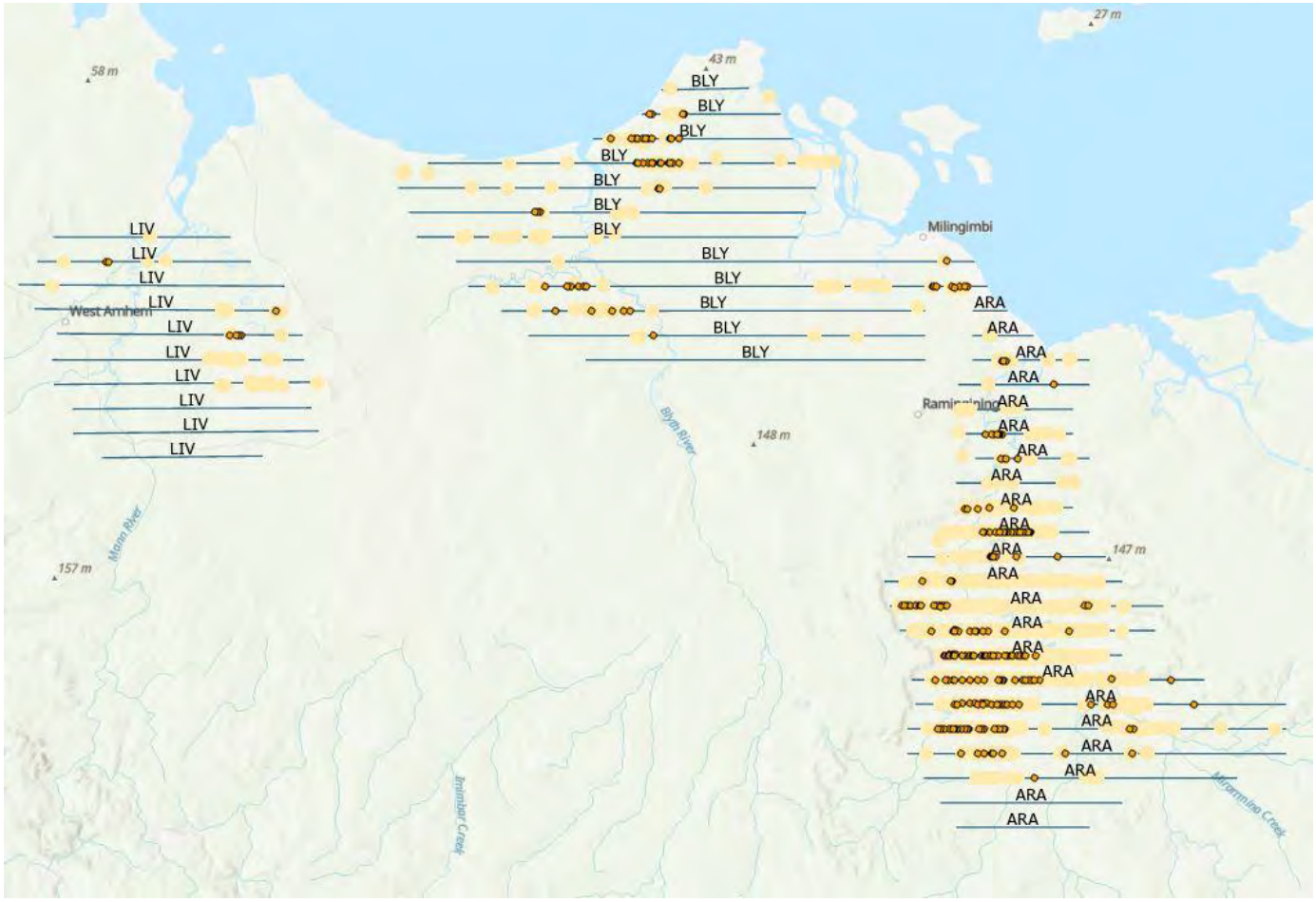

Figure A9. Magpie Goose observations in 2025 (dark orange points) compared to historical data (light orange shading) in the central Arnhem region

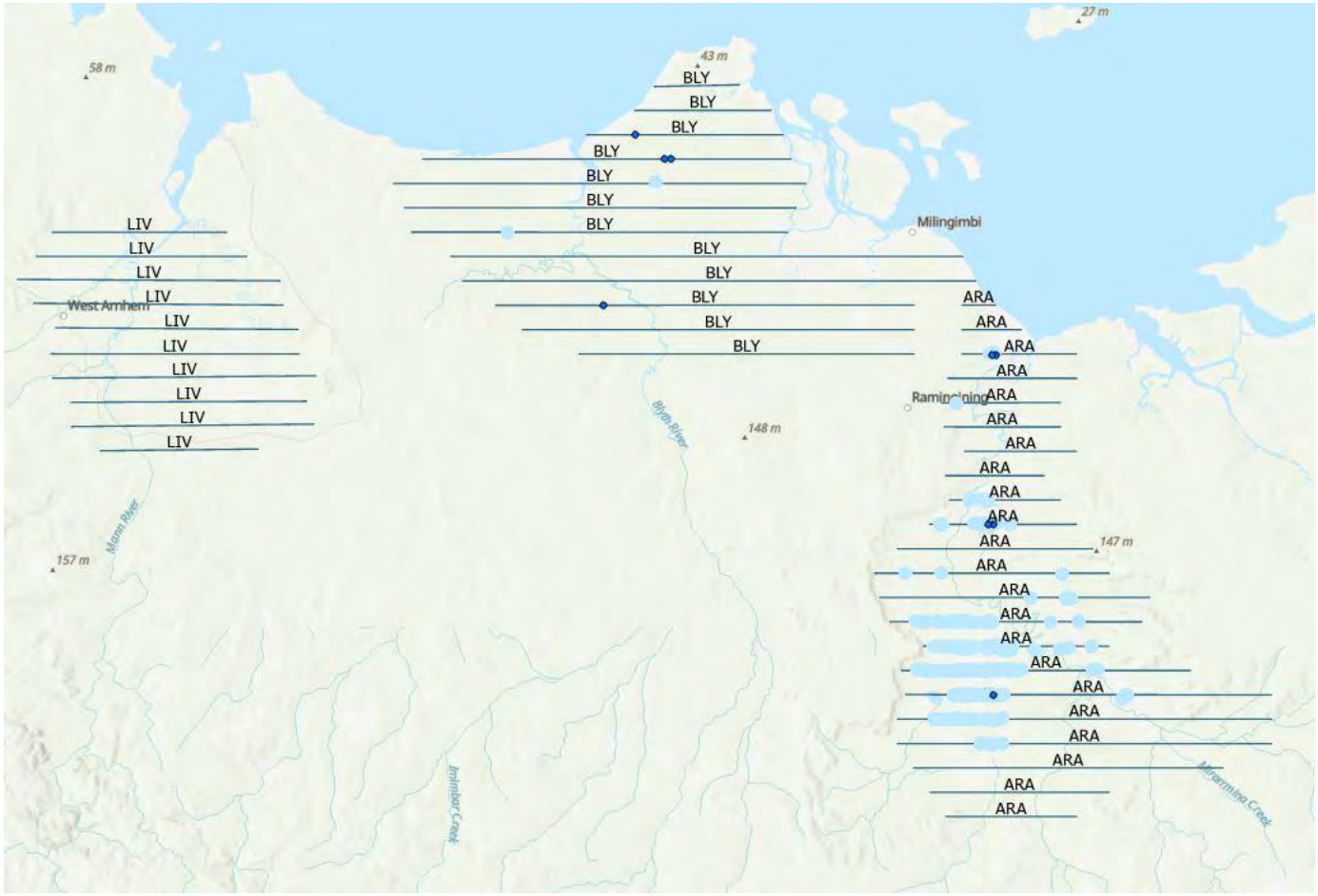

Figure A10. Magpie Goose nest observations in 2025 (dark blue points) compared to historical data (light blue shading) in the central Arnhem region

Figure A11. Magpie Goose observations in 2025 (dark orange points) compared to historical data (light orange shading) in the east Arnhem region

Figure A12. Magpie Goose nest observations in 2025 (dark blue points) compared to historical data (light blue shading) in the east Arnhem region