Aerial Survey of Magpie Geese in the Moyle River floodplain to Finniss River floodplain region of the 'Top End', Northern Territory.

8th May, 2012 to 14th May, 2012

A report to the Department of Natural Resources, Environment, the Arts and Sport

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Abstract

During the period of 5th May to 14th May 2012, an aerial survey of the floodplains/wetlands in the Moyle River floodplain to Finniss River floodplain area, was conducted to determine the distribution and abundance of Magpie Geese within this area of the overall distribution of Magpie Geese in the Top End of the Northern Territory. The total survey area of 8,831 km^2 was surveyed at a sampling intensity of 14.4%. Species counted were Magpie Goose and Magpie Goose nests. Counts for Magpie Goose and Magpie Goose nests are corrected for a combined perception and visibility bias based on correction factors derived from Baylis and Yeomans (1990a & b).

The resultant population estimate for Magpie Geese was 1,020,116 ± 181,623 a density of 115.5 ± 20.6 Magpie Geese per km^2 at a precision of 17.8% within the survey area. The population estimate for Magpie Goose nests was 71,354 ± 13,989 a density of 8.1 ± 1.6 nests per km^2 at a precision of 19.6% within the survey area. These estimates are considered to be minimum estimates due to the negative biases' commonly associated with aerial surveys. Extrapolating these estimates to the whole of the Top End based on the surveys of Bayliss and Yeomans (1990a), gave a Magpie Goose population range of 2.4 to 3.4 million geese and 148,000 to 220,000 nests.

Introduction

The Magpie Goose, *Anseranas semipalmata*, was once widely distributed throughout Australia, with it's breeding range extending from the tropical wetlands of Northern Australia down into the Temperate wetlands of the southern States. From the early 1900's up until the early 2000's Magpie Goose populations outside the tropics had declined precipitately, resulting in an almost exclusively tropical distribution. The factors leading to this decline are poorly known, but were most likely associated with the degradation of wetland habitats in the more developed southern regions.

From the early 2000's, Australia's Magpie Goose population has steadily expanded southwards, primarily along the eastern coastal area from the tropics into the temperate regions of eastern Australia (Delaney *et. al.* 2009). This expansion into their former ranger is attributed to the recovery/rehabilitation of wetland habitats in the southern temperate regions.

The coastal and sub-coastal floodplains of the Northern Territory support Australia's largest populations of Magpie Geese, with the wetlands of Kakadu National Park supporting a significant percentage of the total magpie goose population of the Northern Territory.

Both the Department of Natural Resources, Environment, the Arts and Sport and the Department of Sustainability, Environment, Water, Populations and Community have recognised the national significance of the Northern Territory's Magpie Goose populations, and the particular significance of the population(s) occurring within Kakadu National Park, and established (from 1983 to the early 2000's) a program to monitor the distribution and abundance of the populations on the major coastal and sub-coastal floodplains of the Top End of the Northern Territory (Bayliss and Yeomans 1990a, Saalfeld, 1994 and Saalfeld 1996), including Kakadu National Park.

During the period 1983 to 1993 the annual aerial survey of Magpie Geese on the Top End floodplains was conducted during the "Wet Season", so that additional data on nesting activity could be collected. Analysis of these data, while providing detailed information on instantaneous relative population distribution and abundance, was not of sufficient accuracy to develop a predictive model of Magpie Goose population distribution and abundance (Delaney et. al. 2009). Between 1994 and 2001 surveys were undertaken during the "Dry Season" (see Bayliss and Yeomans 1990 for characterisation of "Dry Season" survey), however as with the earlier "Wet Season" surveys the results were not of sufficient accuracy to develop a predictive model of Magpie Goose population distribution and abundance. (Delaney et. al. 2009)

Between 2000 and 2010 only two major aerial surveys of Magpie Geese populations in the Top End of the Northern Territory were undertaken, one in 2000 and a second in 2006. Both of these surveys covered the floodplain area from the Moyle River in the west to Murganella in the east, including Kakadu National Park (Delaney et. al. 2009).

In 2009 the "Management Program for the Magpie Goose (*Anseranas semipalmata*) in the Northern Territory of Australia, 2009-2014" was implemented by the Department of Natural Resources, Environment, the Arts and Sport. This program has the aim of "Ensure the long-

term conservation of the Magpie Goose and its habitats in the Northern Territory".One of the actions within this program was to review and re-design the monitoring program for Magpie Geese surveys in 2010 and to implement a survey monitoring program in 2011.

Review and re-design on the Magpie Geese surveys has been completed and the outcome reported in the "Biodiversity Monitoring Programs Reports - Monitoring program for Magpie Geese (*Anseranas semipalmata*) in the Northern Territory" (Appendix 1). The review identified broad-scale aerial survey as the most effective method of obtaining precise population distribution and abundance information for Magpie Geese in the Top End of the Northern Territory. Whilst a full aerial survey covering the entire range of the Magpie Goose annually would provide the maximal combination of precision and accuracy, resource limitations do not allow for this. As a means of addressing the resource limitations, the range of the Magpie Goose in the Top End has been broken into three major distributions (Figure 1) and each will be surveyed tri-annually.

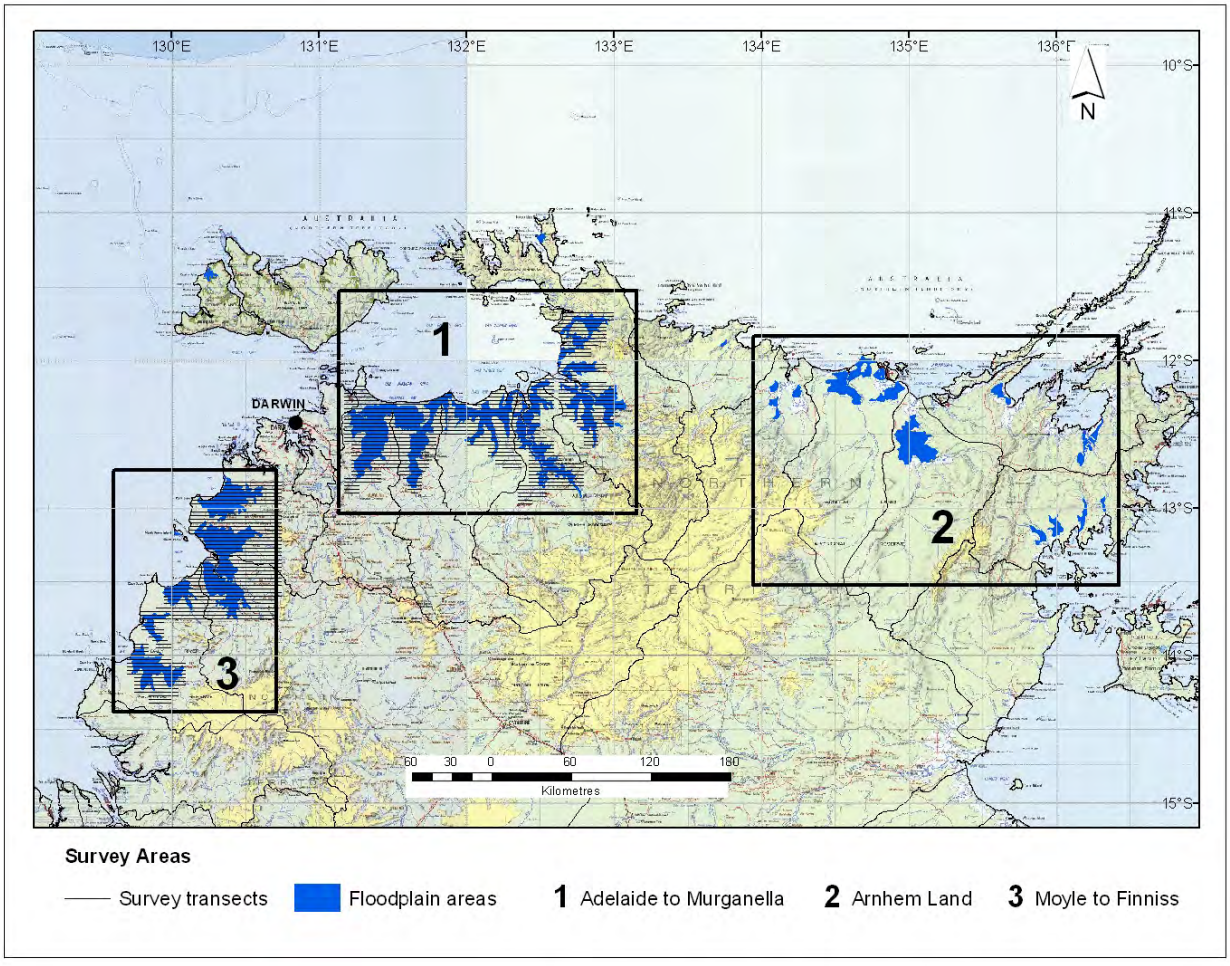

Figure 1: Survey areas for Magpie Goose aerial surveys. Each area will be surveyed tri-annually.

The first of the three major distribution areas to be surveyed is the Adelaide River floodplain to Murganella floodplain (see Figure 1). This will be followed by the Arnhem Land floodplain

area in the second year and the Moyle River floodplain to Finniss River floodplain area in the third year (see Figure 1).

This report details briefly the results of the 2012 aerial survey of Magpie Geese in the Moyle River floodplain to Finniss River floodplain area. This survey represents only a proportion (approximately one third) of the total distribution of Magpie Geese in the Top End. This area is being covered in the second year of surveys rather than the third to provide current Magpie Goose population estimates in the Wadeye area to support trial commercial Magpie Goose harvesting in the area by the Thamarrurr Development Corporation. The Arnhem Land floodplains will be surveyed in 2013.

Methods

Survey Area and Design

The Moyle River floodplains to Finniss River floodplains survey area (latitude $11^0$50'S to $14^0$20'S, longitude $129^0$40'E to $130^0$45'E) covered all major floodplains and wetland habitat within the area (Figure 2) and was surveyed between 8 May, 2012 and 14 May, 2012. This area was divided into six major survey blocks.

The survey was conducted using a Cessna 182 high-wing aircraft flown at a ground speed of 185 km^{-1} (100 knots) and an altitude of 61 m (200 ft) above ground level. Altitude was maintained using a radar altimeter. Transect width on each side of the aircraft was demarcated by marker rods attached to the aircraft wing struts and calibrated (Marsh and Sinclair 1989a) to give a transect width of 200 m on each side of the aircraft at survey altitude.

Transect lines flown on the survey are shown in Figure 2. All lines were aligned east-west to traverse perpendicularly the north-south orientation of the major river systems, ridges and escarpments of the area. Transects were spaced at an interval of 1.5' of latitude (2.778 km) to give a survey intensity of 14.4% with a combined port and starboard transect width of 400 m. Navigation of transects was by Global Positioning System pre-programmed with all transect waypoints.

Counting Procedure

Survey crew comprised a pilot/navigator, a starboard front seat observer (survey leader) and a port rear seat observer.

The pilot/navigator indicated the start and finish of each transect by calling either 'start transect' or 'finish transect'.

Sightings were recorded as groups of individuals ranging from 1 to 10,000. Observers recorded their observations of Magpie Goose (*Anseranas semipalmata*) and Magpie Goose nests in a standard format using individual Hewlett Packard HP iPAQ RX5910 Palmtop Computers programmed as GPS data-logger. Data entry for each observer is as outlined in the Magpie Goose Aerial Survey Standard Operating Procedure (Appendix 2).

Post Survey Data Editing

Data was downloaded daily from each observer's Palmtop computer to a Laptop Personal Computer. Data was immediately checked for gross errors (e.g. transects missed or errors reported by the observers), which were corrected, and the daily files from the observers merged. The resultant file was then appended to the survey master file for analysis. If the data entry procedure outlined in Appendix 1 had been followed correctly there was no requirement for any further data editing.

Analysis

Because transects were variable in area, the Ratio Method (Jolly 1969, Caughley and Grigg 1981, Marsh and Sinclair 1989) was used to estimate density, population size and their associated standard errors for the survey area. Input data were the estimated numbers of each species for each observer. The resultant standard error was adjusted to incorporate the error associated with the appropriate estimates of mean group size following the method of Jolly and Watson (1979) and Marsh and Sinclair (1989). Estimates were corrected for perception and visibility bias using the wet season correction factors of Bayliss and Yeomans (1990a & b). Correction factors were 3.28 for Magpie Geese and 2.23 for Magpie Goose nests.

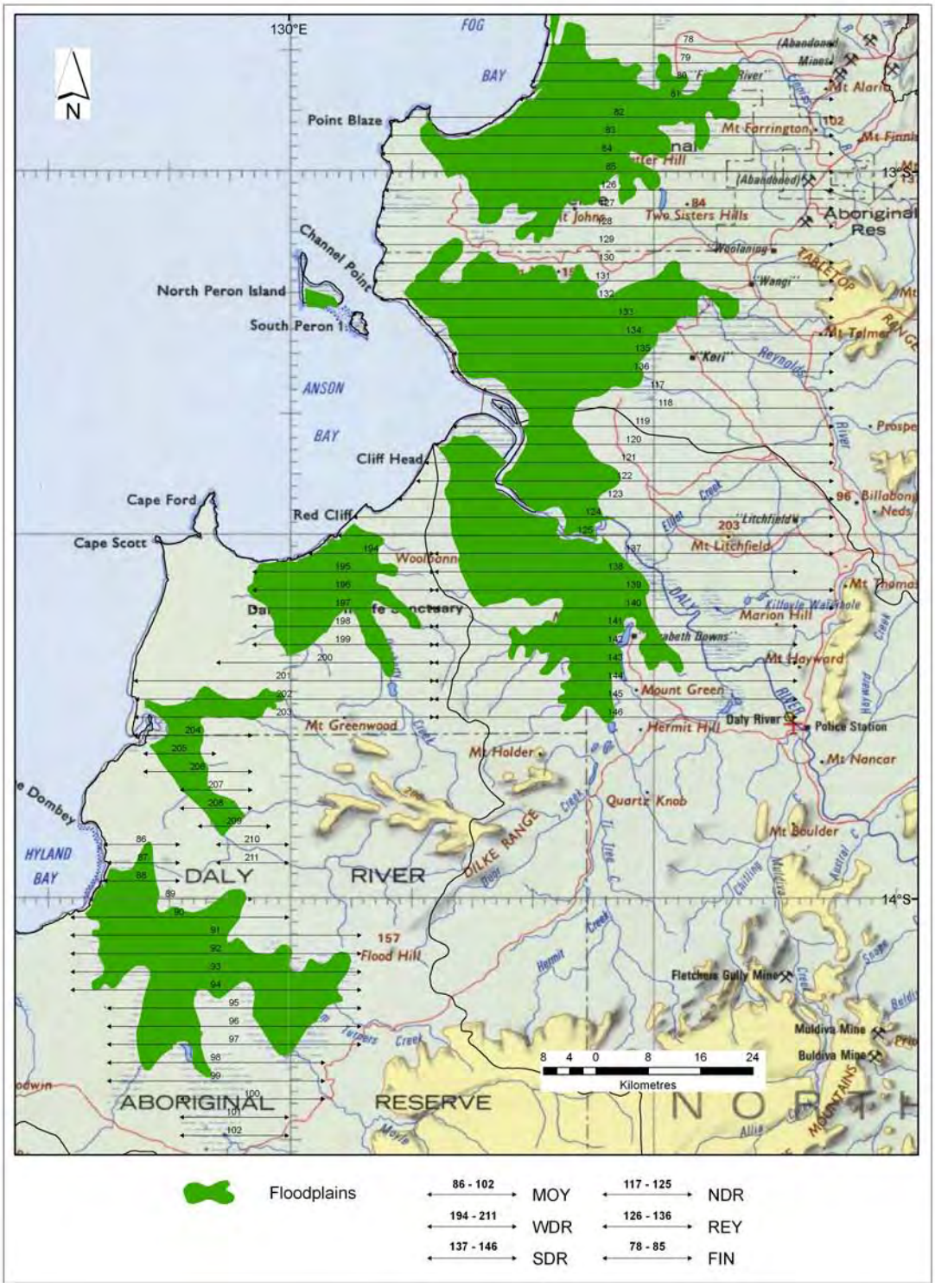

Figure 2: Survey blocks and survey transects flown

Results

Minimum Population and Density Estimates

The value of mean group size and associated coefficient of variation used in obtaining the population abundance and density for Magpie Goose and Magpie Goose nests are summarised in Table 1.

Table 1: Details of mean group size and associated standard error used in the population estimates.

Species	Mean Group Size	Standard Error
Magpie Goose	46.2	4.35
Magpie Goose nests	9.9	1.04

The population estimates, density and precision figures for the survey area are presented in Table 2.

From Table 2 it is apparent that the precision for individual species within survey blocks is variable and quite low (greater than 20%, the level considered acceptable in providing a reasonable compromise between survey cost and ability to detect moderate to substantial change in population abundance). However, the overall precision of the estimates for the entire survey area is 17.8% for the Magpie Goose population estimate and 19.6% for the Magpie Goose nest population estimate. These are also quite low levels of precision for the survey overall but are higher than the acceptable limit of 20%..

Distribution of Magpie Goose and Magpie Goose nests

Figures 3 and 4 shown sighting distribution maps for Magpie Goose and Magpie Goose nests within the survey area. Figures 5 and 6 show kernel density distribution maps Magpie Goose and Magpie Goose nests within the survey area.

From Figures 3 through 6 it can be seen that the distribution of Magpie Geese and Magpie Goose nests within the survey area is very patchy, with a number of patches of very high density surrounded by large areas of much lower density. Also apparent is that the pattern of both Magpie Goose and Magpie Goose nest distribution is toward the downstream areas of each of the major river/floodplain systems within the survey area.

Table 2: Estimated population, density figures (in brackets), and precision (as a percentage), for Magpie Goose and Magpie Goose nests. Values are ± standard error incorporating the errors resulting from sampling and in estimating mean group size.

Block (area in km^2)	Magpie Goose	Magpie Goose nests
Moyle River (1,375)	147,233 ± 53,710 (107.1 ± 39.1) 36.5	26,393 ± 9,656 (19.2 ± 7.0) 36.6
Daly River west (1,164)	90,443 ± 41,904 (77.7 ± 36.0) 46.3	9,821 ± 4,923 (8.4 ± 4.2) 50.1
Daly River south (1,548)	165,112 ± 58,224 (106.7 ± 37.6) 35.3	10,588 ± 4,391 (6.8 ± 2.8) 41.5
Daly River north (1,536)	171,422 ± 59,271 (111.6 ± 38.6) 34.6	4,143 ± 2,096 (2.7 ± 1.4) 50.6
Reynolds River (1,974)	354,411 ± 140,954 (179.5 ± 71.4) 39.8	17,033 ± 7,056 (8.6 ± 3.6) 41.4
Finniss River (1,233)	91,495 ± 39,689 (74.2 ± 32.2) 43.4	3,376 ± 2,215 (2.7 ± 1.8) 65.6
Total survey area (8,831)	1,020,116 ± 181,623 (115.5 ± 20.6) 17.8	71,354 ± 13,989 (8.1 ± 1.6) 19.6

Discussion

Correction Factors

Population estimates are corrected for perception and visibility bias using the wet season correction factors of Bayliss and Yeomans (1990a & b). Use of the correction factors of Bayliss and Yeomans (1990 a & b) is considered to be the best alternative in the absence of survey/observer specific corrections. Survey/observer specific corrections would require a replication of Bayliss and Yeomans (1990b) experiment for each survey. This is not considered to be a cost effective use of limited resources.

It is proposed that for large scale surveys over seasonally variable habitat, survey specific correction factors are essential if accurate estimates are to be derived. The use of generalised correction factors based on past surveys is subject to a high degree of error due to variability in environmental bias in the same area depending on 'wet' and 'dry' season conditions. Weighing against obtaining survey specific corrections is the high cost associated with the necessary experimental models, particularly those involving index-manipulate-index designs or observer/photo contrast designs.

Using the correction factors of Bayliss and Yeomans (1990a & b) gives population estimates of 1.0 million Magpie Geese and 71,000 Magpie Goose nests within the survey area.

Population Size and Distribution

The distribution of both Magpie Geese and Magpie Goose nests within the survey area was very patchy with a number of major areas of goose and nest distribution clearly visible in Figures 3 through 6. Very low densities of Magpie Geese and Magpie Goose nests were seen on the inland (upstream) reaches of the major floodplains encompassed within the survey area.

The population estimate for Magpie Geese of 1.02 $\pm$ 0.18 million, potentially represents anywhere from 30% to 42% of the total 'Top End' Magpie Goose population; based on earlier 'wet' season surveys (Bayliss and Yeomans 1990a) which covered the entire Top End distribution. Using a mean proportion (35.7%) of the Bayliss and Yeomans (1990a) surveys covering the Top End distribution, gives a minimum to maximum Top End population estimate range of 2.35 to 3.37 million Magpie Geese.

The population estimate for Magpie Goose nests of 71,000 $\pm$ 14,000, potentially represents anywhere from 26% to 48% of the total 'Top End' Magpie Goose nesting; based on earlier 'wet' season surveys (Bayliss and Yeomans 1990a) which covered the entire Top End distribution. Using a mean proportion (38.8%) of the Bayliss and Yeomans (1990a) surveys covering the Top End distribution, gives a minimum to maximum Top End nesting estimate range of 148,000 to 220,000 Magpie Goose nests.

The population range derived above puts the current Top End Magpie Goose population at the mid to upper end of the known range based on past surveys (reported survey estimates range from as low as 1.1 million up to 3.9 million) and would indicate that the Northern Territory's

Magpie Goose population is in good condition.

Magpie Goose nesting as reported here is in the lower to mid end of the known range based on past surveys (reported survey estimates range from less than 100,000 up to 300,000) and combined with the Magpie Goose population estimate is taken as indicating reduced nesting in 2012.

These results reinforce the importance of the Top End's floodplains for the maintenance of the Magpie Goose in the Northern Territory and the need for management to continue to be directed towards to the maintenance of the area in a manner that avoids any loss or degradation of the floodplains, particularly the downstream reaches which appear to provide major nesting areas.

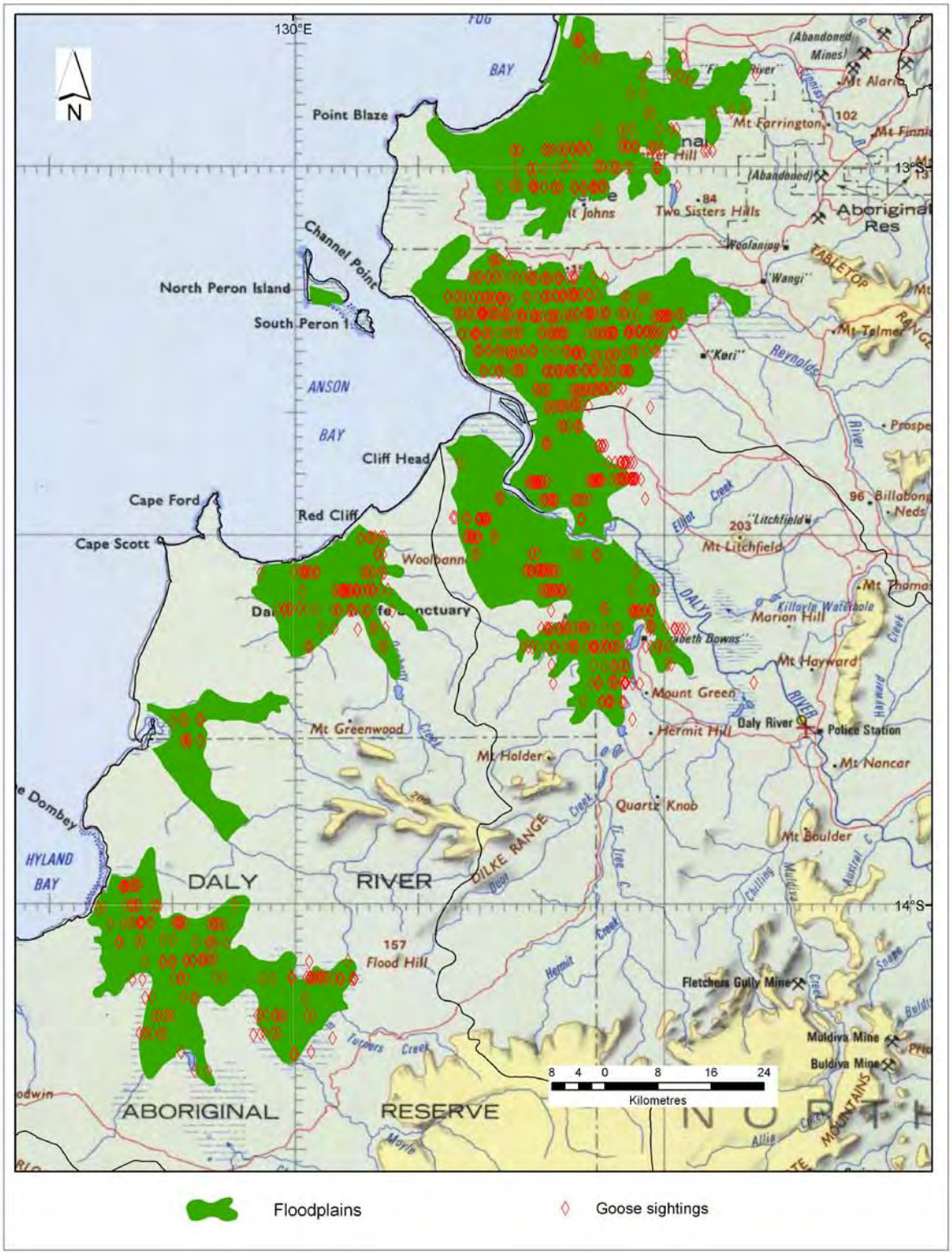

Figure 3: Distribution of Magpie Goose sightings across the survey area.

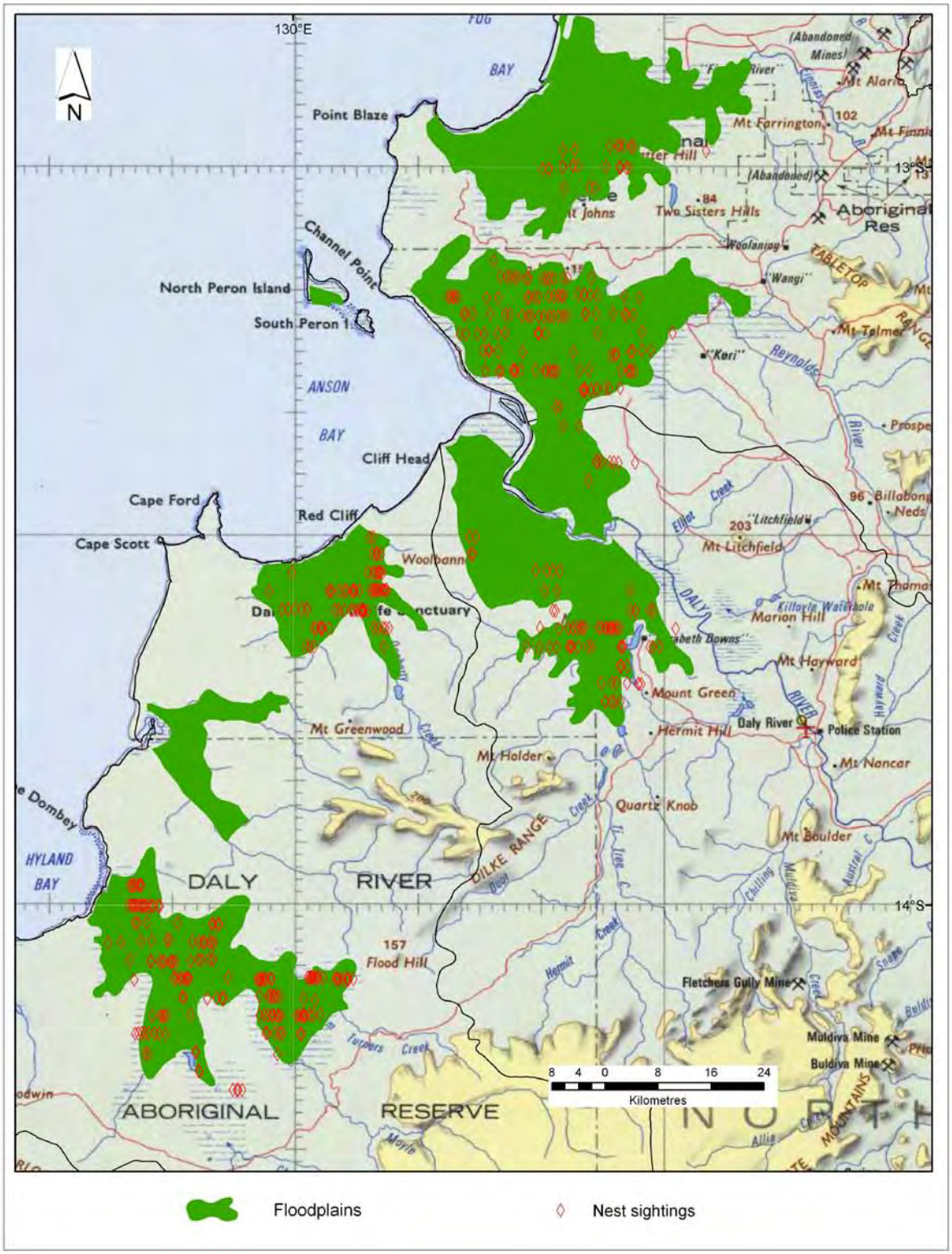

Figure 4: Distribution of Magpie Goose nest sightings across the survey area.

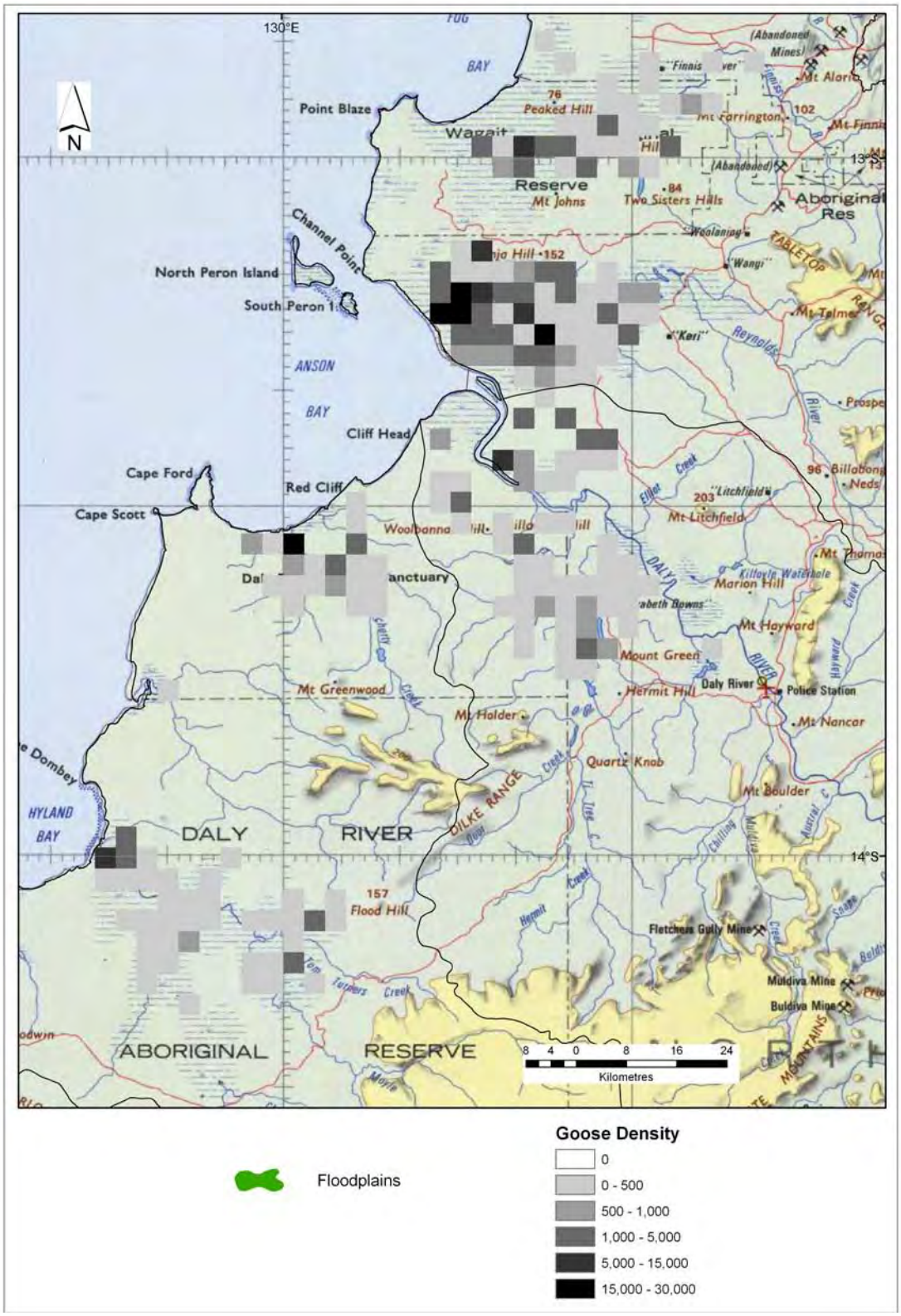

Figure 5: Magpie Goose density across the survey area (Geese.km^{-2})

Figure 6: Magpie Goose nest density across the survey area (nests.km^{-2})

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